

Beca Ltd



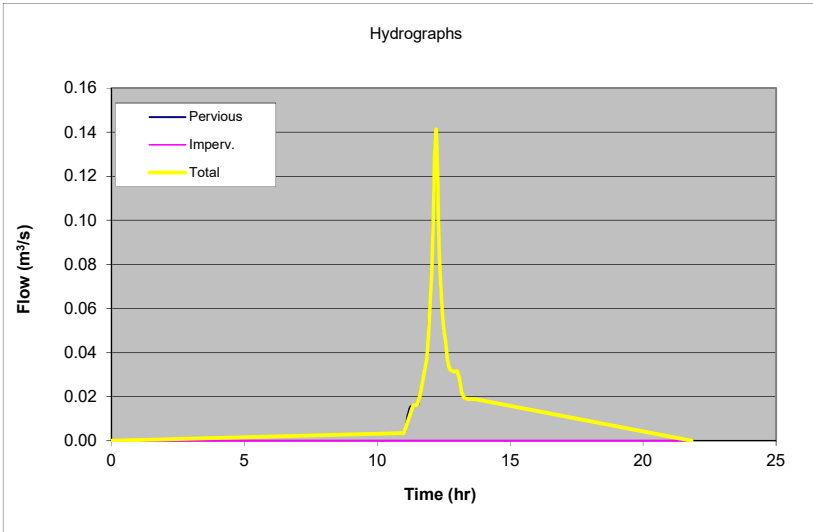
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Overland Catchment Catchment (A9, A10, A11 & A12)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m³/s)
0.000	0.000
11.001	0.004
11.351	0.016
11.495	0.016
11.607	0.020
11.700	0.027
11.783	0.032
11.857	0.037
11.926	0.048
11.990	0.063
12.050	0.076
12.107	0.103
12.161	0.130
12.212	0.141
12.243	0.134
12.275	0.116
12.308	0.098
12.341	0.083
12.375	0.074
12.410	0.066
12.446	0.058
12.483	0.053
12.522	0.049
12.561	0.045
12.602	0.041
12.645	0.037
12.689	0.034
12.736	0.032
12.785	0.032
12.837	0.031
12.892	0.031
12.951	0.031
13.015	0.032
13.087	0.028
13.167	0.022
13.263	0.020
13.388	0.019
13.690	0.019
21.822	0.000
-1.000	0.000

Calculation Sheet

Beca Ltd

JOB NO: 3124460

Hydraulic Grade Line Analysis:

Project Description HGL of Downstream Network

Downstream HGL (m)	0
Downstream Distance (m)	0
Flow Factor	1 (Actual/Specified)

Notes:

Input

The following table can input 20 components.
 Input data starts at the d/s end and progresses u/s
 Input data on pipe dia, flow, and k_s applies to the pipe u/s.
 Terminate list by making length = -1.0

Basis of computations

Calculations are from downstream (d/s) to upstream (u/s) as per the table input.
 Energy ($E_{u/s}$) = $E_{d/s} + S_f \Delta x + k_{local} v^2 / 2g$
 $HGL_{u/s} = E_{u/s} - v^2 / 2g$
 Where S_f is the friction slope based on Colebrook-White and v is the pipe velocity.
 If HGL falls below the pipe overt, some partial full condition is assumed.

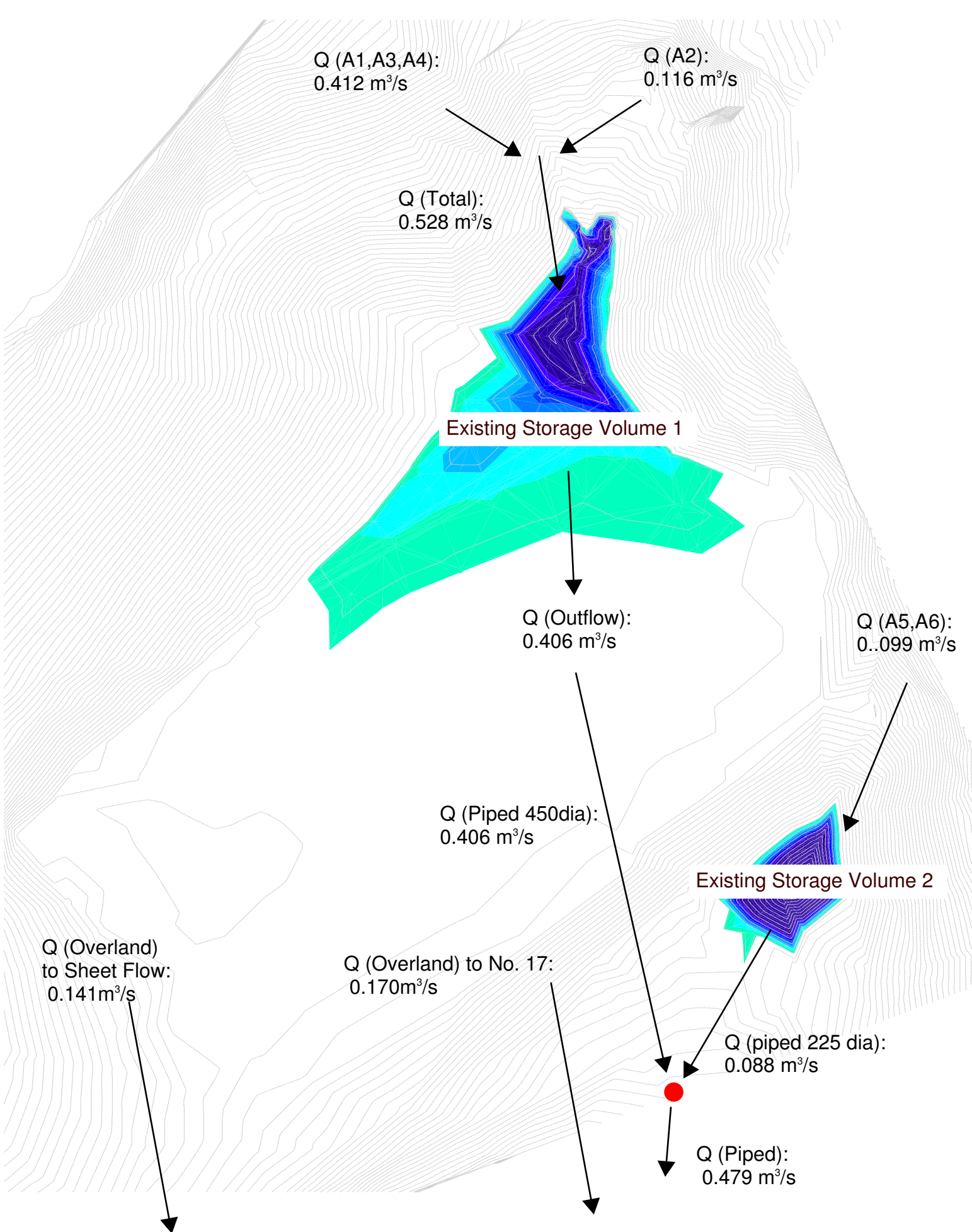
Location	Length (to u/s-m)	Pipe dia. (m)	Invert level		Ground level (d/s-RL m)	Specified Flow (m³/s)	k_s (mm)	k_{local} (u/s)	Data output at the u/s end of the pipe (see diagram)						
			(d/s-RL m)	(u/s-RL m)					Distance (m)	Actual Flow (m³/s)	Pipe full Vel (m/s)	Pipe slope (m/m)	HGL (m)	Energy (m)	Freeboard to GL (m)
X. SW Outfall (Pourewa)	17.32	1.35	8.66	8.66	12.30	3.003	1.5	0.2	0.00	3.003	2.10	0.0700	9.83	10.05	2.47
SWMH NP4983	55.4	0.825	9.87	10.39	14.37	2.618	1.5	0.2	17.32	2.618	4.90	0.0717	10.80	11.22	3.57
SWMH NP4996	88.88	0.75	14.36	14.46	19.56	2.167	1.5	0.2	72.72	2.167	4.90	0.0532	15.17	16.40	4.39
SWMH NP4965	56.47	0.75	19.19	19.21	23.40	2.167	1.5	0.2	161.60	2.167	4.90	0.0491	19.93	21.16	3.47
SWMH NP4954	70.97	0.6	21.98	22.00	26.98	0.558	1.5	1.5	218.07	0.558	1.97	0.0166	22.72	23.95	4.26
SWMH NP4849	20.87	0.6	23.18	23.20	27.54	0.479	1.5	0.2	289.04	0.479	1.69	0.0182	26.18	26.38	1.36
SWMH NP4851	-1		23.58		27.38		1.5	0.2	309.91				26.40	26.55	0.98

HGL Analysis

Recommended local manhole losses (k_{local}) for haunched MHs
 (Losses based on d/s velocity)

Deviation Angle °	No surcharge	With Surcharge		Drop MH
		Lateral inflow	Some	
0	0.2	0.2	0.5	1.5
45	0.5	0.5	1.0	1.5
90	1.2	1.5	1.5	2.0

Total energy change (m)	16.54
Energy loss due to friction (m)	8.26
Energy loss due to local headlosses (m)	2.46
Energy loss due to geometry (m)	5.83



Schematic Sketch of Existing Attenuation and Associated Peak Flows During 1 in 10 Year Events

**EXISTING Q10
CALCULATIONS WITH
CLIMATE CHANGE
ALLOWANCE**

Beca Ltd



JOB NO: 3124460/221

Hydrographs- SCS Method:

Project Description SCS Calc for 1ha Catchment Areas

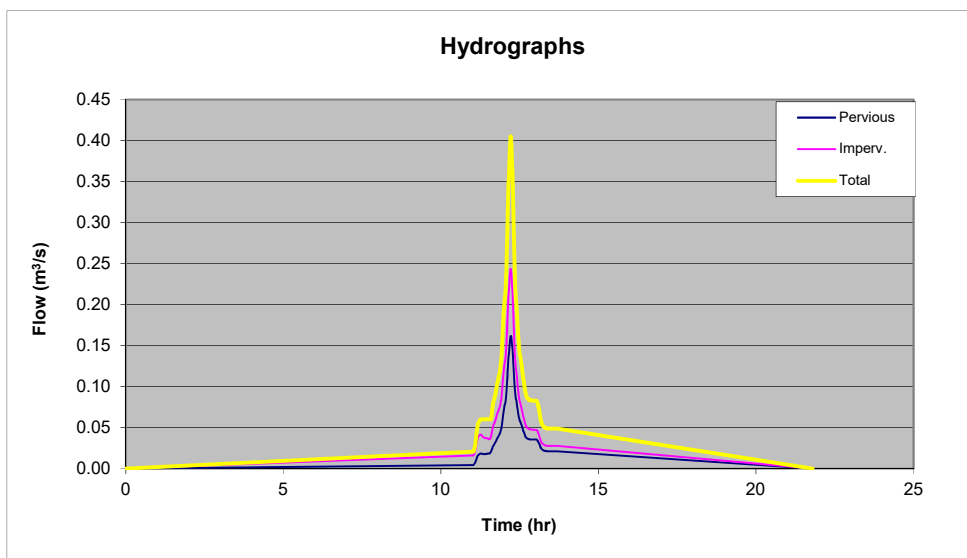
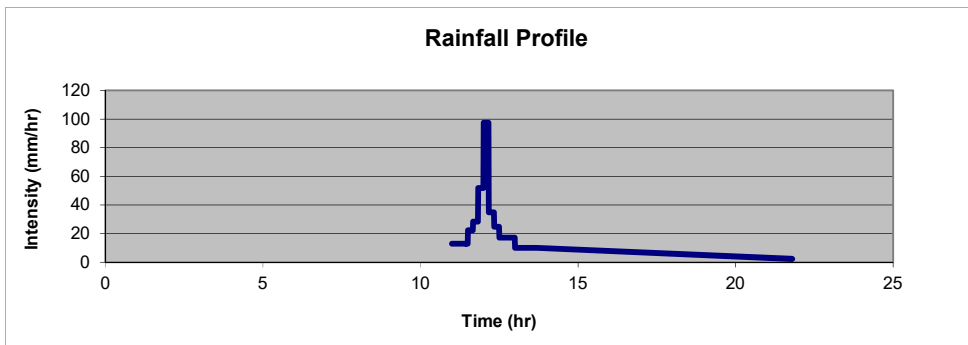
Rainfall Depth (mm) 140

Notes:

1. Inputs
2. Typical inputs for CN 20000 are in 'Typical CN Values' Sheet
3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	1	1
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	1	1	Total
Area (ha)	1	1	2
Runoff (mm)	81.6	135.4	108.5
Peak Flow (m ³ /s)	0.162	0.243	0.405
Time (hr) at Peak Flow	12.22	12.21	12.21
Rainfall (mm/h) over tc	97.38	97.38	97.38
Runoff Coefficient - Peak	0.60	0.90	0.75
Runoff Coefficient - Volume	0.58	0.96	0.77



Calculation Sheet

Existing Stormwater Catchment Area & Flow Allocation

Peak flow from 1ha ignoring CN values		
Impermeable	0.243	m ³ /s
Permeable	0.162	m ³ /s
CN _{impermeable}	0.98	
CN _{permeable}	0.74	
Factor of Safety	1	
Design Rainfall	140	mm
Time of Concentration	10	mins

On-Site & Upstream Catchments	Total Area	Pervious Area	Impervious Area	% Impervious	Design Runoff (m ³ /s)	Notes
A1	15318	2737	12581	0.82	0.351	
A2	5596	560	5036	0.90	0.132	Limited to the Q10
A3	6843	6843	0	0.00	0.111	
A4	733	293	440	0.60	0.015	
A5 - Primary Catchment	1480	592	888	0.60	0.031	
A5 - Overland Flow	3538	1415	2123	0.60	0.075	
A6	5322	5322	0	0.00	0.086	
A7	9879	9879	0	0.00	0.160	
A8	1833	245	1588	0.87	0.043	
A9 - Primary Catchment	741	741	0	0.00	0.012	
A9 - Overland Flow	5543	5543	0	0.00	0.090	
A10	5779	5779	0	0.00	0.094	
A11	3329	3329	0	0.00	0.054	
A12	640	640	0	0.00	0.010	

Off-Site Catchments	Total Area	Pervious Area	Impervious Area	% Impervious	Notes
B1	4173	1669.2	2503.8	0.6	
B2	11737	4694.8	7042.2	0.6	
B3	12964	5185.6	7778.4	0.6	
B4	16845	6738	10107	0.6	
B5	929	371.6	557.4	0.6	
B6	1622	648.8	973.2	0.6	
B7	2216	886.4	1329.6	0.6	
B8	2539	1015.6	1523.4	0.6	
B9	1499	599.6	899.4	0.6	
B10	5976	2390.4	3585.6	0.6	
B11	23122	9248.8	13873.2	0.6	
B12	2593	1037	1556	0.6	
B13	1707	682.8	1024.2	0.6	
C1	4262	1704.8	2557.2	0.6	
C2	11750	4700	7050	0.6	
C3	9328	3731.2	5596.8	0.6	
C4	12843	5137.2	7705.8	0.6	
C5	6034	2413.6	3620.4	0.6	
C6	5910	2364	3546	0.6	

	Catchment Area			Permeable Cumulative Catchment area (m ²)	Impermeable Cumulative Catchment Area (m ²)	Design FLOW (m ³ /s)	Notes
	Permeable	Impermeable	Total				
Ashwell Street							
SWMH NP4954	0	0	0	20051	30076	1.057	-
SWMH NP5167	1705	2557	4262	20051	30076	1.057	C1
SWMH NP7810	0	0	0	18346	27519	0.967	-
SWMH NP5693	4700	7050	11750	18346	27519	0.967	C2
SWMH 11519	3731	5597	9328	13646	20469	0.719	C3
SWMH NP5690	5137	7706	12843	9915	14872	0.523	C4
SWMH NP5672	2414	3620	6034	4778	7166	0.252	C5
SWMH NP5668	2364	3546	5910	2364	3546	0.125	C6

SW John Rymer							
EX. SW Outfall (Pourewa Creek)	0	0	0	83106	105485	3.448	none
SWMH NP4983	8407	12611	21018	83106	105485	3.448	B1, B4
SWMH NP4996	9880	14821	24701	74698	92875	3.005	B2, B3
SWMH NP4965	0	0	0	64818	78054	2.484	none
SWMH NP4954	35212	52818	88030	64818	78054	2.484	B5-B11, C1
SWMH NP4849	1720	2580	4300	29606	25236	0.628	B12, B13
SWMH NP4851	27886	22656	50542	27886	22656	0.537	(A1-A8) Att

Kohi Road							
SWMH NP4954	0	0	0	15161	22742	0.799	none
SWMH NP4952	1387	2081	3468	15161	22742	0.799	B5, B8
SWMH NP5466	1535	2303	3838	13774	20661	0.726	B6, B7
SWMH NP5468	2390	3586	5976	12239	18358	0.645	B10
SWMH NP5470	600	899	1499	9848	14773	0.519	B9
SWMH NP5456	0	0	0	9249	13873	0.488	none
SWMH NP5459	9249	13873	23122	9249	13873	0.488	B11

Calculation Sheet

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JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Storage Volume 1 Catchment (A1, A3, A4)

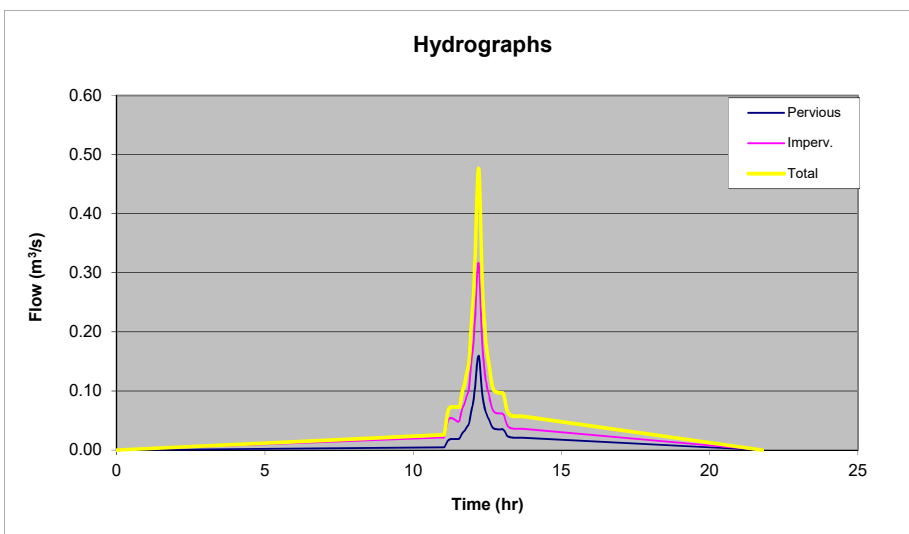
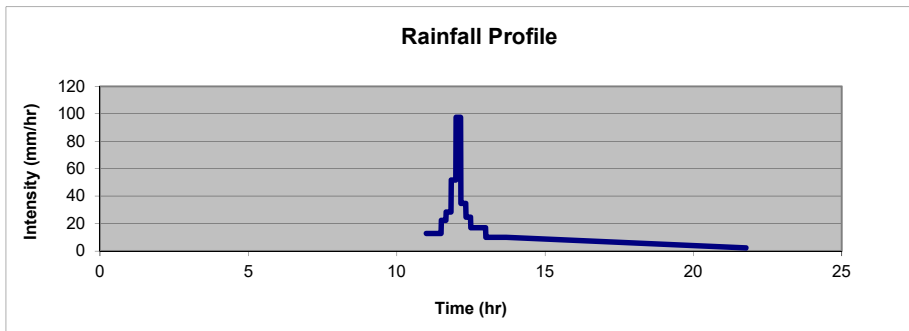
Rainfall Depth (mm) 140

Notes:

1. Inputs
2. Typical inputs for CN are in 'Typical CN Values' Sheet
3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.9873	1.3021
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	Total		
Area (ha)	0.98732	1.30208	2.2894
Runoff (mm)	81.6	135.4	112.2
Peak Flow (m ³ /s)	0.160	0.317	0.477
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	97.38	97.38	97.38
Runoff Coefficient - Peak	0.60	0.90	0.77
Runoff Coefficient - Volume	0.58	0.96	0.80



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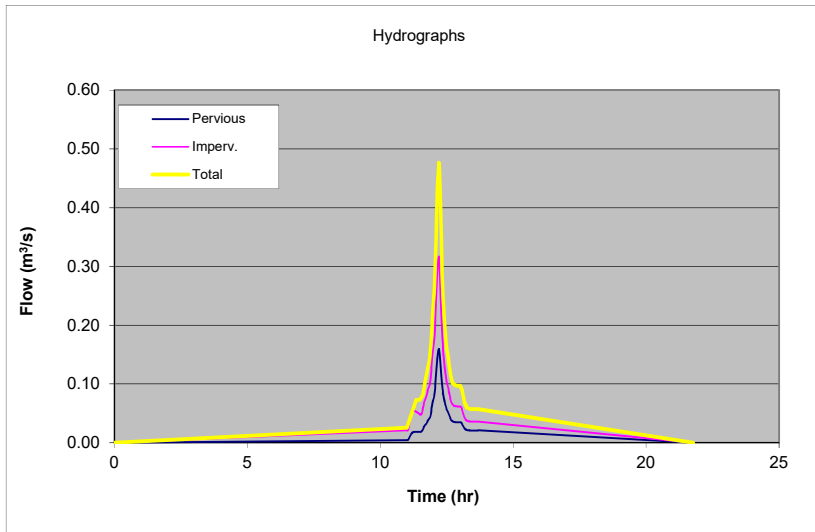
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Storage Volume 1 Catchment (A1, A3, A4)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m³/s)
0.000	0.000
11.001	0.025
11.347	0.073
11.491	0.073
11.601	0.081
11.694	0.105
11.776	0.123
11.850	0.139
11.918	0.173
11.981	0.225
12.040	0.263
12.096	0.343
12.150	0.434
12.201	0.477
12.232	0.461
12.264	0.407
12.297	0.341
12.331	0.284
12.365	0.247
12.400	0.219
12.437	0.193
12.474	0.172
12.513	0.157
12.553	0.146
12.594	0.132
12.637	0.117
12.682	0.107
12.729	0.102
12.778	0.099
12.830	0.098
12.886	0.097
12.945	0.097
13.010	0.097
13.082	0.088
13.163	0.068
13.260	0.060
13.386	0.057
13.690	0.057
21.769	0.000
-1.000	0.000

Calculation Sheet

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

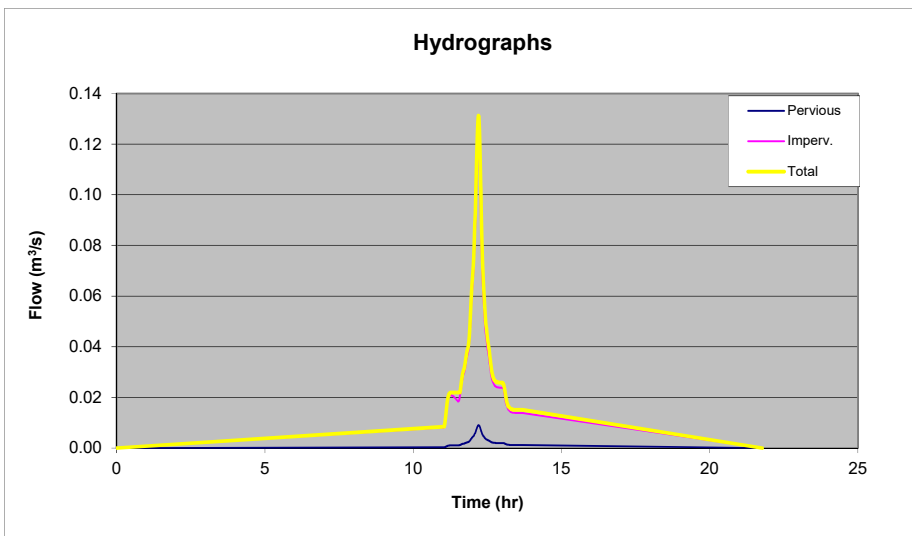
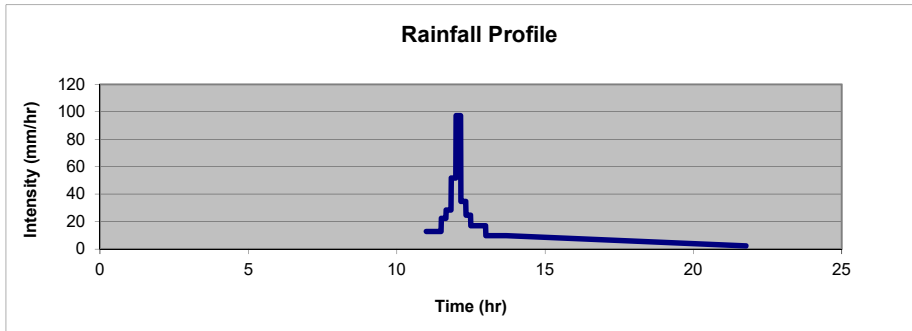
Project Description **Kohi -Existing Storage Volume 1 Catchment (A2 limited to Q10)**

Rainfall Depth (mm) **140**

- Notes:**
1. Inputs
 2. Typical inputs for CN are in 'Typical CN Values' Sheet
 3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.0560	0.5036
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	Total		
Area (ha)	0.05596	0.50364	0.5596
Runoff (mm)	81.3	135.0	129.6
Peak Flow (m ³ /s)	0.009	0.122	0.131
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	97.13	97.13	97.13
Runoff Coefficient - Peak	0.60	0.90	0.87
Runoff Coefficient - Volume	0.58	0.96	0.93



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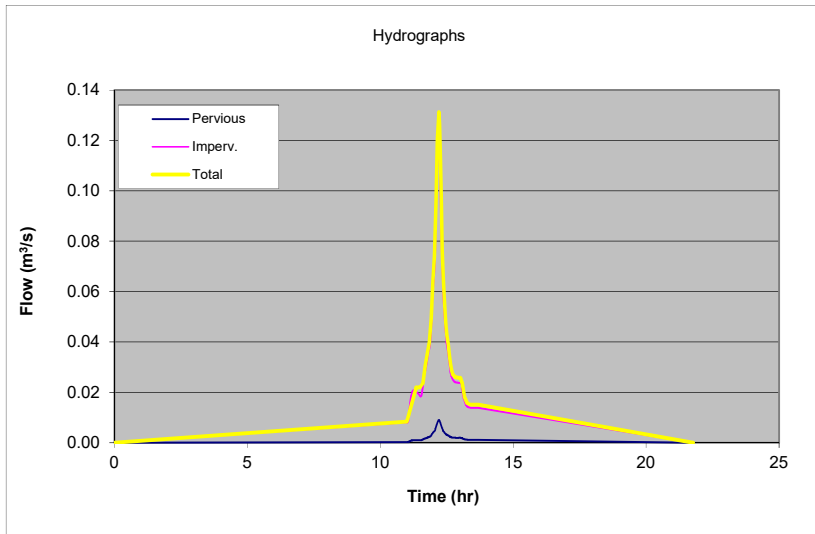
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi -Existing Storage Volume 1 Catchment (A2 limited to Q10)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m³/s)
0.000	0.000
11.001	0.008
11.347	0.022
11.491	0.022
11.601	0.024
11.694	0.030
11.776	0.036
11.850	0.040
11.918	0.049
11.981	0.064
12.040	0.074
12.096	0.096
12.150	0.120
12.201	0.131
12.232	0.127
12.264	0.111
12.297	0.093
12.331	0.077
12.365	0.067
12.400	0.059
12.437	0.052
12.474	0.046
12.513	0.042
12.553	0.039
12.594	0.035
12.637	0.031
12.682	0.029
12.729	0.027
12.778	0.026
12.830	0.026
12.886	0.026
12.945	0.026
13.010	0.026
13.082	0.023
13.163	0.018
13.260	0.016
13.386	0.015
13.690	0.015
21.770	0.000
-1.000	0.000



JOB NO: 3124460

Hydrograph Routing - Storage Volume 1
Project Description Kohi - Storage Volume 1 Catchment (A1, A3, A4 & A2)

Stability Coefficient (0.5-1.0)	0.50
Start time (hr)	0
Finish time (hr)	24
Extraction rate (m ³ /s)	0.00

Inflow Hydrograph (A1, A3, A4 & A2)

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.034
11.347	0.095
11.491	0.095
11.601	0.105
11.694	0.135
11.776	0.159
11.850	0.179
11.918	0.222
11.981	0.289
12.040	0.338
12.096	0.439
12.150	0.554
12.201	0.608
12.232	0.587
12.264	0.518
12.297	0.434
12.331	0.362
12.365	0.314
12.400	0.278
12.437	0.245
12.474	0.218
12.513	0.200
12.553	0.186
12.594	0.167
12.637	0.149
12.682	0.135
12.729	0.129
12.778	0.125
12.830	0.124
12.886	0.123
12.945	0.123
13.010	0.123
13.082	0.112
13.163	0.086
13.260	0.075
13.386	0.072
13.690	0.072
21.769	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m ³)
31.610	0
31.710	1.1
31.810	3.9
31.910	9.4
32.010	18.9
32.110	32.8
32.210	50.5
32.310	73.0
32.410	103.5
32.510	149.4
32.610	234.6
32.635	271.0
32.660	307.3
32.685	343.7
32.710	380.0
32.735	421.6
32.760	463.2
32.785	504.8
32.810	546.4
32.835	588.0
-1.000	

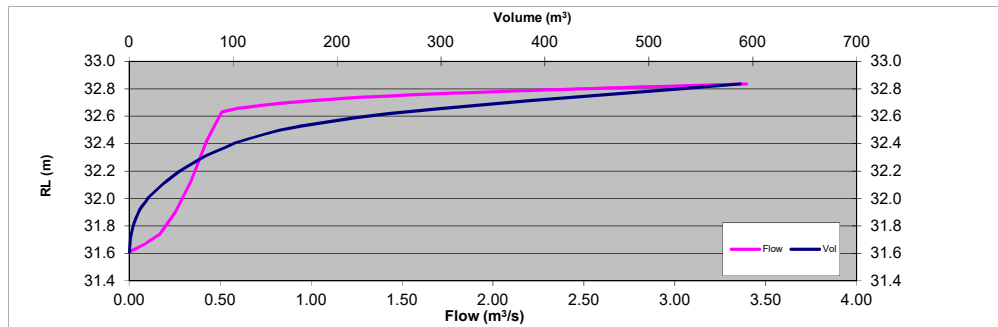
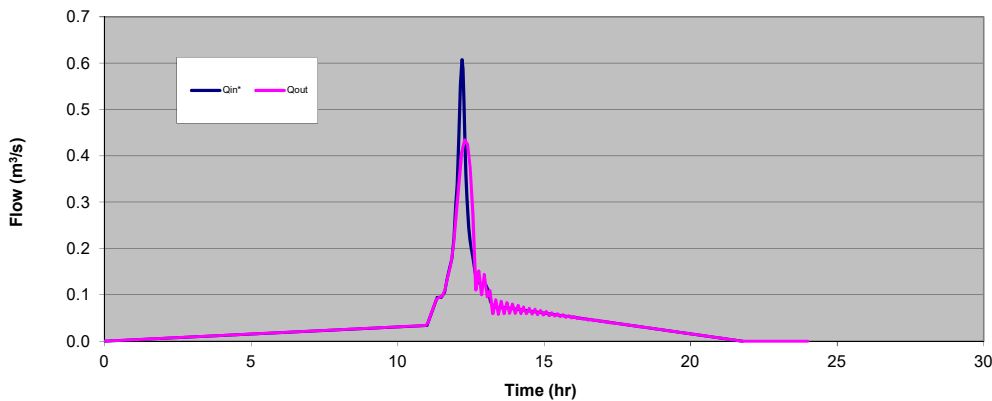
Flow Rating Curve

RL (m)	Flow (m ³ /s)		
	Pipe	Overland	Total
31.610	0.000		0.000
31.710	0.149		0.149
31.810	0.211		0.211
31.910	0.259		0.259
32.010	0.299		0.299
32.110	0.334		0.334
32.210	0.366		0.366
32.310	0.395		0.395
32.410	0.422		0.422
32.510	0.448		0.448
32.610	0.472	0.000	0.472
32.635	0.478	0.036	0.514
32.660	0.484	0.125	0.609
32.685	0.489	0.269	0.758
32.710	0.495	0.466	0.961
32.735	0.501	0.730	1.231
32.760	0.506	1.113	1.619
32.785	0.512	1.626	2.138
32.810	0.517	2.214	2.731
32.835	0.522	2.873	3.395
-1.000			

- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:

Max. Inflow (m ³ /s)	0.608
Time at Max. Inflow (hr)	12.19
Max. Outflow (m ³ /s)	0.435
Time at Max. Outflow (hr)	12.29
Initial RL (m)	31.610
Max. RL (m)	32.459
Max. Volume (m ³)	125.8
Inflow Volume (m ³)	3331.5
Volumetric error	0.00%
Extraction Volume (m ³)	0.0

 Cd 0.670
 Pipe Diameter 0.450 m

Inflow and Outflow Hydrographs


Beca Infrastructure Ltd



JOB NO:

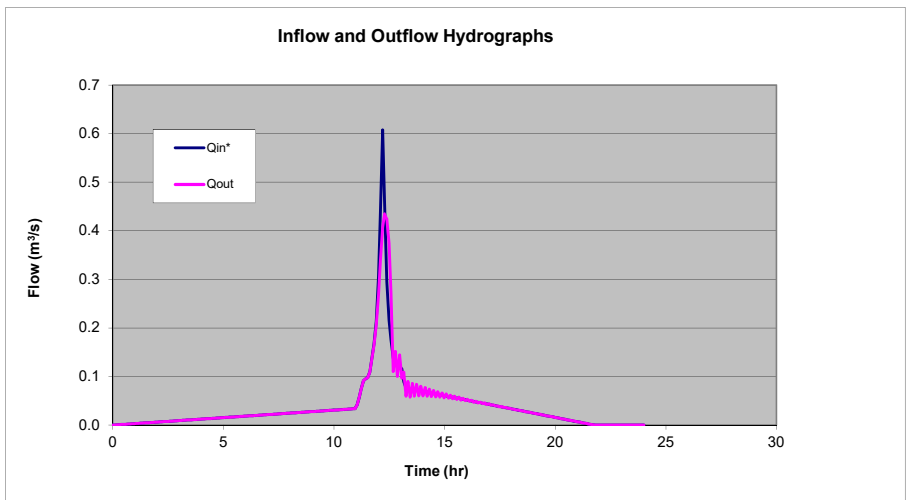
Hydrograph Routing

Project Description **Kohi - Storage Volume 1 Catchment (A1, A3, A4 & A2)**

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 2.24%

Time (hr)	Flow (m ³ /s)
0.000	0.000
3.547	0.011
5.017	0.015
6.144	0.019
7.094	0.022
7.932	0.024
8.689	0.027
9.385	0.029
10.033	0.031
10.642	0.033
11.217	0.072
11.765	0.153
12.288	0.435
12.515	0.337
12.747	0.143
12.984	0.132
13.227	0.071
13.474	0.068
13.728	0.084
13.988	0.066
14.255	0.067
14.530	0.067
14.812	0.060
15.104	0.061
15.406	0.057
15.718	0.053
16.043	0.053
16.382	0.048
16.737	0.045
17.109	0.041
17.503	0.038
17.923	0.034
18.374	0.030
18.864	0.026
19.406	0.021
20.022	0.016
20.752	0.009
21.703	0.001
24.000	0.000
-1.000	0.000



Calculation Sheet

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Existing Storage Volume 2 Catchment (A5&A6)

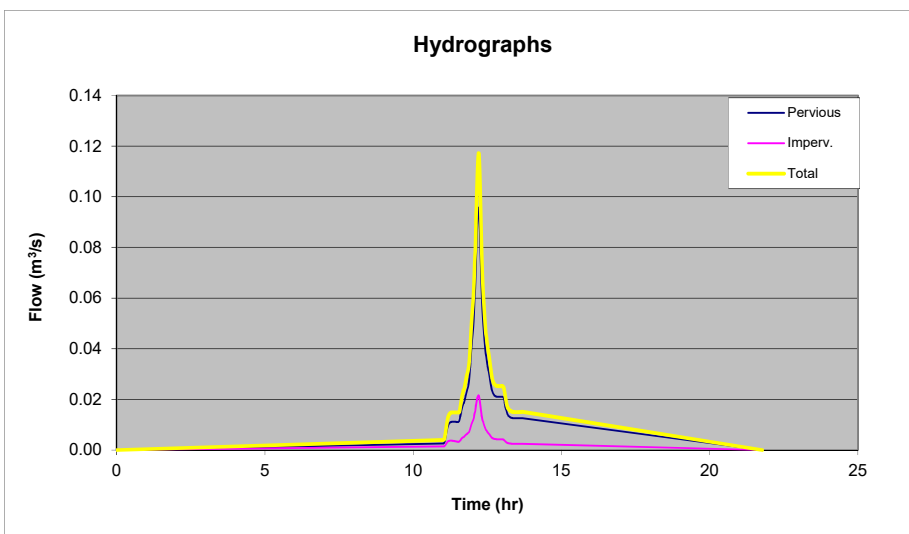
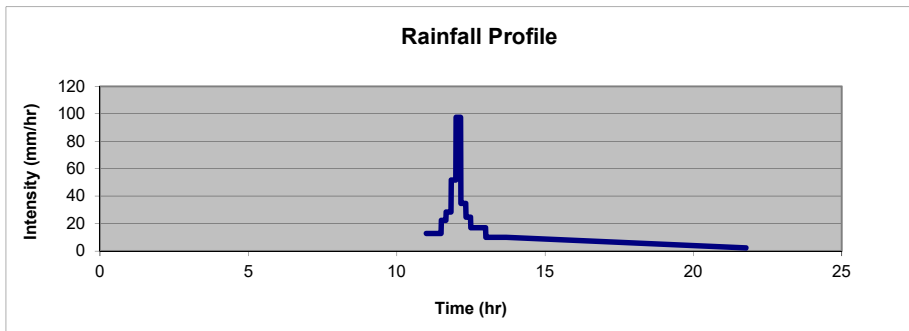
Rainfall Depth (mm) 140

Notes:

1. Inputs
2. Typical inputs for CN are in 'Typical CN Values' Sheet
3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.5914	0.0888
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	Total		
Area (ha)	0.5914	0.0888	0.6802
Runoff (mm)	81.6	135.4	88.6
Peak Flow (m ³ /s)	0.096	0.022	0.117
Time (hr) at Peak Flow	12.21	12.20	12.21
Rainfall (mm/h) over tc	97.38	97.38	97.38
Runoff Coefficient - Peak	0.60	0.90	0.64
Runoff Coefficient - Volume	0.58	0.96	0.63



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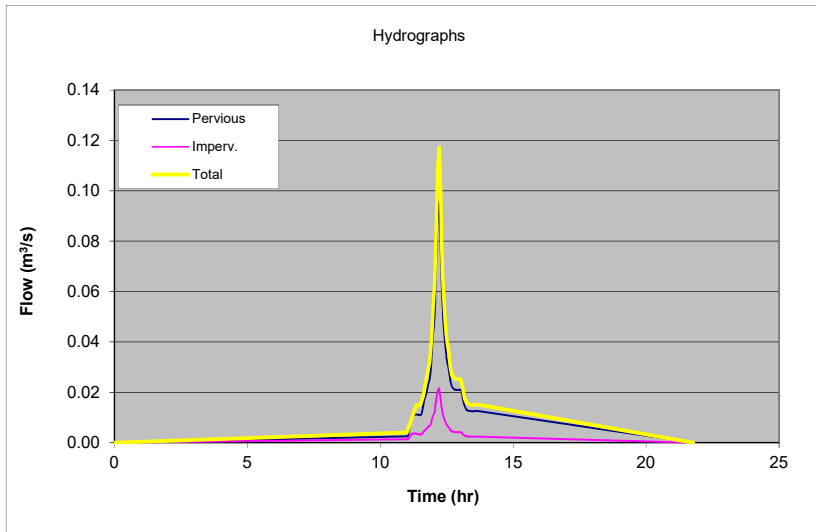
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Existing Storage Volume 2 Catchment (A5&A6)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m³/s)
0.000	0.000
11.001	0.004
11.351	0.015
11.495	0.015
11.607	0.018
11.700	0.024
11.783	0.028
11.857	0.032
11.926	0.041
11.990	0.054
12.050	0.064
12.107	0.087
12.161	0.109
12.212	0.117
12.243	0.110
12.275	0.096
12.308	0.080
12.341	0.068
12.375	0.060
12.410	0.054
12.446	0.048
12.483	0.043
12.522	0.040
12.561	0.037
12.602	0.033
12.645	0.030
12.689	0.027
12.736	0.026
12.785	0.026
12.837	0.025
12.892	0.025
12.951	0.025
13.015	0.025
13.087	0.023
13.167	0.018
13.263	0.016
13.388	0.015
13.690	0.015
21.769	0.000
-1.000	0.000

Calculation Sheet



JOB NO: 3124460

Hydrograph Routing - Storage Volume 2

 Project Description **Kohi - Existing Storage Volume 2 Catchment (A5 & A6)**

 Stability Coefficient (0.5-1.0) 0.60
 Start time (hr) 0
 Finish time (hr) 24
 Extraction rate (m³/s) 0.00

Inflow Hydrograph (A + B)

Time (hr)	Flow (m ³ /s)
0.001	0.000
3.547	0.001
6.274	0.002
7.145	0.003
7.779	0.003
8.295	0.003
8.738	0.003
9.131	0.003
9.486	0.003
9.812	0.004
10.114	0.004
10.397	0.004
10.663	0.004
10.915	0.004
11.155	0.009
11.383	0.015
11.603	0.018
11.813	0.030
12.016	0.059
12.212	0.117
12.427	0.051
12.649	0.029
12.880	0.025
13.120	0.021
13.371	0.015
13.633	0.015
13.909	0.015
14.201	0.014
14.510	0.014
14.841	0.013
15.198	0.012
15.587	0.012
16.017	0.011
16.503	0.010
17.068	0.009
17.762	0.007
18.716	0.006
21.703	0.000
24.000	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m ³)
26.110	0
26.360	1
26.610	3
26.860	7
27.110	14
27.360	24
27.610	39
27.860	58
28.110	83
28.360	115
28.610	155
28.641	161.8
28.673	168.7
28.704	175.7
28.735	182.7
28.766	189.6
28.798	196.6
28.829	203.5
28.860	210.5
-1.000	

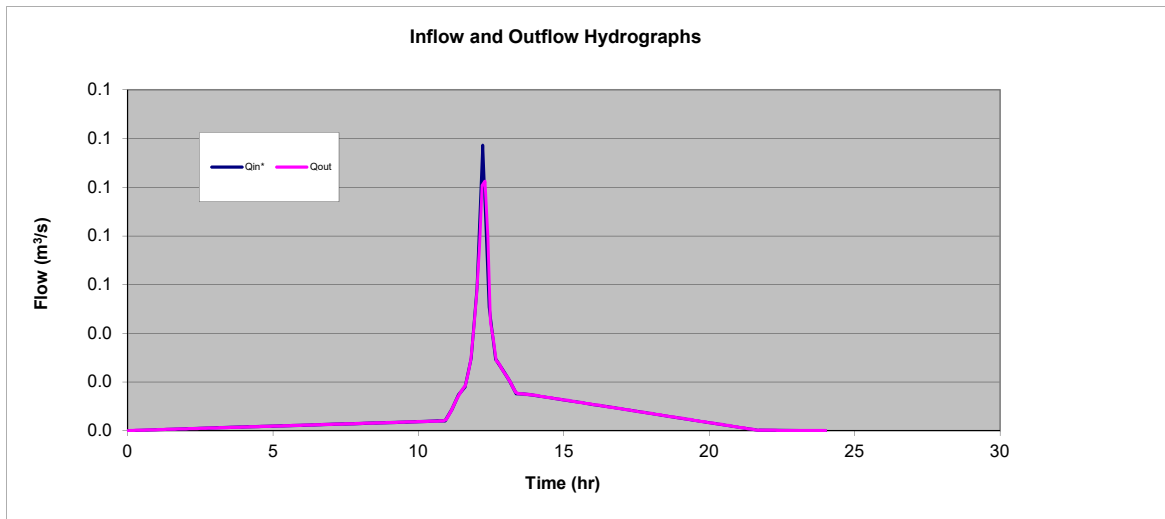
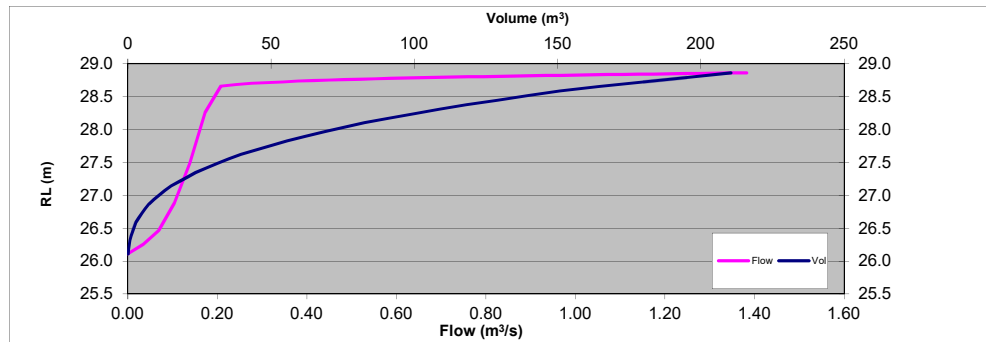
Flow Rating Curve

RL (m)	Flow (m ³ /s)		
	Pipe	Overland	Total (m ³ /s)
26.110	0.000	0.000	0.000
26.360	0.059	0.000	0.059
26.610	0.083	0.000	0.083
26.860	0.102	0.000	0.102
27.110	0.118	0.000	0.118
27.360	0.132	0.000	0.132
27.610	0.145	0.000	0.145
27.860	0.156	0.000	0.156
28.110	0.167	0.000	0.167
28.360	0.177	0.000	0.177
28.610	0.187	0.000	0.187
28.641	0.188	0.005	0.193
28.673	0.189	0.030	0.219
28.704	0.190	0.087	0.277
28.735	0.191	0.187	0.378
28.766	0.192	0.337	0.529
28.798	0.193	0.555	0.748
28.829	0.195	0.835	1.030
28.860	0.196	1.188	1.384
-1.000			

 Cd 0.670
 Pipe Diameter 0.225 m

- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:

 Max. Inflow (m³/s) 0.117
 Time at Max. Inflow (hr) 12.19
 Max. Outflow (m³/s) 0.102
 Time at Max. Outflow (hr) 12.29
 Initial RL (m) 26.110
 Max. RL (m) 26.864
 Max. Volume (m³) 7.2
 Inflow Volume (m³) 611.9
 Volumetric error 0.00%
 Extraction Volume (m³) 0.0


Calculation Sheet

Beca Infrastructure Ltd



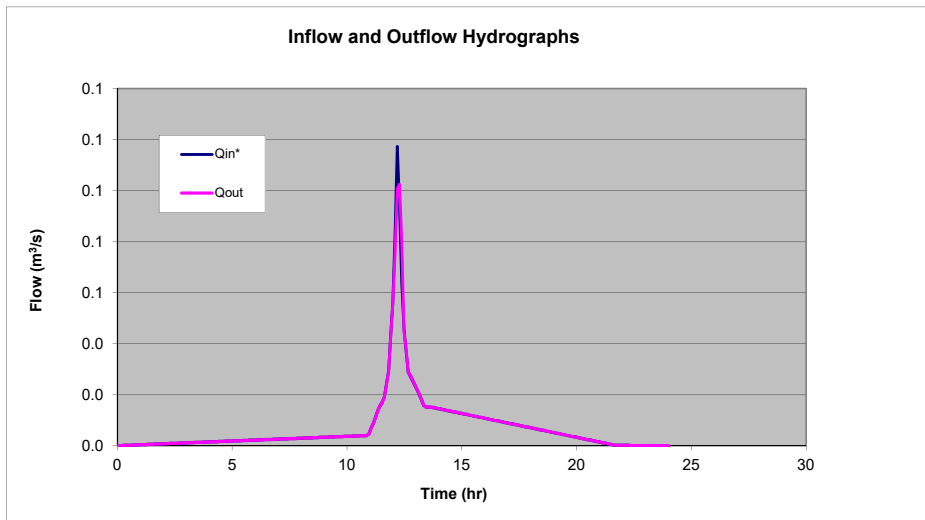
JOB NO:

Hydrograph Routing

Project Description Kohi - Existing Storage Volume 2 Catchment (A5 & A6)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 1.42%



Time (hr)	Flow (m ³ /s)
0.001	0.000
3.548	0.001
5.017	0.002
6.145	0.002
7.095	0.003
7.933	0.003
8.690	0.003
9.386	0.003
10.034	0.004
10.642	0.004
11.218	0.010
11.765	0.027
12.288	0.102
12.516	0.042
12.748	0.028
12.985	0.023
13.227	0.018
13.475	0.015
13.728	0.015
13.988	0.015
14.255	0.014
14.530	0.014
14.813	0.013
15.104	0.012
15.406	0.012
15.719	0.011
16.044	0.011
16.382	0.010
16.737	0.009
17.110	0.009
17.504	0.008
17.923	0.007
18.374	0.006
18.864	0.005
19.406	0.004
20.022	0.003
20.752	0.002
21.703	0.000
24.000	0.000
-1.000	0.000

Calculation Sheet

Beca Ltd



JOB NO: 3124460-221

Hydrograph Combination - Existing Combined Piped Flow

 Project Description Combined Pipe Flow from SV1 & SV2

 Time Lag (min) 0 Time Lag (min) 0

Hydrograph SV1 Piped Outflow

Time (hr)	Flow (m ³ /s)
0.000	0.000
3.547	0.011
5.017	0.015
6.144	0.019
7.094	0.022
7.932	0.024
8.689	0.027
9.385	0.029
10.033	0.031
10.642	0.033
11.217	0.072
11.765	0.153
12.288	0.435
12.515	0.337
12.747	0.143
12.984	0.132
13.227	0.071
13.474	0.068
13.728	0.084
13.988	0.066
14.255	0.067
14.530	0.067
14.812	0.060
15.104	0.061
15.406	0.057
15.718	0.053
16.043	0.053
16.382	0.048
16.737	0.045
17.109	0.041
17.503	0.038
17.923	0.034
18.374	0.030
18.864	0.026
19.406	0.021
20.022	0.016
20.752	0.009
21.703	0.001
24.000	0.000
-1.000	0.000

Hydrograph SV2 Piped Outflow

Time (hr)	Flow (m ³ /s)
0.001	0.000
3.548	0.001
5.017	0.002
6.145	0.002
7.095	0.003
7.933	0.003
8.690	0.003
9.386	0.003
10.034	0.004
10.642	0.004
11.218	0.010
11.765	0.027
12.288	0.102
12.516	0.042
12.748	0.028
12.985	0.023
13.227	0.018
13.475	0.015
13.728	0.015
13.988	0.015
14.255	0.014
14.530	0.014
14.813	0.013
15.104	0.012
15.406	0.012
15.719	0.011
16.044	0.011
16.382	0.010
16.737	0.009
17.110	0.009
17.504	0.008
17.923	0.007
18.374	0.006
18.864	0.005
19.406	0.004
20.022	0.003
20.752	0.002
21.703	0.000
24.000	0.000
-1.000	0.000

Hydrograph Total Pipe Outflow

Time (hr)	Flow (m ³ /s)
0.002	0.000
3.547	0.012
6.298	0.022
7.177	0.025
7.816	0.027
8.336	0.029
8.784	0.030
9.180	0.032
9.538	0.033
9.867	0.034
10.171	0.035
10.457	0.036
10.725	0.043
10.979	0.063
11.221	0.083
11.452	0.124
11.673	0.164
11.886	0.262
12.090	0.402
12.288	0.537
12.501	0.390
12.721	0.194
12.950	0.158
13.188	0.099
13.437	0.084
13.698	0.097
13.971	0.081
14.261	0.081
14.568	0.079
14.896	0.073
15.250	0.071
15.636	0.065
16.063	0.063
16.544	0.056
17.105	0.050
17.794	0.043
18.740	0.033
21.703	0.001
24.000	0.000
-1.000	0.000

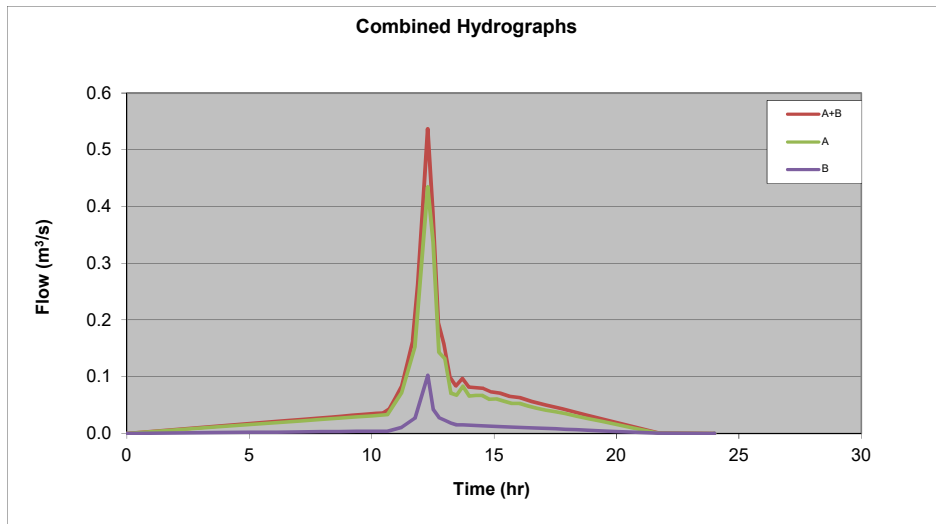
Notes:

- Input data should be in ascending order with time in the boxes provided. The maximum no. of values is 40. If a lesser no. of values is needed then terminate as a -1 for the x value.
- The Time Lag is relative to the hydrograph times.
- Volumetric error is generally due to the interpolation and reassignment of time values.

Results:

Max. Flow (m ³ /s) -A	0.435
Time (hr) at Max Flow	12.29
Max. Flow (m ³ /s) -B	0.102
Time (hr) at Max Flow	12.29
Max. Flow (m ³ /s)	0.537
Time (hr) at Max Flow	12.29
Volumetric Error	0.0%

However it is condiered tha the pipe only has capacity for approximately 520 L/S. there 17 L/S of this will flow overland.



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JOB NO: 3124460

Hydrographs- SCS Method:

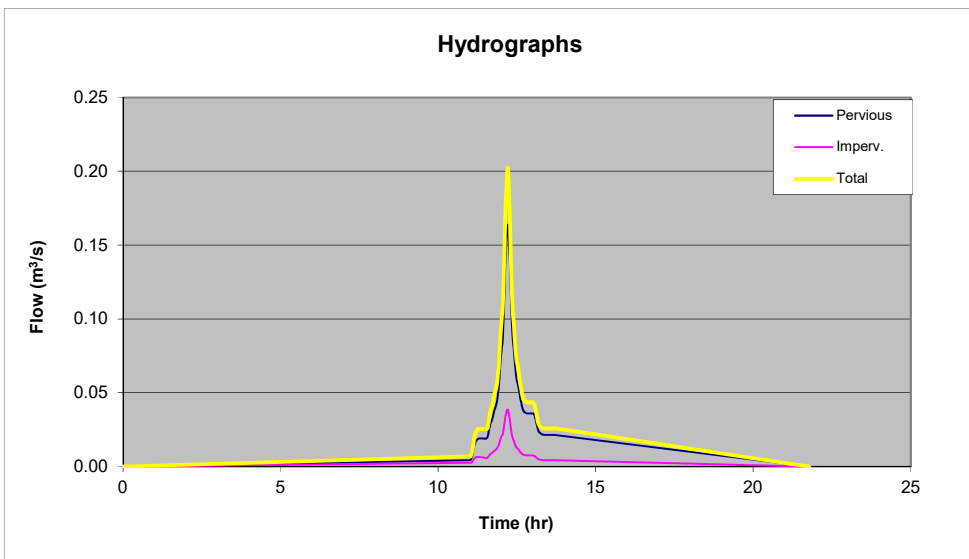
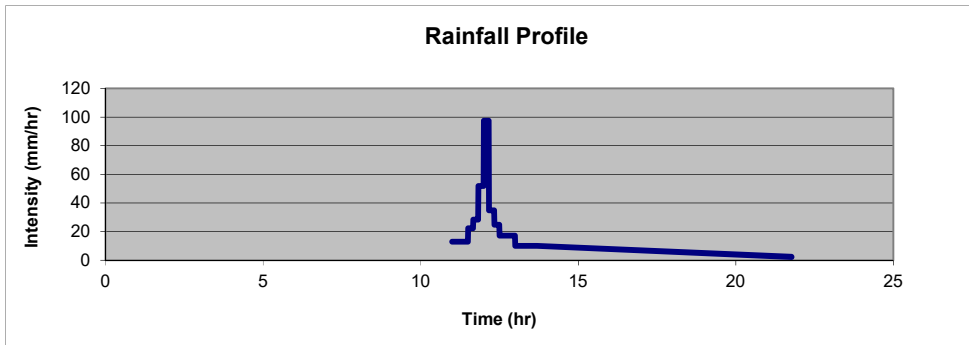
Project Description **Kohi - Catchment to No 17 John Rymer Place(A7 & A8)**

Rainfall Depth (mm) **140**

- Notes:**
1. Inputs
 2. Typical inputs for CN are in 'Typical CN Values' Sheet
 3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	1.0124	0.1588
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	1.0124	0.1588	1.1712
Runoff (mm)	81.6	135.4	88.9
Peak Flow (m ³ /s)	0.164	0.039	0.202
Time (hr) at Peak Flow	12.21	12.20	12.21
Rainfall (mm/h) over tc	97.38	97.38	97.38
Runoff Coefficient - Peak	0.60	0.90	0.64
Runoff Coefficient - Volume	0.58	0.96	0.63



Beca Ltd



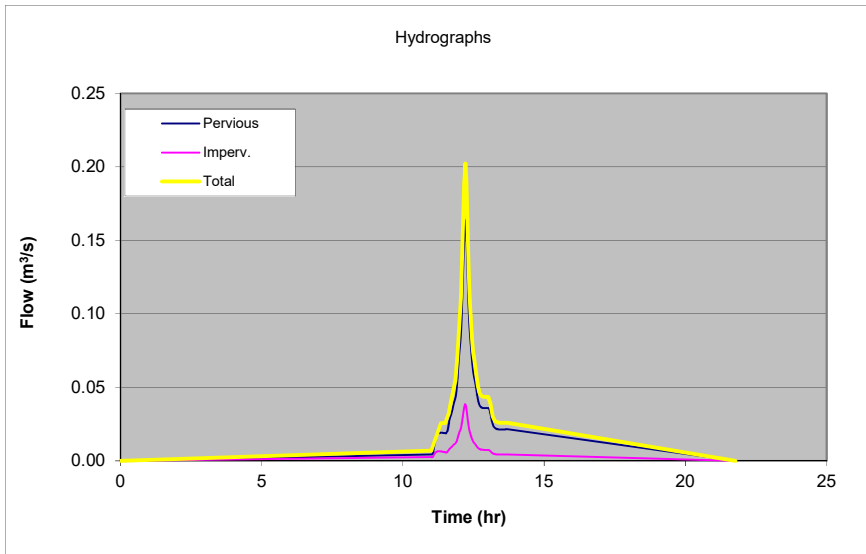
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Catchment to No 17 John Rymer Place(A7 & A8)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.007
11.351	0.026
11.495	0.026
11.607	0.031
11.700	0.041
11.783	0.049
11.857	0.055
11.926	0.072
11.990	0.093
12.050	0.111
12.107	0.150
12.161	0.188
12.212	0.202
12.243	0.191
12.275	0.166
12.308	0.139
12.341	0.118
12.375	0.104
12.410	0.092
12.446	0.082
12.483	0.074
12.522	0.068
12.561	0.064
12.602	0.057
12.645	0.051
12.689	0.047
12.736	0.045
12.785	0.044
12.837	0.044
12.892	0.044
12.951	0.044
13.015	0.044
13.087	0.039
13.167	0.031
13.263	0.027
13.388	0.026
13.690	0.026
21.769	0.000
-1.000	0.000

Calculation Sheet

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kofi - Overland Catchment Catchment (A9, A10, A11 & A12)

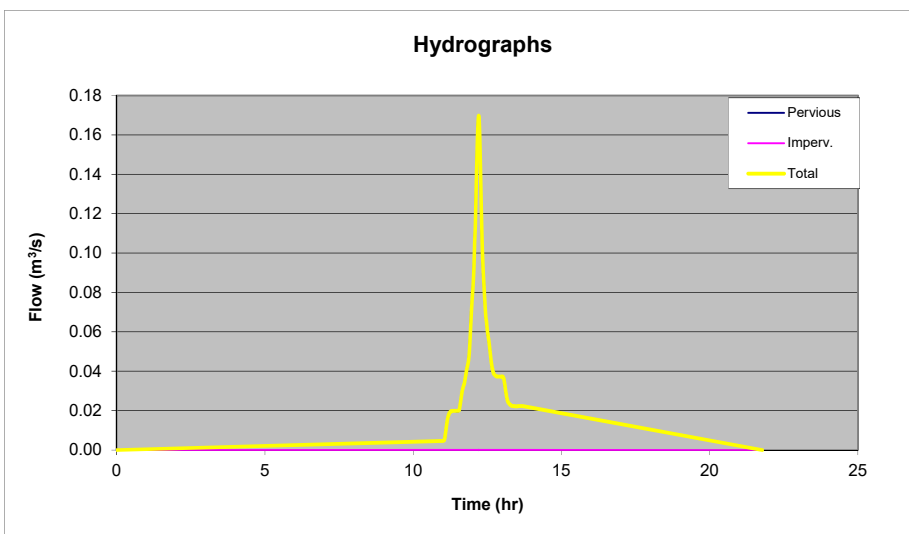
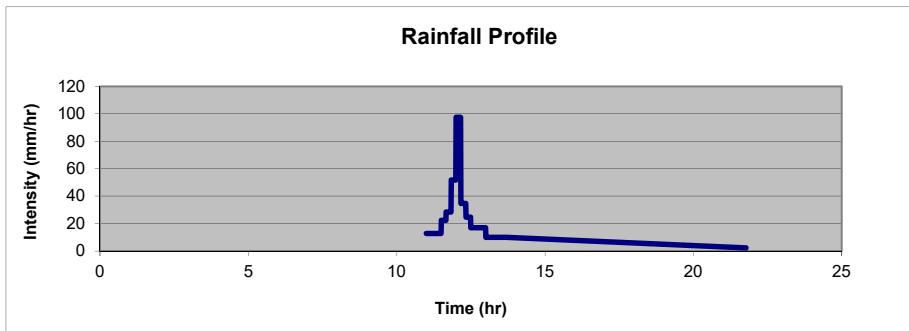
Rainfall Depth (mm) 140

Notes:

1. Inputs
2. Typical inputs for CN are in 'Typical CN Values' Sheet
3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	1.0489	
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	1.0489	0	1.0489
Runoff (mm)	81.6	135.4	81.6
Peak Flow (m ³ /s)	0.170	0.000	0.170
Time (hr) at Peak Flow	12.21	12.20	12.21
Rainfall (mm/h) over tc	97.38	97.38	97.38
Runoff Coefficient - Peak	0.60	0.00	0.60
Runoff Coefficient - Volume	0.58	0.96	0.58



Beca Ltd



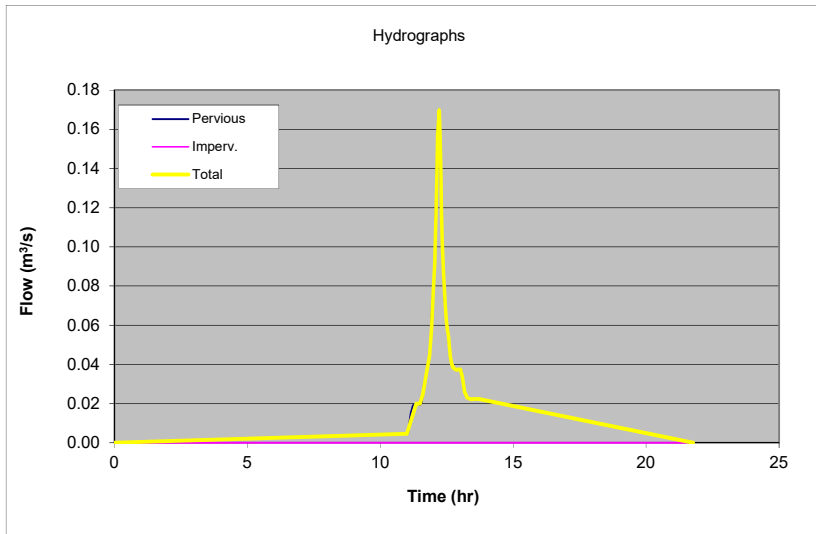
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Overland Catchment Catchment (A9, A10, A11 & A12)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m³/s)
0.000	0.000
11.001	0.005
11.351	0.020
11.495	0.020
11.607	0.025
11.700	0.033
11.783	0.039
11.857	0.045
11.926	0.058
11.990	0.076
12.050	0.092
12.107	0.124
12.161	0.157
12.212	0.170
12.243	0.160
12.275	0.139
12.308	0.117
12.341	0.099
12.375	0.088
12.410	0.078
12.446	0.070
12.483	0.063
12.522	0.058
12.561	0.054
12.602	0.049
12.645	0.044
12.689	0.040
12.736	0.039
12.785	0.038
12.837	0.037
12.892	0.037
12.951	0.037
13.015	0.037
13.087	0.034
13.167	0.026
13.263	0.023
13.388	0.022
13.690	0.022
21.769	0.000
-1.000	0.000

Calculation Sheet

Beca Ltd
JOB NO: 3124460

Hydraulic Grade Line Analysis:

Project Description HGL of Downstream Network

Downstream HGL (m)	0
Downstream Distance (m)	0
Flow Factor	1 (Actual/Specified)

Basis of computations
 Calculations are from downstream (d/s) to upstream (u/s) as per the table input.
 Energy $(E_{u/s}) = E_{d/s} + S_f \Delta x + K_{local} v^2 / 2g$
 $HGL_{u/s} = E_{u/s} - v^2 / 2g$
 Where S_f is the friction slope based on Colebrook-White and v is the pipe velocity.
 If HGL falls below the pipe overt, some partial full condition is assumed.

Notes:
Input
 The following table can input 20 components.
 Input data starts at the d/s end and progresses u/s
 Input data on pipe dia, flow, and k_s applies to the pipe u/s.
 Terminate list by making length = -1.0

Location	Length (to u/s-m)	Pipe dia. (m)	Invert level		Ground level (d/s-RL m)	Specified Flow (m³/s)	k_s (mm)	k_{local} (u/s)	Data output at the u/s end of the pipe (see diagram)						
			(d/s-RL m)	(u/s-RL m)					Distance (m)	Actual Flow (m³/s)	Pipe full Vel (m/s)	Pipe slope (m/m)	HGL (m)	Energy (m)	Freeboard to GL (m)
X. SW Outfall (Pourewa)	17.32	1.35	8.66	8.66	12.30	3.448	1.5	0.2	0.00	3.448	2.41	0.0700	9.89	10.19	2.41
SWMH NP4983	55.4	0.825	9.87	10.39	14.37	3.005	1.5	0.2	17.32	3.005	5.62	0.0717	10.86	11.34	3.51
SWMH NP4996	88.88	0.75	14.36	14.46	19.56	2.484	1.5	0.2	72.72	2.484	5.62	0.0532	15.18	16.79	4.38
SWMH NP4965	56.47	0.75	19.19	19.21	23.40	2.484	1.5	0.2	161.60	2.484	5.62	0.0491	20.00	21.61	3.40
SWMH NP4954	70.97	0.6	21.98	22.00	26.98	0.628	1.5	1.5	218.07	0.628	2.22	0.0166	23.17	24.78	3.81
SWMH NP4849	20.87	0.6	23.18	23.20	27.54	0.537	1.5	0.2	289.04	0.537	1.90	0.0182	27.70	27.95	-0.16
SWMH NP4851	-1		23.58		27.38		1.5	0.2	309.91				27.97	28.16	-0.59

HGL Analysis

Recommended local manhole losses (k_{local}) for haunched MHs
 (Losses based on d/s velocity)

Deviation Angle °	No surcharge	With Surcharge		Drop MH
		Lateral inflow	Some	
0	0.2	0.2	0.5	1.5
45	0.5	0.5	1.0	1.5
90	1.2	1.5	1.5	2.0

Total energy change (m) **18.03**
 Energy loss due to friction (m) 10.81
 Energy loss due to local headlosses (m) 3.23
 Energy loss due to geometry (m) 3.99

**EXISTING Q100
CALCULATIONS WITHOUT
CLIMATE CHANGE
ALLOWANCE**

Beca Ltd



JOB NO: 3124460/221

Hydrographs- SCS Method:

Project Description SCS Calc for 1ha Catchment Areas

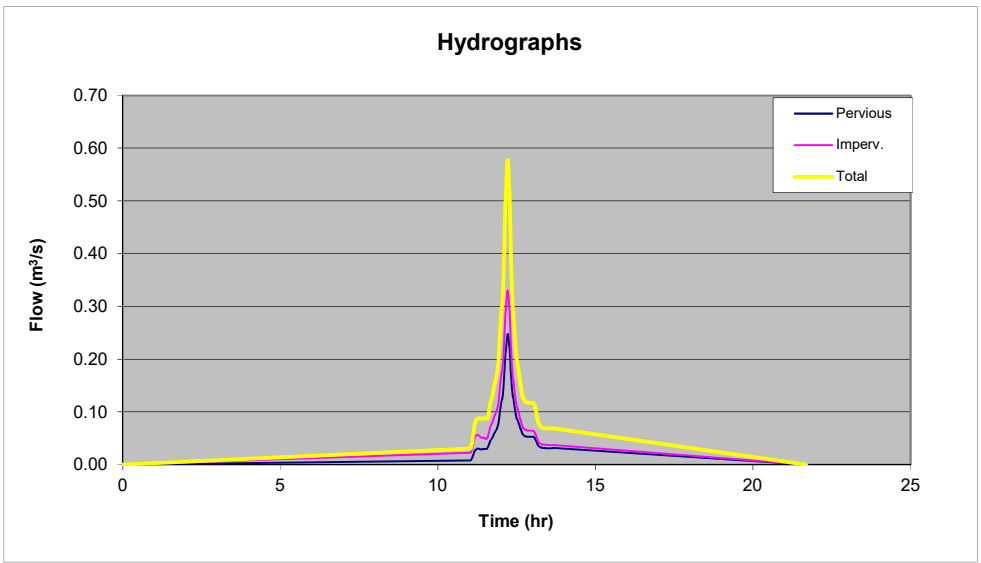
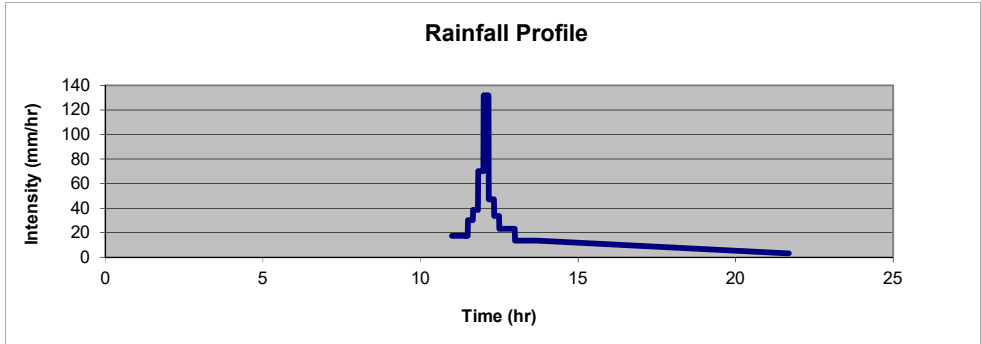
Rainfall Depth (mm) 190

Notes:

1. Inputs
2. Typical inputs for CN 20000 are in 'Typical CN Values' Sheet
3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	1	1
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	1	1	Total
Area (ha)	1	1	2
Runoff (mm)	124.8	185.0	154.9
Peak Flow (m ³ /s)	0.248	0.330	0.578
Time (hr) at Peak Flow	12.22	12.21	12.21
Rainfall (mm/h) over tc	131.81	131.81	131.81
Runoff Coefficient - Peak	0.68	0.90	0.79
Runoff Coefficient - Volume	0.66	0.97	0.82



Calculation Sheet

Existing Stormwater Catchment Area & Flow Allocation

Peak flow from 1ha ignoring CN values		
Impermeable	0.330	m ³ /s
Permeable	0.248	m ³ /s
CN _{impermeable}	0.98	
CN _{permeable}	0.74	
Factor of Safety	1	
Design Rainfall	190	mm
Time of Concentration	10	mins

On-Site & Upstream Catchments	Total Area	Pervious Area	Impervious Area	% Impervious	Design Runoff (m ³ /s)	Notes
A1	15318	2737	12581	0.82	0.483	
A2	5596	560	5036	0.90	0.132	Limited to the Q10
A3	6843	6843	0	0.00	0.169	
A4	733	293	440	0.60	0.022	
A5 - Primary Catchment	1480	592	888	0.60	0.044	
A5 - Overland Flow	3538	1415	2123	0.60	0.105	
A6	5322	5322	0	0.00	0.132	
A7	9879	9879	0	0.00	0.245	
A8	1833	245	1588	0.87	0.059	
A9 - Primary Catchment	741	741	0	0.00	0.018	
A9 - Overland Flow	5543	5543	0	0.00	0.137	
A10	5779	5779	0	0.00	0.143	
A11	3329	3329	0	0.00	0.082	
A12	640	640	0	0	0.016	

Off-Site Catchments	Total Area	Pervious Area	Impervious Area	% Impervious	Notes
B1	4173	1669.2	2503.8	0.6	
B2	11737	4694.8	7042.2	0.6	
B3	12964	5185.6	7778.4	0.6	
B4	16845	6738	10107	0.6	
B5	929	371.6	557.4	0.6	
B6	1622	648.8	973.2	0.6	
B7	2216	886.4	1329.6	0.6	
B8	2539	1015.6	1523.4	0.6	
B9	1499	599.6	899.4	0.6	
B10	5976	2390.4	3585.6	0.6	
B11	23122	9248.8	13873.2	0.6	
B12	2593	1037	1556	0.6	
B13	1707	682.8	1024.2	0.6	
C1	4262	1704.8	2557.2	0.6	
C2	11750	4700	7050	0.6	
C3	9328	3731.2	5596.8	0.6	
C4	12843	5137.2	7705.8	0.6	
C5	6034	2413.6	3620.4	0.6	
C6	5910	2364	3546	0.6	

	Catchment Area			Permeable Cumulative Catchment area (m ²)	Impermeable Cumulative Catchment Area (m ²)	Design FLOW (m ³ /s)	Notes
	Permeable	Impermeable	Total				
Ashwell Street							
SWMH NP4954	0	0	0	20051	30076	1.490	-
SWMH NP5167	1705	2557	4262	20051	30076	1.490	C1
SWMH NP7810	0	0	0	18346	27519	1.363	-
SWMH NP5693	4700	7050	11750	18346	27519	1.363	C2
SWMH 11519	3731	5597	9328	13646	20469	1.014	C3
SWMH NP5690	5137	7706	12843	9915	14872	0.737	C4
SWMH NP5672	2414	3620	6034	4778	7166	0.355	C5
SWMH NP5668	2364	3546	5910	2364	3546	0.176	C6

SW John Rymer							
EX. SW Outfall (Pourewa Creek)	0	0	0	83106	105485	4.705	none
SWMH NP4983	8407	12611	21018	83106	105485	4.705	B1, B4
SWMH NP4996	9880	14821	24701	74698	92875	4.080	B2, B3
SWMH NP4965	0	0	0	64818	78054	3.346	none
SWMH NP4954	35212	52818	88030	64818	78054	3.346	B5-B11, C1
SWMH NP4849	1720	2580	4300	29606	25236	0.730	B12, B13
SWMH NP4851	27886	22656	50542	27886	22656	0.602	(A1-A8) Att

Kohi Road							
SWMH NP4954	0	0	0	15161	22742	1.127	none
SWMH NP4952	1387	2081	3468	15161	22742	1.127	B5, B8
SWMH NP5466	1535	2303	3838	13774	20661	1.024	B6, B7
SWMH NP5468	2390	3586	5976	12239	18358	0.909	B10
SWMH NP5470	600	899	1499	9848	14773	0.732	B9
SWMH NP5456	0	0	0	9249	13873	0.687	none
SWMH NP5459	9249	13873	23122	9249	13873	0.687	B11

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JOB NO: 3124460

Hydrographs- SCS Method:

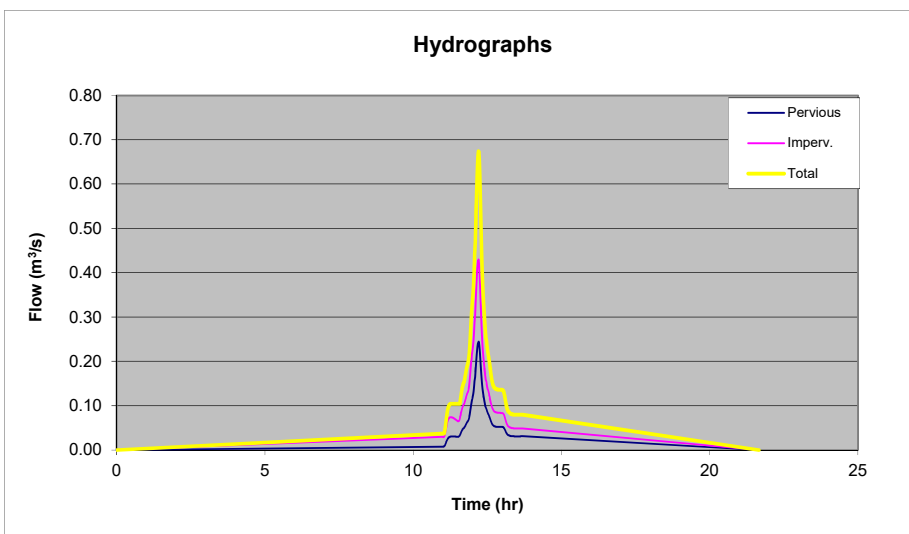
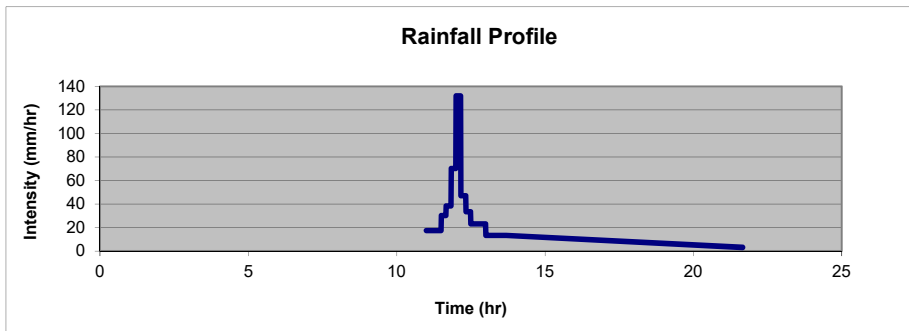
Project Description **Kohi - Storage Volume 1 Catchment (A1, A3, A4)**

Rainfall Depth (mm) **190**

- Notes:**
- Inputs
 - Typical inputs for CN are in 'Typical CN Values' Sheet
 - Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.9873	1.3021
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	Total		
Area (ha)	0.98732	1.30208	2.2894
Runoff (mm)	124.8	185.0	159.0
Peak Flow (m ³ /s)	0.245	0.430	0.674
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	131.81	131.81	131.81
Runoff Coefficient - Peak	0.68	0.90	0.80
Runoff Coefficient - Volume	0.66	0.97	0.84



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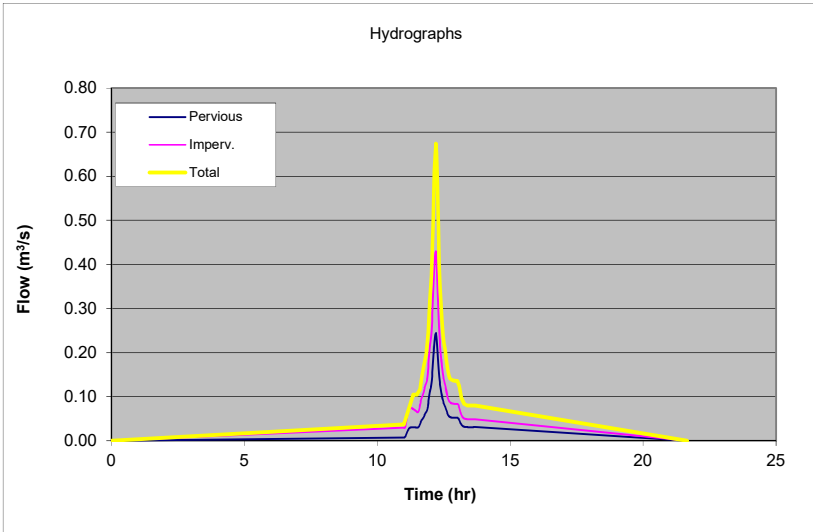
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Storage Volume 1 Catchment (A1, A3, A4)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m³/s)
0.000	0.000
11.001	0.037
11.347	0.105
11.491	0.105
11.601	0.116
11.694	0.150
11.776	0.176
11.850	0.198
11.918	0.246
11.981	0.320
12.040	0.375
12.096	0.488
12.150	0.615
12.201	0.674
12.232	0.652
12.264	0.575
12.297	0.481
12.331	0.401
12.365	0.348
12.400	0.308
12.437	0.272
12.474	0.242
12.513	0.221
12.553	0.206
12.594	0.185
12.637	0.165
12.682	0.150
12.729	0.143
12.778	0.139
12.830	0.137
12.886	0.136
12.945	0.136
13.010	0.136
13.082	0.124
13.163	0.096
13.260	0.083
13.386	0.080
13.690	0.080
21.657	0.000
-1.000	0.000

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JOB NO: 3124460

Hydrographs- SCS Method:

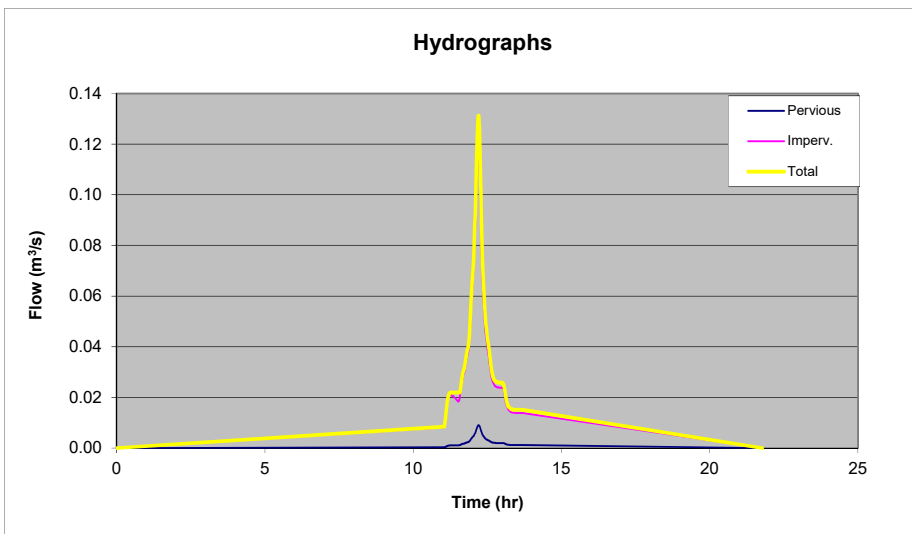
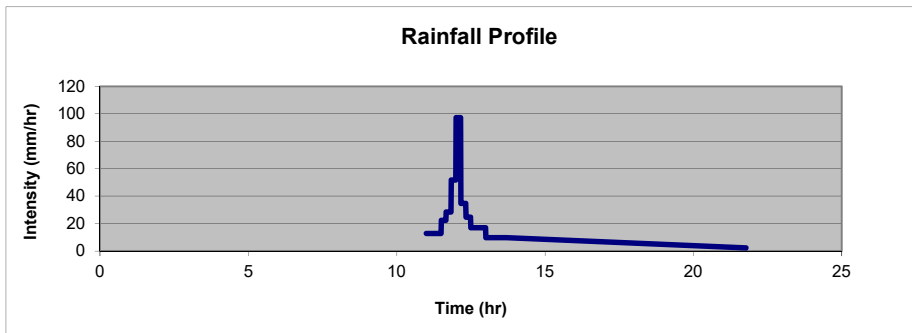
Project Description **Kohi -Existing Storage Volume 1 Catchment (A2 limited to Q10)**

Rainfall Depth (mm) **140**

- Notes:**
- Inputs
 - Typical inputs for CN are in 'Typical CN Values' Sheet
 - Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.0560	0.5036
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	Total		
Area (ha)	0.05596	0.50364	0.5596
Runoff (mm)	81.3	135.0	129.6
Peak Flow (m ³ /s)	0.009	0.122	0.131
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	97.13	97.13	97.13
Runoff Coefficient - Peak	0.60	0.90	0.87
Runoff Coefficient - Volume	0.58	0.96	0.93



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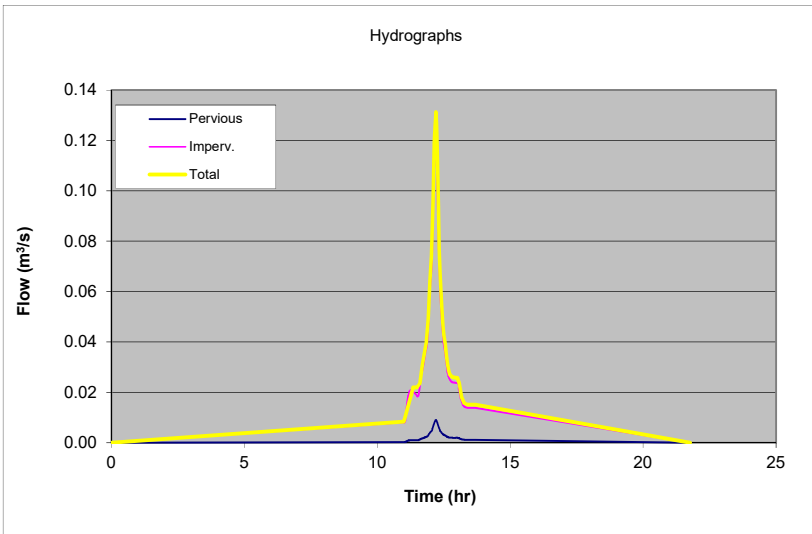
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi -Existing Storage Volume 1 Catchment (A2 limited to Q10)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m³/s)
0.000	0.000
11.001	0.008
11.347	0.022
11.491	0.022
11.601	0.024
11.694	0.030
11.776	0.036
11.850	0.040
11.918	0.049
11.981	0.064
12.040	0.074
12.096	0.096
12.150	0.120
12.201	0.131
12.232	0.127
12.264	0.111
12.297	0.093
12.331	0.077
12.365	0.067
12.400	0.059
12.437	0.052
12.474	0.046
12.513	0.042
12.553	0.039
12.594	0.035
12.637	0.031
12.682	0.029
12.729	0.027
12.778	0.026
12.830	0.026
12.886	0.026
12.945	0.026
13.010	0.026
13.082	0.023
13.163	0.018
13.260	0.016
13.386	0.015
13.690	0.015
21.770	0.000
-1.000	0.000

Calculation Sheet

Hydrograph Routing - Storage Volume 1

Project Description **Kohi - Storage Volume 1 Catchment (A1, A3, A4 & A2)**

Stability Coefficient (0.5-1.0) **0.50**
Start time (hr) **0**

Inflow Hydrograph (A1, A3, A4 & A2)

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.046
11.347	0.127
11.491	0.127
11.601	0.139
11.694	0.180
11.776	0.212
11.850	0.238
11.918	0.296
11.981	0.384
12.040	0.449
12.096	0.584
12.150	0.735
12.201	0.806
12.232	0.778
12.264	0.686
12.297	0.574
12.331	0.478
12.365	0.415
12.400	0.368
12.437	0.324
12.474	0.288
12.513	0.264
12.553	0.245
12.594	0.221
12.637	0.196
12.682	0.179
12.729	0.170
12.778	0.165
12.830	0.163
12.886	0.162
12.945	0.162
13.010	0.162
13.082	0.147
13.163	0.114
13.260	0.099
13.386	0.095
13.690	0.095
21.657	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m ³)
31.610	0
31.710	1.1
31.810	3.9
31.910	9.4
32.010	18.9
32.110	32.8
32.210	50.5
32.310	73.0
32.410	103.5
32.510	149.4
32.610	234.6
32.635	271.0
32.660	307.3
32.685	343.7
32.710	380.0
32.735	421.6
32.760	463.2
32.785	504.8
32.810	546.4
32.835	588.0
-1.000	

Flow Rating Curve

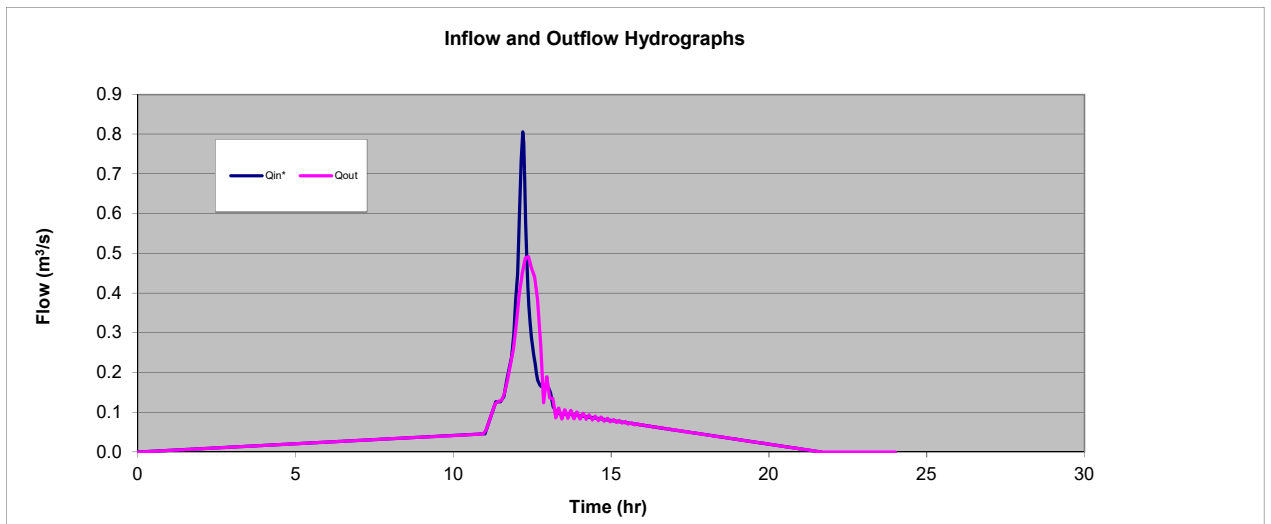
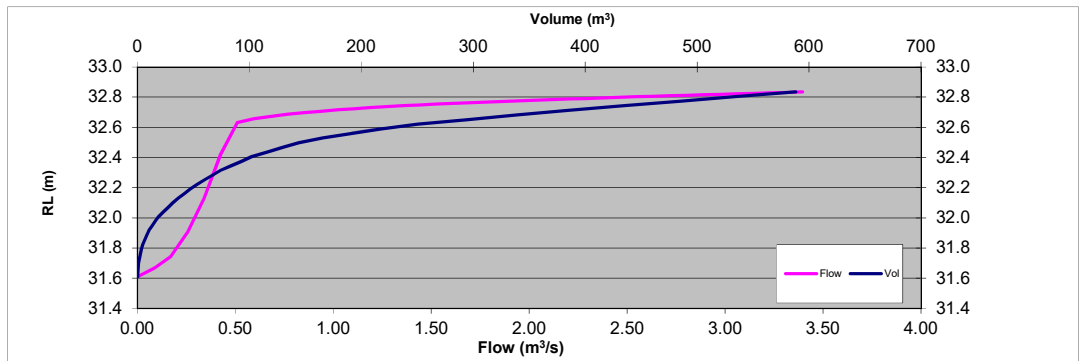
RL (m)	Flow (m ³ /s)		
	Pipe	Overland	Total
31.610	0.000		0.000
31.710	0.149		0.149
31.810	0.211		0.211
31.910	0.259		0.259
32.010	0.299		0.299
32.110	0.334		0.334
32.210	0.366		0.366
32.310	0.395		0.395
32.410	0.422		0.422
32.510	0.448		0.448
32.610	0.472	0.000	0.472
32.635	0.478	0.036	0.514
32.660	0.484	0.125	0.609
32.685	0.489	0.269	0.758
32.710	0.495	0.466	0.961
32.735	0.501	0.730	1.231
32.760	0.506	1.113	1.619
32.785	0.512	1.626	2.138
32.810	0.517	2.214	2.731
32.835	0.522	2.873	3.395
-1.000			

Cd 0.670
Pipe Diameter 0.450 m

Finish time (hr) **24**
Extraction rate (m³/s) **0.00**

- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:
Max. Inflow (m³/s) 0.806
Time at Max. Inflow (hr) 12.19
Max. Outflow (m³/s) **0.492**
Time at Max. Outflow (hr) 12.38
Initial RL (m) 31.610
Max. RL (m) 32.622
Max. Volume (m³) 251.6
Inflow Volume (m³) 4401.4
Volumetric error 0.00%
Extraction Volume (m³) 0.0



Calculation Sheet

Hydrograph Routing - Storage Volume 1

Project Description Kōhi - Storage Volume 1 Catchment (A1, A3, A4 & A2)

 Stability Coefficient (0.5-1.0) 0.50
 Start time (hr) 0

Inflow Hydrograph (A1, A3, A4 & A2)

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.046
11.347	0.127
11.491	0.127
11.601	0.139
11.694	0.180
11.776	0.212
11.850	0.238
11.918	0.296
11.981	0.384
12.040	0.449
12.096	0.584
12.150	0.735
12.201	0.806
12.232	0.778
12.264	0.686
12.297	0.574
12.331	0.478
12.365	0.415
12.400	0.368
12.437	0.324
12.474	0.288
12.513	0.264
12.553	0.245
12.594	0.221
12.637	0.196
12.682	0.179
12.729	0.170
12.778	0.165
12.830	0.163
12.886	0.162
12.945	0.162
13.010	0.162
13.082	0.147
13.163	0.114
13.260	0.099
13.386	0.095
13.690	0.095
21.657	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m ³)
31.610	0
31.710	1.1
31.810	3.9
31.910	9.4
32.010	18.9
32.110	32.8
32.210	50.5
32.310	73.0
32.410	103.5
32.510	149.4
32.610	234.6
32.635	271.0
32.660	307.3
32.685	343.7
32.710	380.0
32.735	421.6
32.760	463.2
32.785	504.8
32.810	546.4
32.835	588.0
-1.000	

Flow Rating Curve

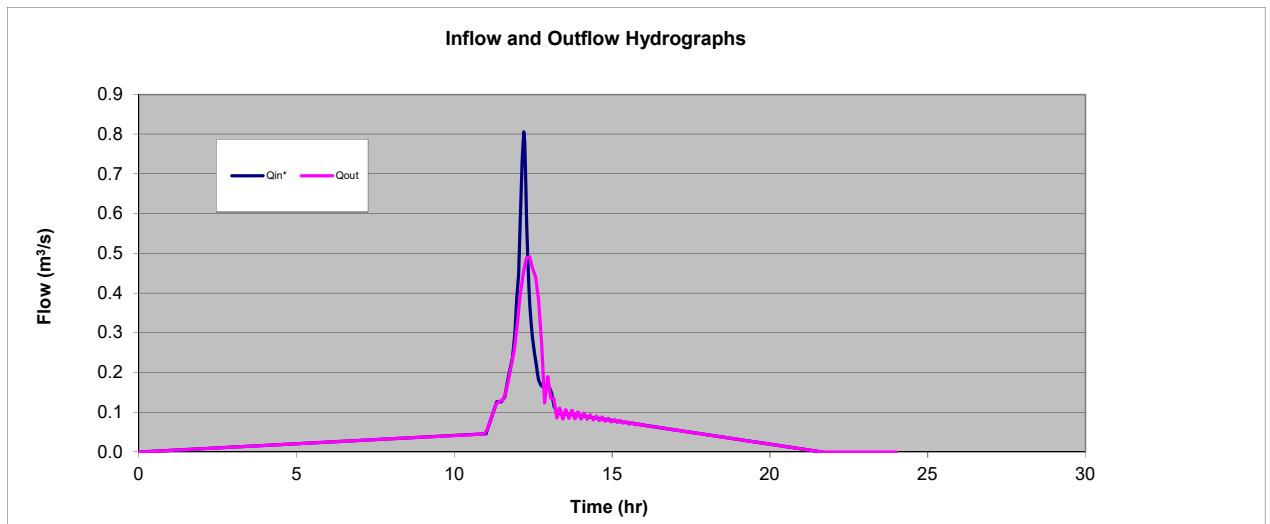
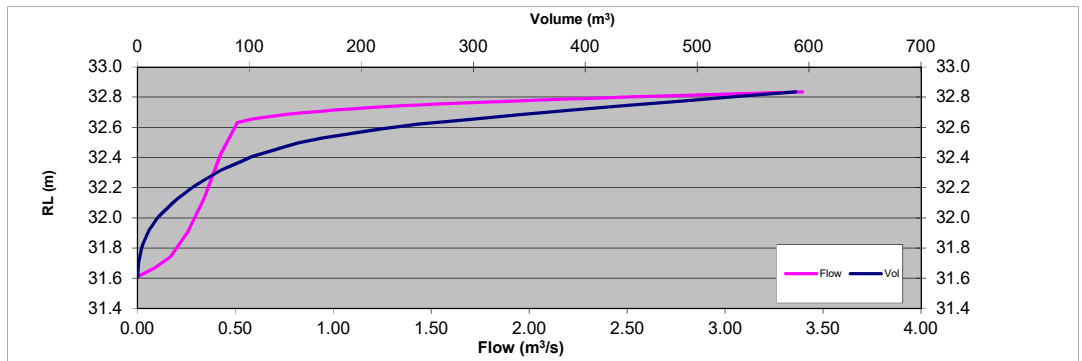
RL (m)	Flow (m ³ /s)		
	Pipe	Overland	Total
31.610	0.000		0.000
31.710	0.149		0.149
31.810	0.211		0.211
31.910	0.259		0.259
32.010	0.299		0.299
32.110	0.334		0.334
32.210	0.366		0.366
32.310	0.395		0.395
32.410	0.422		0.422
32.510	0.448		0.448
32.610	0.472	0.000	0.472
32.635	0.478	0.036	0.514
32.660	0.484	0.125	0.609
32.685	0.489	0.269	0.758
32.710	0.495	0.466	0.961
32.735	0.501	0.730	1.231
32.760	0.506	1.113	1.619
32.785	0.512	1.626	2.138
32.810	0.517	2.214	2.731
32.835	0.522	2.873	3.395
-1.000			

 Finish time (hr) 24
 Extraction rate (m³/s) 0.00

- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:

 Max. Inflow (m³/s) 0.806
 Time at Max. Inflow (hr) 12.19
 Max. Outflow (m³/s) 0.492
 Time at Max. Outflow (hr) 12.38
 Initial RL (m) 31.610
 Max. RL (m) 32.622
 Max. Volume (m³) 251.6
 Inflow Volume (m³) 4401.4
 Volumetric error 0.00%
 Extraction Volume (m³) 0.0

 Cd 0.670
 Pipe Diameter 0.450 m


Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

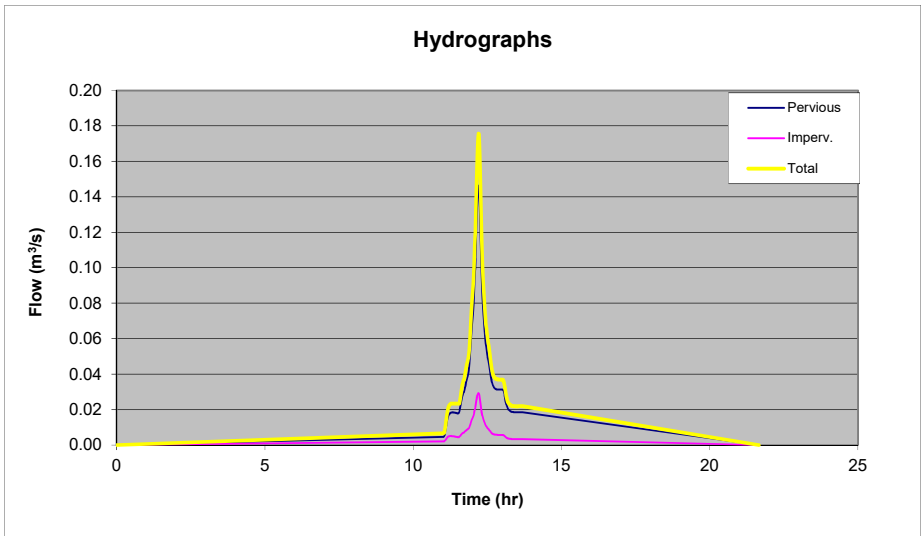
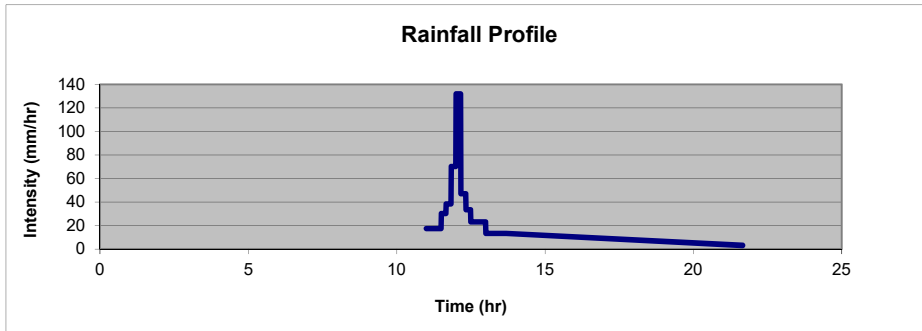
Project Description **Kohi - Existing Storage Volume 2 Catchment (A5&A6)**

Rainfall Depth (mm) **190**

- Notes:**
- Inputs
 - Typical inputs for CN are in 'Typical CN Values' Sheet
 - Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.5914	0.0888
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	Total		
Area (ha)	0.5914	0.0888	0.6802
Runoff (mm)	124.8	185.0	132.7
Peak Flow (m ³ /s)	0.146	0.029	0.176
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	131.81	131.81	131.81
Runoff Coefficient - Peak	0.68	0.90	0.71
Runoff Coefficient - Volume	0.66	0.97	0.70



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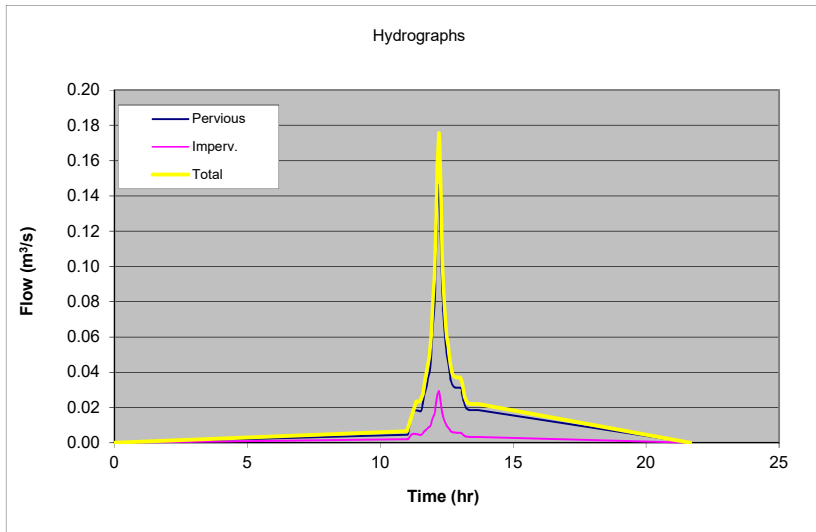
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Existing Storage Volume 2 Catchment (A5&A6)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m³/s)
0.000	0.000
11.001	0.007
11.347	0.023
11.491	0.023
11.601	0.028
11.694	0.036
11.776	0.043
11.850	0.049
11.918	0.061
11.981	0.080
12.040	0.094
12.096	0.124
12.150	0.159
12.201	0.176
12.232	0.171
12.264	0.151
12.297	0.127
12.331	0.106
12.365	0.092
12.400	0.082
12.437	0.073
12.474	0.065
12.513	0.059
12.553	0.055
12.594	0.050
12.637	0.044
12.682	0.040
12.729	0.039
12.778	0.038
12.830	0.037
12.886	0.037
12.945	0.037
13.010	0.037
13.082	0.034
13.163	0.026
13.260	0.023
13.386	0.022
13.690	0.022
21.657	0.000
-1.000	0.000

Calculation Sheet



JOB NO: 3124460

Hydrograph Routing - Storage Volume 2

Project Description Kohi - Existing Storage Volume 2 Catchment (A5 & A6)

Inflow Hydrograph (A + B)

Time (hr)	Flow (m ³ /s)
0.001	0.000
3.575	0.002
6.290	0.004
7.157	0.004
7.788	0.005
8.301	0.005
8.743	0.005
9.134	0.005
9.487	0.006
9.811	0.006
10.112	0.006
10.394	0.006
10.659	0.006
10.910	0.007
11.148	0.014
11.376	0.023
11.594	0.027
11.804	0.045
12.006	0.091
12.201	0.187
12.416	0.092
12.639	0.044
12.871	0.037
13.112	0.031
13.363	0.022
13.626	0.022
13.903	0.021
14.196	0.021
14.506	0.020
14.838	0.019
15.196	0.018
15.587	0.017
16.018	0.016
16.505	0.014
17.072	0.013
17.768	0.011
18.726	0.008
21.722	0.000
24.000	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m ³)
26.110	0
26.360	1
26.610	3
26.860	7
27.110	14
27.360	24
27.610	39
27.860	58
28.110	83
28.360	115
28.610	155
28.641	161.8
28.673	168.7
28.704	175.7
28.735	182.7
28.766	189.6
28.798	196.6
28.829	203.5
28.860	210.5
-1.000	

Flow Rating Curve

RL (m)	Flow (m ³ /s)		
	Pipe	Overland	Total (m ³ /s)
26.110	0.000	0.000	0.000
26.360	0.059	0.000	0.059
26.610	0.083	0.000	0.083
26.860	0.102	0.000	0.102
27.110	0.118	0.000	0.118
27.360	0.132	0.000	0.132
27.610	0.145	0.000	0.145
27.860	0.156	0.000	0.156
28.110	0.167	0.000	0.167
28.360	0.177	0.000	0.177
28.610	0.187	0.000	0.187
28.641	0.188	0.005	0.193
28.673	0.189	0.030	0.219
28.704	0.190	0.087	0.277
28.735	0.191	0.187	0.378
28.766	0.192	0.337	0.529
28.798	0.193	0.555	0.748
28.829	0.195	0.835	1.030
28.860	0.196	1.188	1.384
-1.000			

Cd 0.670

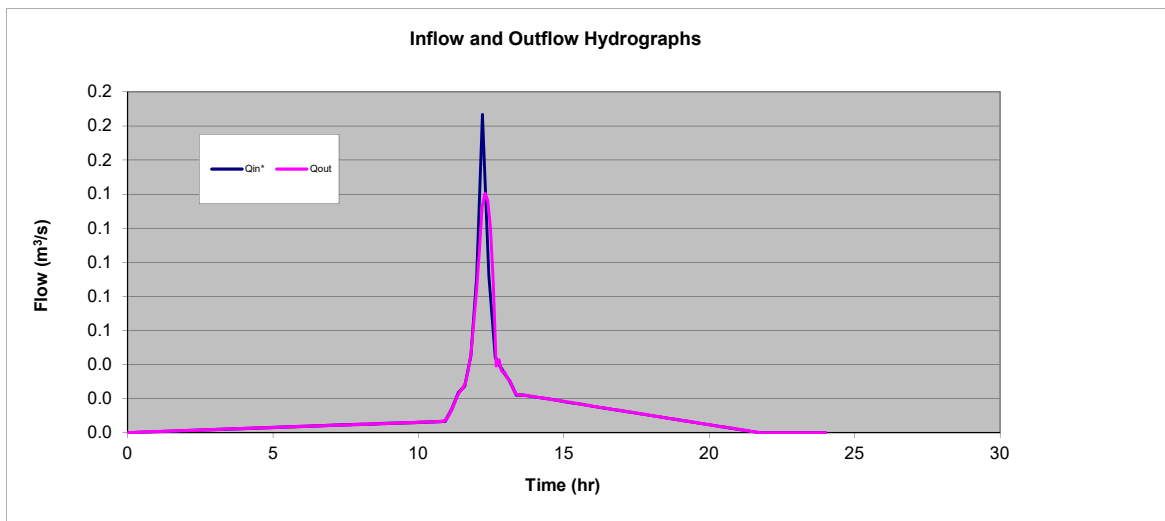
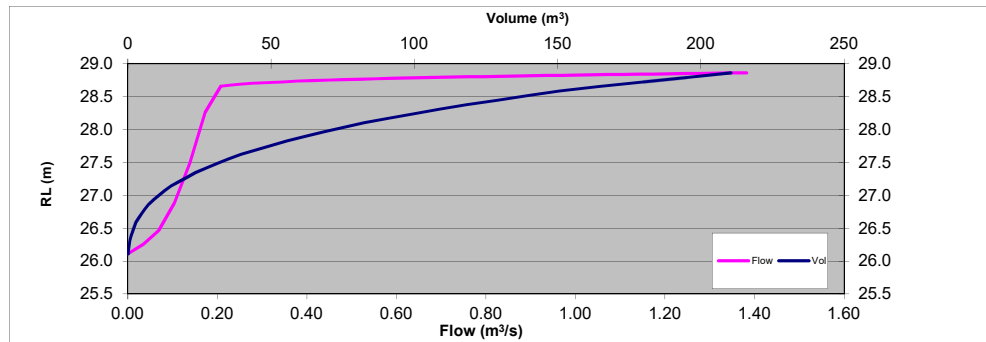
Pipe Diameter 0.225 m

Stability Coefficient (0.5-1.0)	0.60
Start time (hr)	0
Finish time (hr)	24
Extraction rate (m ³ /s)	0.00

- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:

Max. Inflow (m ³ /s)	0.187
Time at Max. Inflow (hr)	12.19
Max. Outflow (m ³ /s)	0.140
Time at Max. Outflow (hr)	12.29
Initial RL (m)	26.110
Max. RL (m)	27.528
Max. Volume (m ³)	33.8
Inflow Volume (m ³)	938.6
Volumetric error	0.00%
Extraction Volume (m ³)	0.0



Calculation Sheet



JOB NO: 3124460

Hydrograph Routing - Storage Volume 2

 Project Description **Kohi - Existing Storage Volume 2 Catchment (A5 & A6)**

 Stability Coefficient (0.5-1.0) 0.60
 Start time (hr) 0
 Finish time (hr) 24
 Extraction rate (m³/s) 0.00

Inflow Hydrograph (A + B)

Time (hr)	Flow (m ³ /s)
0.001	0.000
3.575	0.002
6.290	0.004
7.157	0.004
7.788	0.005
8.301	0.005
8.743	0.005
9.134	0.005
9.487	0.006
9.811	0.006
10.112	0.006
10.394	0.006
10.659	0.006
10.910	0.007
11.148	0.014
11.376	0.023
11.594	0.027
11.804	0.045
12.006	0.091
12.201	0.187
12.416	0.092
12.639	0.044
12.871	0.037
13.112	0.031
13.363	0.022
13.626	0.022
13.903	0.021
14.196	0.021
14.506	0.020
14.838	0.019
15.196	0.018
15.587	0.017
16.018	0.016
16.505	0.014
17.072	0.013
17.768	0.011
18.726	0.008
21.722	0.000
24.000	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m ³)
26.110	0
26.360	1
26.610	3
26.860	7
27.110	14
27.360	24
27.610	39
27.860	58
28.110	83
28.360	115
28.610	155
28.641	161.8
28.673	168.7
28.704	175.7
28.735	182.7
28.766	189.6
28.798	196.6
28.829	203.5
28.860	210.5
-1.000	

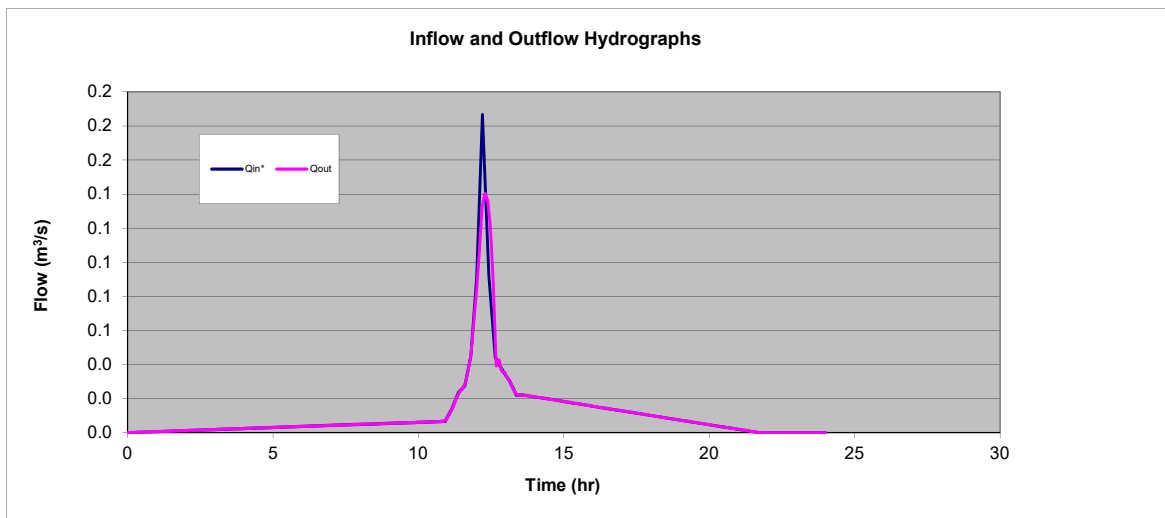
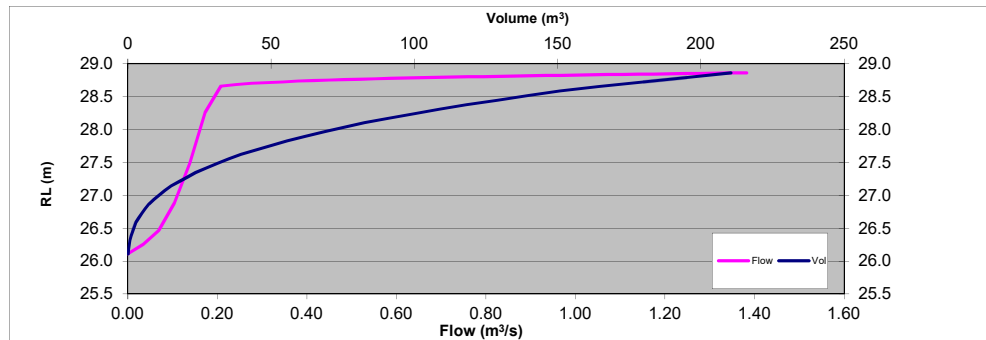
Flow Rating Curve

RL (m)	Flow (m ³ /s)		
	Pipe	Overland	Total (m ³ /s)
26.110	0.000	0.000	0.000
26.360	0.059	0.000	0.059
26.610	0.083	0.000	0.083
26.860	0.102	0.000	0.102
27.110	0.118	0.000	0.118
27.360	0.132	0.000	0.132
27.610	0.145	0.000	0.145
27.860	0.156	0.000	0.156
28.110	0.167	0.000	0.167
28.360	0.177	0.000	0.177
28.610	0.187	0.000	0.187
28.641	0.188	0.005	0.193
28.673	0.189	0.030	0.219
28.704	0.190	0.087	0.277
28.735	0.191	0.187	0.378
28.766	0.192	0.337	0.529
28.798	0.193	0.555	0.748
28.829	0.195	0.835	1.030
28.860	0.196	1.188	1.384
-1.000			

Cd 0.670
 Pipe Diameter 0.225 m

- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:

 Max. Inflow (m³/s) 0.187
 Time at Max. Inflow (hr) 12.19
 Max. Outflow (m³/s) 0.140
 Time at Max. Outflow (hr) 12.29
 Initial RL (m) 26.110
 Max. RL (m) 27.528
 Max. Volume (m³) 33.8
 Inflow Volume (m³) 938.6
 Volumetric error 0.00%
 Extraction Volume (m³) 0.0


Calculation Sheet

Beca Ltd



JOB NO: 3124460-221

Hydrograph Combination - Existing Combined Piped Flow

 Project Description Combined Pipe Flow from SV1 & SV2

 Time Lag (min) Time Lag (min)

Hydrograph SV1 Piped Outflow

Time (hr)	Flow (m ³ /s)
0.000	0.000
3.575	0.015
5.056	0.021
6.192	0.026
7.150	0.030
7.994	0.033
8.757	0.036
9.458	0.039
10.111	0.042
10.725	0.045
11.305	0.116
11.857	0.240
12.384	0.475
12.610	0.421
12.840	0.161
13.075	0.136
13.315	0.103
13.561	0.101
13.812	0.087
14.070	0.091
14.335	0.090
14.607	0.081
14.888	0.084
15.177	0.075
15.476	0.075
15.786	0.070
16.108	0.065
16.444	0.063
16.796	0.059
17.166	0.054
17.557	0.049
17.973	0.044
18.420	0.038
18.906	0.033
19.444	0.026
20.054	0.019
20.778	0.010
21.722	0.000
24.000	0.000
-1.000	0.000

Hydrograph SV2 Piped Outflow

Time (hr)	Flow (m ³ /s)
0.001	0.000
3.548	0.002
5.017	0.003
6.145	0.004
7.095	0.004
7.933	0.005
8.690	0.005
9.386	0.006
10.034	0.006
10.642	0.006
11.218	0.017
11.765	0.042
12.288	0.140
12.516	0.108
12.748	0.042
12.985	0.035
13.227	0.027
13.475	0.022
13.728	0.022
13.988	0.021
14.255	0.020
14.530	0.020
14.813	0.019
15.104	0.018
15.406	0.017
15.719	0.016
16.044	0.015
16.382	0.015
16.737	0.014
17.110	0.013
17.504	0.011
17.923	0.010
18.374	0.009
18.864	0.008
19.406	0.006
20.022	0.005
20.752	0.003
21.703	0.000
24.000	0.000
-1.000	0.000

Hydrograph Total Pipe Outflow

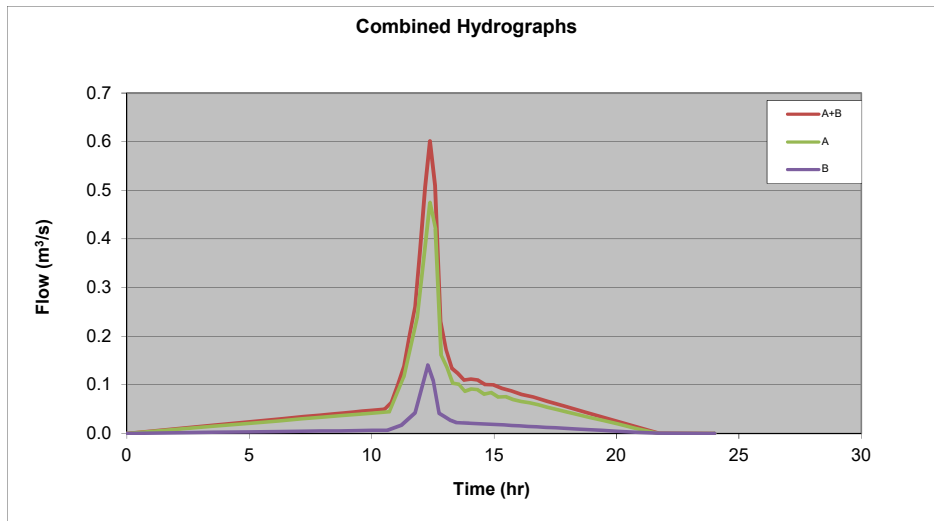
Time (hr)	Flow (m ³ /s)
0.002	0.000
3.548	0.017
6.329	0.030
7.217	0.034
7.863	0.037
8.389	0.040
8.841	0.042
9.242	0.044
9.604	0.046
9.936	0.047
10.244	0.049
10.533	0.050
10.804	0.064
11.061	0.100
11.306	0.137
11.539	0.200
11.763	0.260
11.977	0.375
12.184	0.506
12.384	0.602
12.595	0.510
12.814	0.230
13.041	0.172
13.277	0.134
13.524	0.123
13.782	0.110
14.054	0.112
14.340	0.110
14.645	0.100
14.971	0.100
15.322	0.092
15.705	0.087
16.128	0.080
16.606	0.075
17.162	0.066
17.844	0.056
18.783	0.042
21.722	0.000
24.000	0.000
-1.000	0.000

Notes:

- Input data should be in ascending order with time in the boxes provided. The maximum no. of values is 40. If a lesser no. of values is needed then terminate as a -1 for the x value.
- The Time Lag is relative to the hydrograph times.
- Volumetric error is generally due to the interpolation and reassignment of time values.

Results:

Max. Flow (m ³ /s) -A	0.475
Time (hr) at Max Flow	12.38
Max. Flow (m ³ /s) -B	0.140
Time (hr) at Max Flow	12.29
Max. Flow (m ³ /s)	0.602
Time (hr) at Max Flow	12.38
Volumetric Error	0.0%



Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

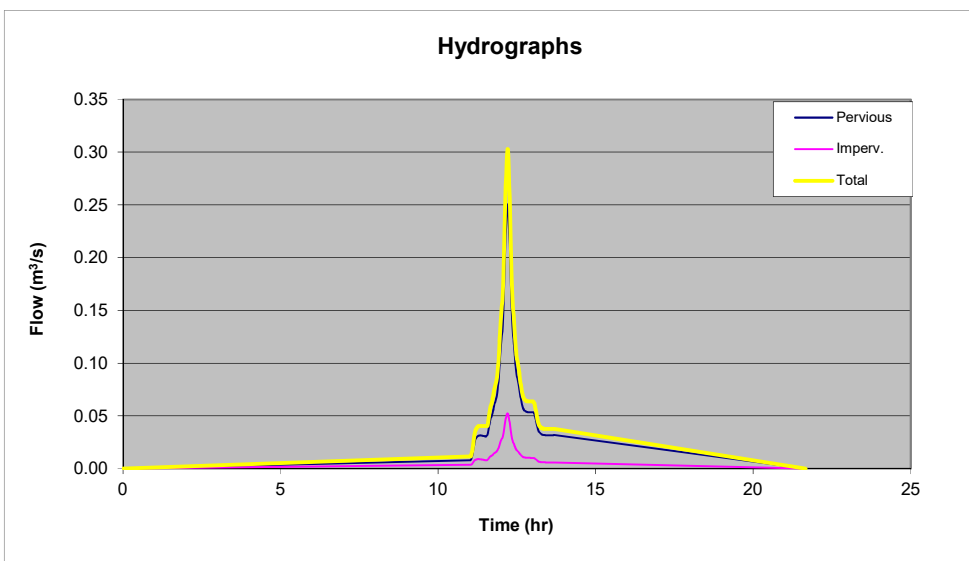
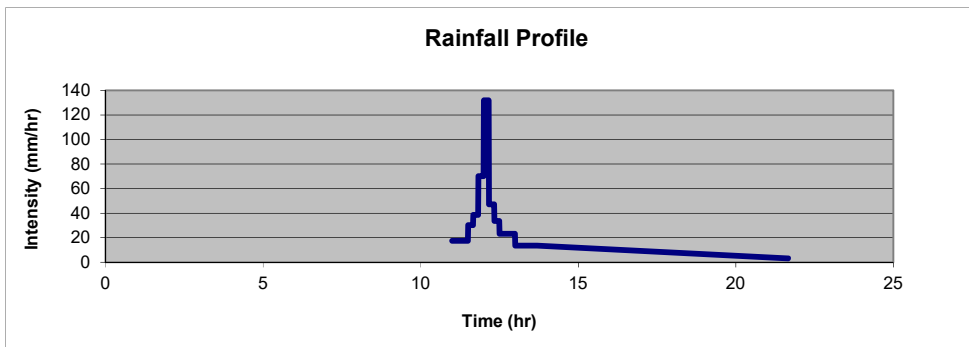
Project Description **Kohi - Catchment to No 17 John Rymer Place(A7 & A8)**

Rainfall Depth (mm) **190**

- Notes:**
1. Inputs
 2. Typical inputs for CN are in 'Typical CN Values' Sheet
 3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	1.0124	0.1588
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	1.0124	0.1588	1.1712
Runoff (mm)	124.8	185.0	133.0
Peak Flow (m ³ /s)	0.251	0.052	0.303
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	131.81	131.81	131.81
Runoff Coefficient - Peak	0.68	0.90	0.71
Runoff Coefficient - Volume	0.66	0.97	0.70



Calculation Sheet

Beca Ltd



JOB NO: 0

Hydrograph Combination

Project Description Separate Pipe Flow and Overflow at Outfall Manhole

Time Lag (min)

Time Lag (min)

Inflow to Outfall Manhole

Time (hr)	Flow (m ³ /s)
0.002	0.000
3.548	0.017
6.329	0.030
7.217	0.034
7.863	0.037
8.389	0.040
8.841	0.042
9.242	0.044
9.604	0.046
9.936	0.047
10.244	0.049
10.533	0.050
10.804	0.064
11.061	0.100
11.306	0.137
11.539	0.200
11.763	0.260
11.977	0.375
12.184	0.506
12.384	0.602
12.595	0.510
12.814	0.230
13.041	0.172
13.277	0.134
13.524	0.123
13.782	0.110
14.054	0.112
14.340	0.110
14.645	0.100
14.971	0.100
15.322	0.092
15.705	0.087
16.128	0.080
16.606	0.075
17.162	0.066
17.844	0.056
18.783	0.042
21.722	0.000
24.000	0.000
-1.000	0.000

Pipe Outflow from Site

Limited to Pipe Capacity

Time (hr)	Flow (m ³ /s)
0.002	0.000
3.548	0.017
6.329	0.030
7.217	0.034
7.863	0.037
8.389	0.040
8.841	0.042
9.242	0.044
9.604	0.046
9.936	0.047
10.244	0.049
10.533	0.050
10.804	0.064
11.061	0.100
11.306	0.137
11.539	0.200
11.763	0.260
11.977	0.375
12.184	0.506
12.384	0.520
12.595	0.510
12.814	0.230
13.041	0.172
13.277	0.134
13.524	0.123
13.782	0.110
14.054	0.112
14.340	0.110
14.645	0.100
14.971	0.100
15.322	0.092
15.705	0.087
16.128	0.080
16.606	0.075
17.162	0.066
17.844	0.056
18.783	0.042
21.722	0.000
24.000	0.000
-1.000	0.000

Overflow from Outfall Manhole

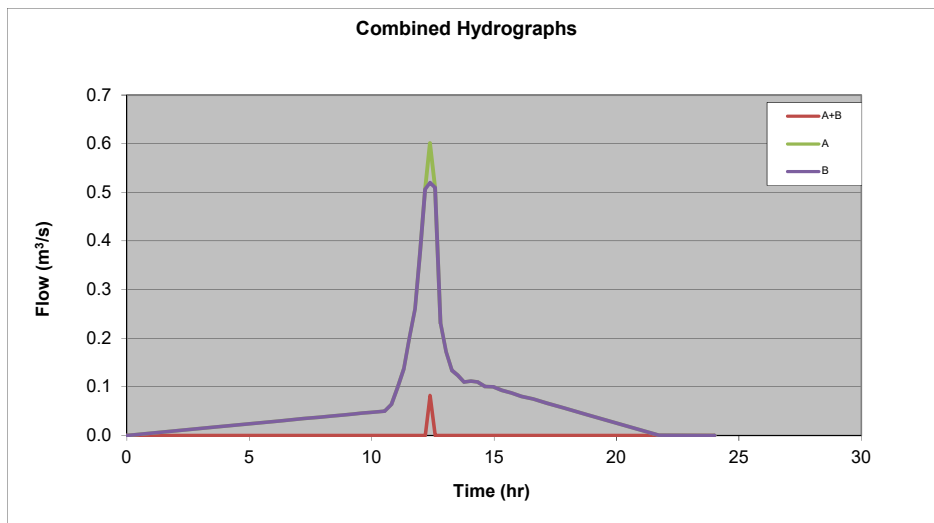
Time (hr)	Flow (m ³ /s)
0.002	0.000
3.548	0.000
6.329	0.000
7.217	0.000
7.863	0.000
8.389	0.000
8.841	0.000
9.242	0.000
9.604	0.000
9.936	0.000
10.244	0.000
10.533	0.000
10.804	0.000
11.061	0.000
11.306	0.000
11.539	0.000
11.763	0.000
11.977	0.000
12.184	0.000
12.384	0.082
12.595	0.000
12.814	0.000
13.041	0.000
13.277	0.000
13.524	0.000
13.782	0.000
14.054	0.000
14.340	0.000
14.645	0.000
14.971	0.000
15.322	0.000
15.705	0.000
16.128	0.000
16.606	0.000
17.162	0.000
17.844	0.000
18.783	0.000
21.722	0.000
24.000	0.000
-1.000	0.000

Notes:

- Input data should be in ascending order with time in the boxes provided. The maximum no. of values is 40. If a lesser no. of values is needed then terminate as a -1 for the x value.
- The Time Lag is relative to the hydrograph times.
- Volumetric error is generally due to the interpolation and reassignment of time values.

Results:

Max. Flow (m ³ /s) -A	0.602
Time (hr) at Max Flow	12.38
Max. Flow (m ³ /s) -B	0.520
Time (hr) at Max Flow	12.38
Max. Flow (m ³ /s)	1.122
Time (hr) at Max Flow	12.38
Volumetric Error	0.0%



Calculation Sheet

Beca Ltd



JOB NO: 0

Hydrograph Combination

 Project Description Total Overland Flow from Site to No 17

 Time Lag (min) 0 Time Lag (min) 0

Comt incd Ovrflow

Hydrograph (A7& A8)

Total Overland Flow

Time (hr)	Flow (m ³ /s)
0.003	0.000
3.548	0.000
6.329	0.000
7.217	0.000
7.863	0.000
8.389	0.000
8.841	0.000
9.242	0.000
9.604	0.000
9.936	0.000
10.244	0.000
10.533	0.000
10.804	0.000
11.061	0.000
11.306	0.000
11.539	0.000
11.763	0.000
11.977	0.000
12.184	0.002
12.384	0.082
12.595	0.000
12.814	0.000
13.041	0.000
13.277	0.000
13.524	0.000
13.782	0.000
14.054	0.000
14.340	0.000
14.645	0.000
14.971	0.000
15.322	0.000
15.705	0.000
16.128	0.000
16.606	0.000
17.162	0.000
17.844	0.000
18.783	0.000
21.722	0.000
24.000	0.000
-1.000	0.000

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.011
11.347	0.041
11.491	0.041
11.601	0.048
11.694	0.062
11.776	0.074
11.850	0.084
11.918	0.105
11.981	0.138
12.040	0.163
12.096	0.215
12.150	0.273
12.201	0.303
12.232	0.294
12.264	0.260
12.297	0.219
12.331	0.183
12.365	0.159
12.400	0.141
12.437	0.125
12.474	0.112
12.513	0.102
12.553	0.095
12.594	0.086
12.637	0.076
12.682	0.070
12.729	0.066
12.778	0.065
12.830	0.064
12.886	0.064
12.945	0.064
13.010	0.064
13.082	0.058
13.163	0.045
13.260	0.039
13.386	0.038
13.690	0.038
21.657	0.000
-1.000	0.000

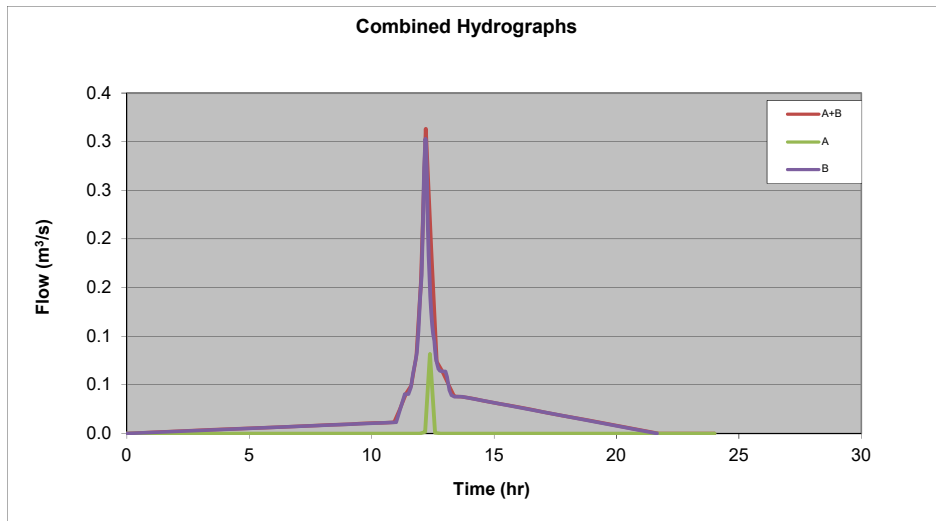
Time (hr)	Flow (m ³ /s)
0.001	0.000
3.548	0.004
6.277	0.007
7.149	0.007
7.782	0.008
8.299	0.009
8.742	0.009
9.135	0.010
9.491	0.010
9.817	0.010
10.119	0.011
10.402	0.011
10.668	0.011
10.921	0.011
11.160	0.025
11.389	0.041
11.609	0.049
11.820	0.080
12.023	0.156
12.219	0.313
12.434	0.189
12.656	0.074
12.887	0.064
13.128	0.051
13.379	0.038
13.641	0.038
13.918	0.037
14.210	0.035
14.520	0.034
14.851	0.032
15.209	0.031
15.598	0.029
16.029	0.027
16.515	0.024
17.081	0.022
17.776	0.018
18.731	0.014
21.722	0.000
24.000	0.000
-1.000	0.000

Notes:

- Input data should be in ascending order with time in the boxes provided. The maximum no. of values is 40. If a lesser no. of values is needed then terminate as a -1 for the x value.
- The Time Lag is relative to the hydrograph times.
- Volumetric error is generally due to the interpolation and reassignment of time values.

Results:

Max. Flow (m ³ /s) -A	0.082
Time (hr) at Max Flow	12.38
Max. Flow (m ³ /s) -B	0.303
Time (hr) at Max Flow	12.20
Max. Flow (m ³ /s)	0.313
Time (hr) at Max Flow	12.20
Volumetric Error	0.0%



Calculation Sheet

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

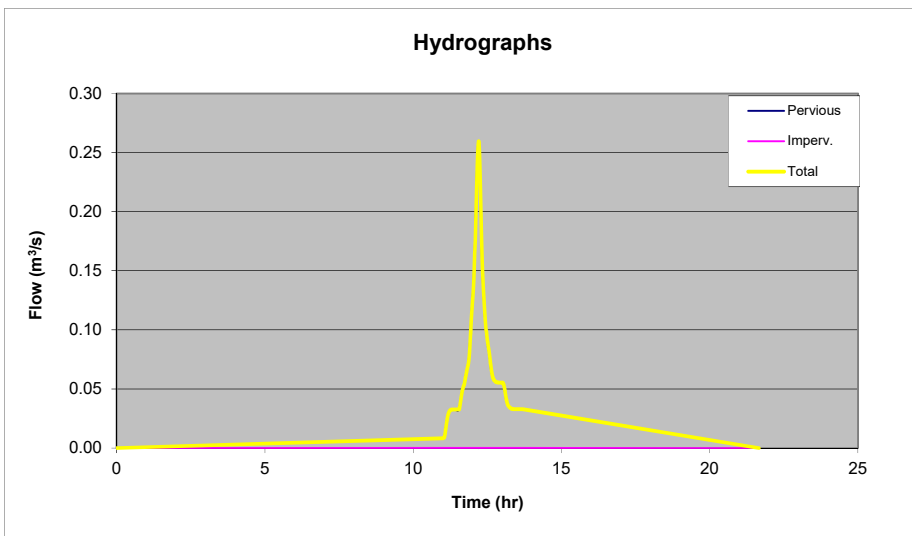
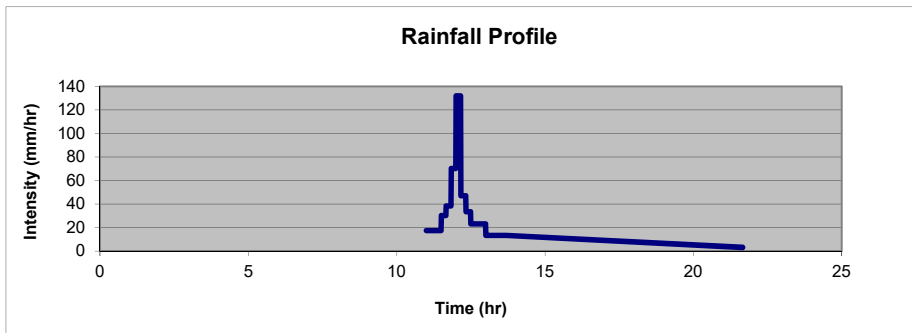
Project Description **Kohi - Overland Catchment Catchment (A9, A10, A11 & A12)**

Rainfall Depth (mm) **190**

- Notes:**
- Inputs
 - Typical inputs for CN are in 'Typical CN Values' Sheet
 - Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	1.0489	
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	Total		
Area (ha)	1.0489	0	1.0489
Runoff (mm)	124.8	185.0	124.8
Peak Flow (m ³ /s)	0.260	0.000	0.260
Time (hr) at Peak Flow	12.21	12.20	12.21
Rainfall (mm/h) over tc	131.81	131.81	131.81
Runoff Coefficient - Peak	0.68	0.00	0.68
Runoff Coefficient - Volume	0.66	0.97	0.66



**EXISTING Q100
CALCULATIONS WITH
CLIMATE CHANGE
ALLOWANCE**

Beca Ltd



JOB NO: 3124460/221

Hydrographs- SCS Method:

Project Description SCS Calc for 1ha Catchment Areas

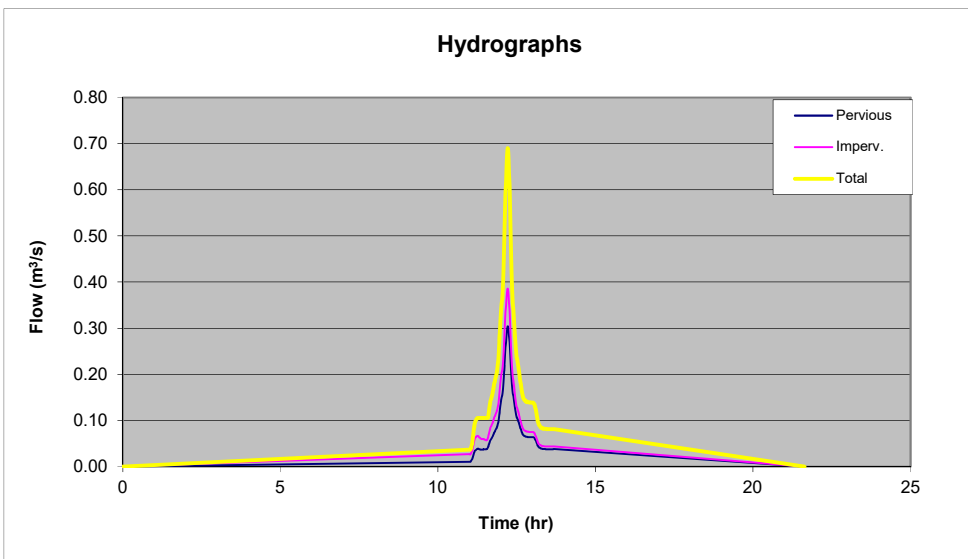
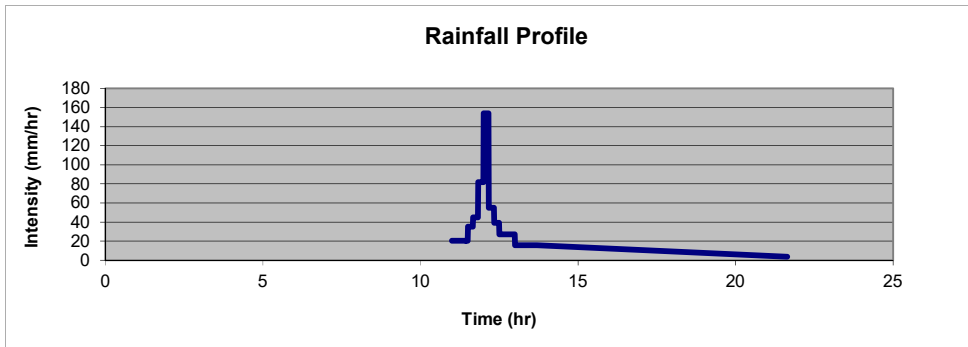
Rainfall Depth (mm) 222

Notes:

1. Inputs
2. Typical inputs for CN 20000 are in 'Typical CN Values' Sheet
3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	1	1
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	1	1	Total
Area (ha)	1	1	2
Runoff (mm)	153.7	216.9	185.3
Peak Flow (m ³ /s)	0.304	0.386	0.690
Time (hr) at Peak Flow	12.21	12.21	12.21
Rainfall (mm/h) over tc	153.96	153.96	153.96
Runoff Coefficient - Peak	0.71	0.90	0.81
Runoff Coefficient - Volume	0.69	0.98	0.83



Calculation Sheet

Existing Stormwater Catchment Area & Flow Allocation

Peak flow from 1ha ignoring CN values		
Impermeable	0.386	m ³ /s
Permeable	0.304	m ³ /s
CN _{impermeable}	0.98	
CN _{permeable}	0.74	
Factor of Safety	1	
Design Rainfall	222	mm
Time of Concentration	10	mins

On-Site & Upstream Catchments	Total Area	Pervious Area	Impervious Area	% Impervious	Design Runoff (m ³ /s)	Notes
A1	15318	2737	12581	0.82	0.569	
A2	5596	560	5036	0.90	0.132	Limited to the Q10
A3	6843	6843	0	0.00	0.208	
A4	733	293	440	0.60	0.026	
A5 - Primary Catchment	1480	592	888	0.60	0.052	
A5 - Overland Flow	3538	1415	2123	0.60	0.125	
A6	5322	5322	0	0.00	0.162	
A7	9879	9879	0	0.00	0.301	
A8	1833	245	1588	0.87	0.069	
A9 - Primary Catchment	741	741	0	0.00	0.023	
A9 - Overland Flow	5543	5543	0	0.00	0.169	
A10	5779	5779	0	0.00	0.176	
A11	3329	3329	0	0.00	0.101	
A12	640	640	0	0	0.019	

Off-Site Catchments	Total Area	Pervious Area	Impervious Area	% Impervious	Notes
B1	4173	1669.2	2503.8	0.6	
B2	11737	4694.8	7042.2	0.6	
B3	12964	5185.6	7778.4	0.6	
B4	16845	6738	10107	0.6	
B5	929	371.6	557.4	0.6	
B6	1622	648.8	973.2	0.6	
B7	2216	886.4	1329.6	0.6	
B8	2539	1015.6	1523.4	0.6	
B9	1499	599.6	899.4	0.6	
B10	5976	2390.4	3585.6	0.6	
B11	23122	9248.8	13873.2	0.6	
B12	2593	1037	1556	0.6	
B13	1707	682.8	1024.2	0.6	
C1	4262	1704.8	2557.2	0.6	
C2	11750	4700	7050	0.6	
C3	9328	3731.2	5596.8	0.6	
C4	12843	5137.2	7705.8	0.6	
C5	6034	2413.6	3620.4	0.6	
C6	5910	2364	3546	0.6	

	Catchment Area			Permeable Cumulative Catchment area (m ²)	Impermeable Cumulative Catchment Area (m ²)	Design FLOW (m ³ /s)	Notes
	Permeable	Impermeable	Total				
Ashwell Street							
SWMH NP4954	0	0	0	20051	30076	1.771	-
SWMH NP5167	1705	2557	4262	20051	30076	1.771	C1
SWMH NP7810	0	0	0	18346	27519	1.621	-
SWMH NP5693	4700	7050	11750	18346	27519	1.621	C2
SWMH 11519	3731	5597	9328	13646	20469	1.205	C3
SWMH NP5690	5137	7706	12843	9915	14872	0.876	C4
SWMH NP5672	2414	3620	6034	4778	7166	0.422	C5
SWMH NP5668	2364	3546	5910	2364	3546	0.209	C6

SW John Rymer							
EX. SW Outfall (Pourewa Creek)	0	0	0	83106	105485	5.548	none
SWMH NP4983	8407	12611	21018	83106	105485	5.548	B1, B4
SWMH NP4996	9880	14821	24701	74698	92875	4.805	B2, B3
SWMH NP4965	0	0	0	64818	78054	3.932	none
SWMH NP4954	35212	52818	88030	64818	78054	3.932	B5-B11, C1
SWMH NP4849	1720	2580	4300	29606	25236	0.822	B12, B13
SWMH NP4851	27886	22656	50542	27886	22656	0.670	(A1-A8) Att

Kohi Road							
SWMH NP4954	0	0	0	15161	22742	1.339	none
SWMH NP4952	1387	2081	3468	15161	22742	1.339	B5, B8
SWMH NP5466	1535	2303	3838	13774	20661	1.217	B6, B7
SWMH NP5468	2390	3586	5976	12239	18358	1.081	B10
SWMH NP5470	600	899	1499	9848	14773	0.870	B9
SWMH NP5456	0	0	0	9249	13873	0.817	none
SWMH NP5459	9249	13873	23122	9249	13873	0.817	B11

Calculation Sheet

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

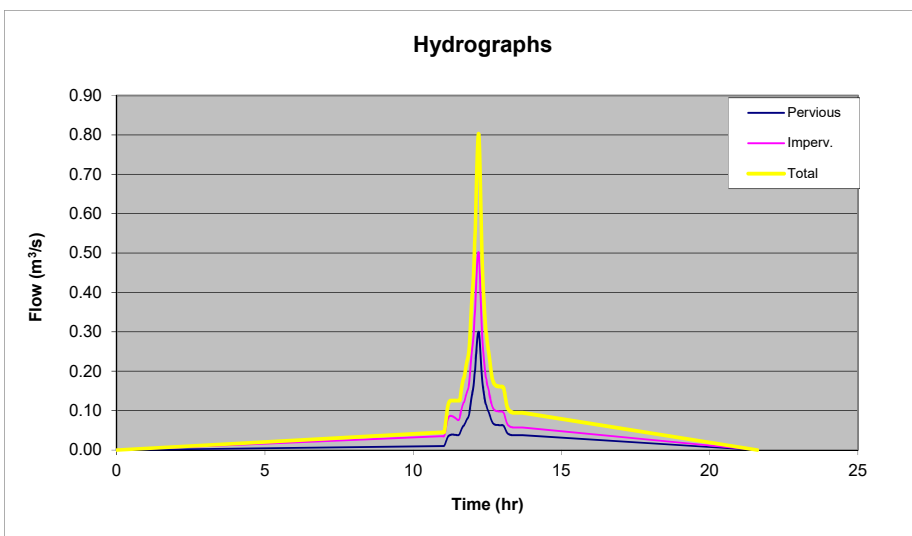
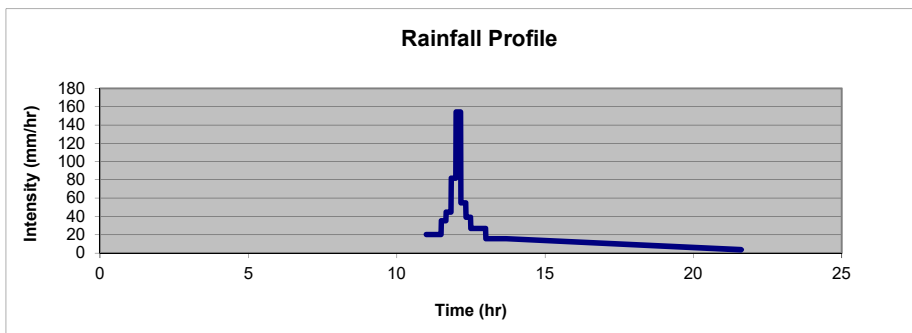
Project Description **Kohi - Storage Volume 1 Catchment (A1, A3, A4)**

Rainfall Depth (mm) **222**

- Notes:**
- Inputs
 - Typical inputs for CN are in 'Typical CN Values' Sheet
 - Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.9873	1.3021
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	Total		
Area (ha)	0.98732	1.30208	2.2894
Runoff (mm)	153.7	216.9	189.6
Peak Flow (m ³ /s)	0.300	0.503	0.803
Time (hr) at Peak Flow	12.20	12.20	12.20
Rainfall (mm/h) over tc	153.96	153.96	153.96
Runoff Coefficient - Peak	0.71	0.90	0.82
Runoff Coefficient - Volume	0.69	0.98	0.85



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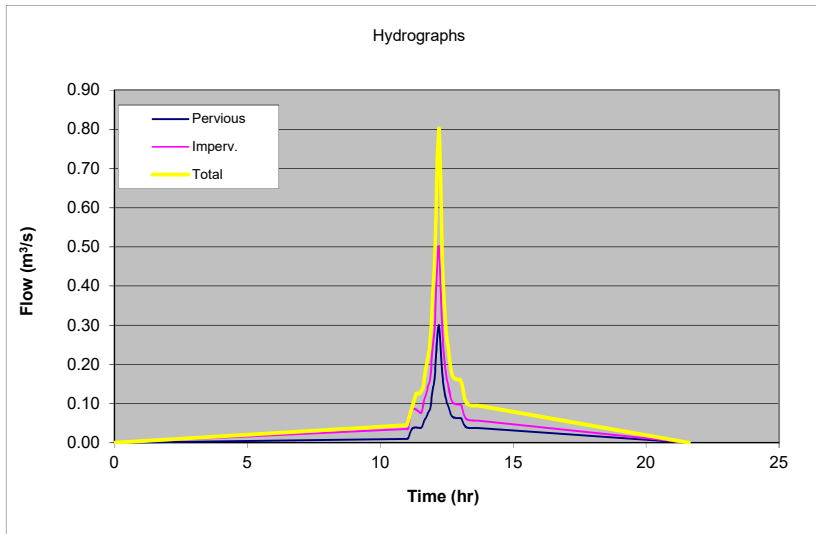
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Storage Volume 1 Catchment (A1, A3, A4)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m³/s)
0.000	0.000
11.001	0.045
11.347	0.126
11.491	0.126
11.601	0.139
11.694	0.179
11.776	0.211
11.850	0.237
11.918	0.295
11.981	0.383
12.040	0.447
12.096	0.582
12.150	0.732
12.201	0.803
12.232	0.776
12.264	0.684
12.297	0.573
12.331	0.477
12.365	0.414
12.400	0.366
12.437	0.323
12.474	0.287
12.513	0.263
12.553	0.244
12.594	0.220
12.637	0.195
12.682	0.178
12.729	0.169
12.778	0.165
12.830	0.163
12.886	0.162
12.945	0.161
13.010	0.161
13.082	0.147
13.163	0.113
13.260	0.099
13.386	0.095
13.690	0.094
21.610	0.000
-1.000	0.000

Calculation Sheet

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi -Existing Storage Volume 1 Catchment (A2 limited to Q10)

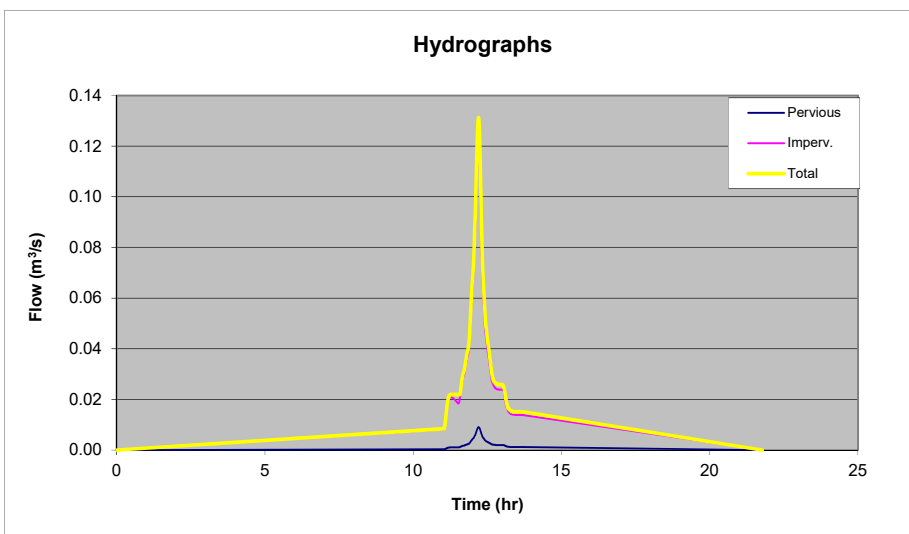
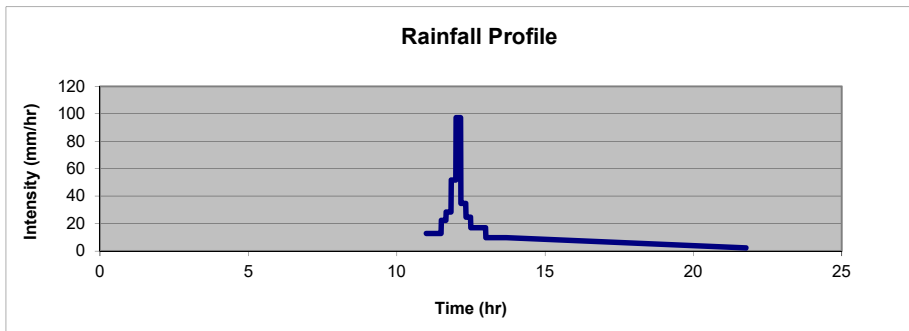
Rainfall Depth (mm) 140

Notes:

1. Inputs
2. Typical inputs for CN are in 'Typical CN Values' Sheet
3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.0560	0.5036
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	0.05596	0.50364	0.5596
Runoff (mm)	81.3	135.0	129.6
Peak Flow (m ³ /s)	0.009	0.122	0.131
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	97.13	97.13	97.13
Runoff Coefficient - Peak	0.60	0.90	0.87
Runoff Coefficient - Volume	0.58	0.96	0.93



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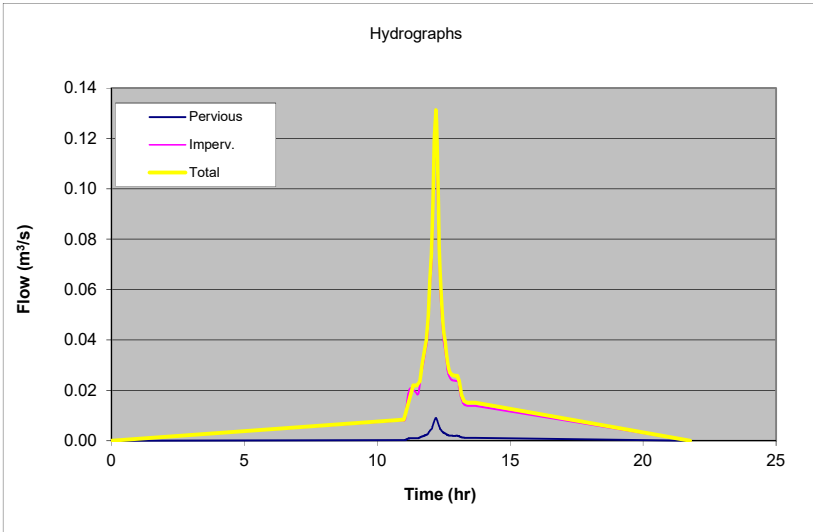
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi -Existing Storage Volume 1 Catchment (A2 limited to Q10)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m³/s)
0.000	0.000
11.001	0.008
11.347	0.022
11.491	0.022
11.601	0.024
11.694	0.030
11.776	0.036
11.850	0.040
11.918	0.049
11.981	0.064
12.040	0.074
12.096	0.096
12.150	0.120
12.201	0.131
12.232	0.127
12.264	0.111
12.297	0.093
12.331	0.077
12.365	0.067
12.400	0.059
12.437	0.052
12.474	0.046
12.513	0.042
12.553	0.039
12.594	0.035
12.637	0.031
12.682	0.029
12.729	0.027
12.778	0.026
12.830	0.026
12.886	0.026
12.945	0.026
13.010	0.026
13.082	0.023
13.163	0.018
13.260	0.016
13.386	0.015
13.690	0.015
21.770	0.000
-1.000	0.000

Calculation Sheet

Hydrograph Routing - Storage Volume 1

Project Description Kōhi - Storage Volume 1 Catchment (A1, A3, A4 & A2)

 Stability Coefficient (0.5-1.0) 0.50
 Start time (hr) 0

Inflow Hydrograph (A1, A3, A4 & A2)

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.054
11.347	0.148
11.491	0.148
11.601	0.162
11.694	0.210
11.776	0.247
11.850	0.277
11.918	0.344
11.981	0.447
12.040	0.521
12.096	0.678
12.150	0.853
12.201	0.934
12.232	0.902
12.264	0.796
12.297	0.666
12.331	0.554
12.365	0.481
12.400	0.426
12.437	0.375
12.474	0.334
12.513	0.305
12.553	0.283
12.594	0.255
12.637	0.227
12.682	0.207
12.729	0.196
12.778	0.191
12.830	0.189
12.886	0.188
12.945	0.187
13.010	0.187
13.082	0.170
13.163	0.132
13.260	0.115
13.386	0.110
13.690	0.110
21.610	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m ³)
31.610	0
31.710	1.1
31.810	3.9
31.910	9.4
32.010	18.9
32.110	32.8
32.210	50.5
32.310	73.0
32.410	103.5
32.510	149.4
32.610	234.6
32.635	271.0
32.660	307.3
32.685	343.7
32.710	380.0
32.735	421.6
32.760	463.2
32.785	504.8
32.810	546.4
32.835	588.0
-1.000	

Flow Rating Curve

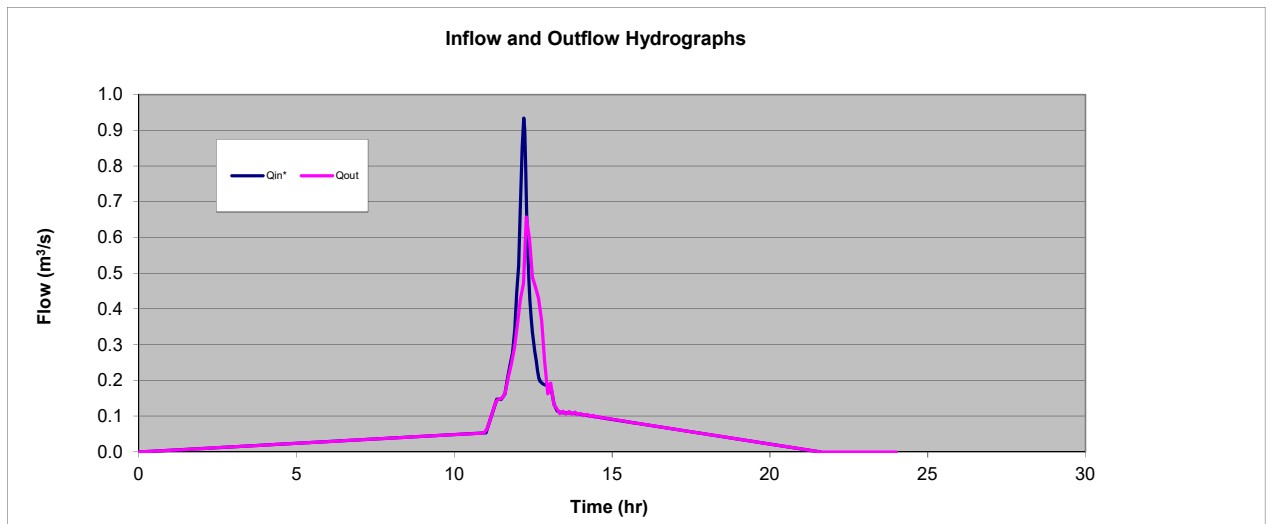
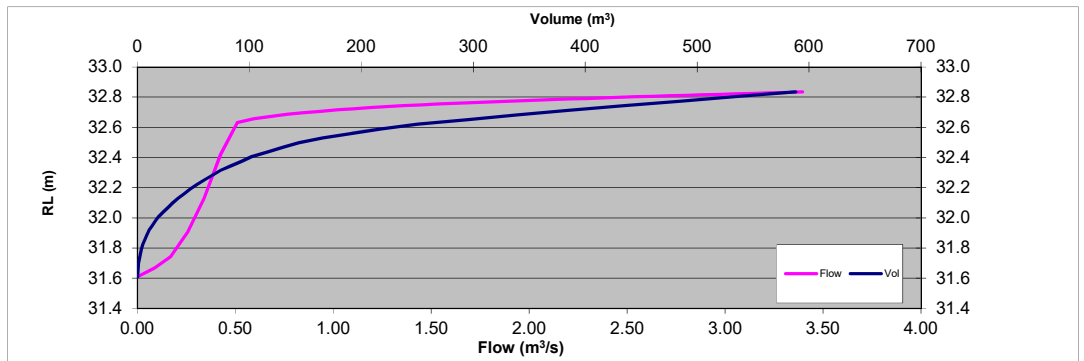
RL (m)	Flow (m ³ /s)		
	Pipe	Overland	Total
31.610	0.000		0.000
31.710	0.149		0.149
31.810	0.211		0.211
31.910	0.259		0.259
32.010	0.299		0.299
32.110	0.334		0.334
32.210	0.366		0.366
32.310	0.395		0.395
32.410	0.422		0.422
32.510	0.448		0.448
32.610	0.472	0.000	0.472
32.635	0.478	0.036	0.514
32.660	0.484	0.125	0.609
32.685	0.489	0.269	0.758
32.710	0.495	0.466	0.961
32.735	0.501	0.730	1.231
32.760	0.506	1.113	1.619
32.785	0.512	1.626	2.138
32.810	0.517	2.214	2.731
32.835	0.522	2.873	3.395
-1.000			

 Cd 0.670
 Pipe Diameter 0.450 m

 Finish time (hr) 24
 Extraction rate (m³/s) 0.00

- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:

 Max. Inflow (m³/s) 0.934
 Time at Max. Inflow (hr) 12.19
 Max. Outflow (m³/s) 0.657
 Time at Max. Outflow (hr) 12.29
 Initial RL (m) 31.610
 Max. RL (m) 32.668
 Max. Volume (m³) 319.1
 Inflow Volume (m³) 5100.9
 Volumetric error 0.00%
 Extraction Volume (m³) 0.0


Calculation Sheet

Hydrograph Routing - Storage Volume 1

 Project Description **Kohi - Storage Volume 1 Catchment (A1, A3, A4 & A2)**

 Stability Coefficient (0.5-1.0) **0.50**
 Start time (hr) **0**

Inflow Hydrograph (A1, A3, A4 & A2)

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.054
11.347	0.148
11.491	0.148
11.601	0.162
11.694	0.210
11.776	0.247
11.850	0.277
11.918	0.344
11.981	0.447
12.040	0.521
12.096	0.678
12.150	0.853
12.201	0.934
12.232	0.902
12.264	0.796
12.297	0.666
12.331	0.554
12.365	0.481
12.400	0.426
12.437	0.375
12.474	0.334
12.513	0.305
12.553	0.283
12.594	0.255
12.637	0.227
12.682	0.207
12.729	0.196
12.778	0.191
12.830	0.189
12.886	0.188
12.945	0.187
13.010	0.187
13.082	0.170
13.163	0.132
13.260	0.115
13.386	0.110
13.690	0.110
21.610	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m ³)
31.610	0
31.710	1.1
31.810	3.9
31.910	9.4
32.010	18.9
32.110	32.8
32.210	50.5
32.310	73.0
32.410	103.5
32.510	149.4
32.610	234.6
32.635	271.0
32.660	307.3
32.685	343.7
32.710	380.0
32.735	421.6
32.760	463.2
32.785	504.8
32.810	546.4
32.835	588.0
-1.000	

Flow Rating Curve

RL (m)	Flow (m ³ /s)		
	Pipe	Overland	Total
31.610	0.000		0.000
31.710	0.149		0.149
31.810	0.211		0.211
31.910	0.259		0.259
32.010	0.299		0.299
32.110	0.334		0.334
32.210	0.366		0.366
32.310	0.395		0.395
32.410	0.422		0.422
32.510	0.448		0.448
32.610	0.472	0.000	0.472
32.635	0.478	0.036	0.514
32.660	0.484	0.125	0.609
32.685	0.489	0.269	0.758
32.710	0.495	0.466	0.961
32.735	0.501	0.730	1.231
32.760	0.506	1.113	1.619
32.785	0.512	1.626	2.138
32.810	0.517	2.214	2.731
32.835	0.522	2.873	3.395
-1.000			

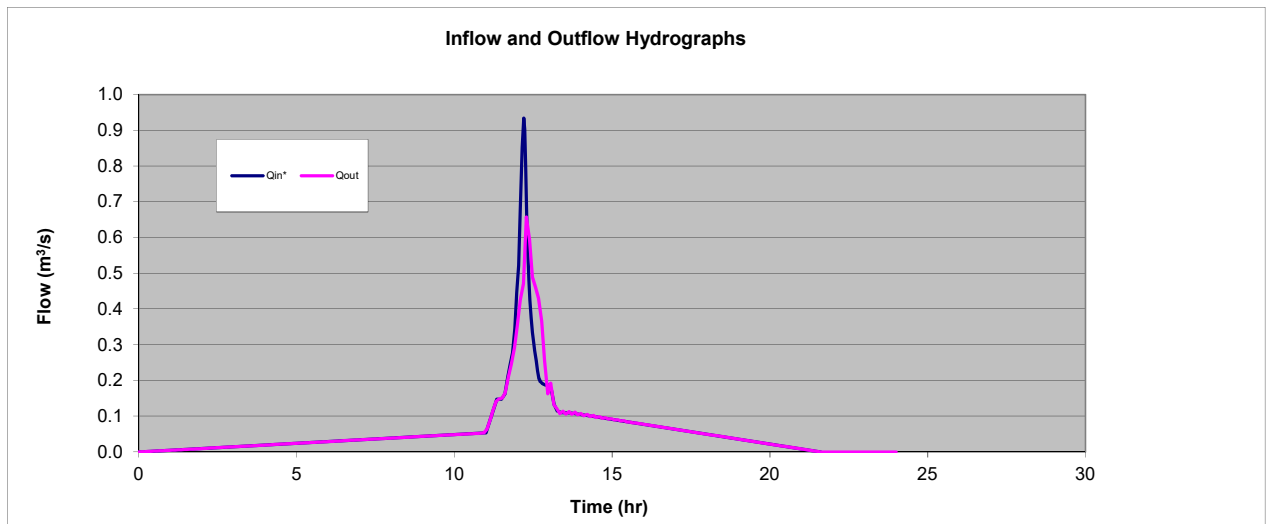
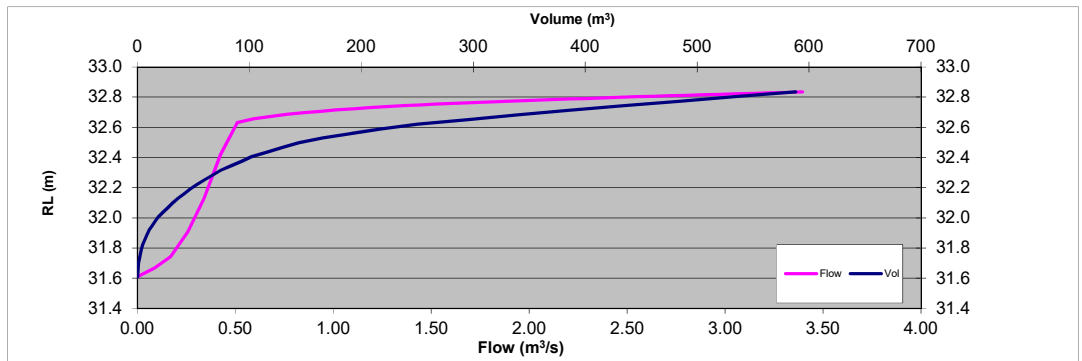
Cd 0.670
 Pipe Diameter 0.450 m

 Finish time (hr) **24**
 Extraction rate (m³/s) **0.00**

- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:

Max. Inflow (m³/s) 0.934
 Time at Max. Inflow (hr) 12.19
 Max. Outflow (m³/s) **0.657**
 Time at Max. Outflow (hr) 12.29
 Initial RL (m) 31.610
 Max. RL (m) 32.668
 Max. Volume (m³) 319.1
 Inflow Volume (m³) 5100.9
 Volumetric error 0.00%
 Extraction Volume (m³) 0.0



Calculation Sheet

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

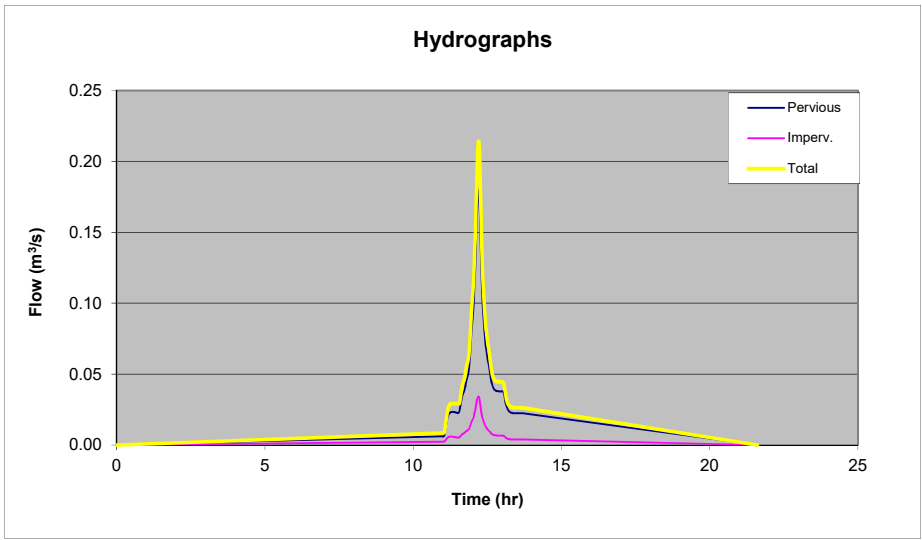
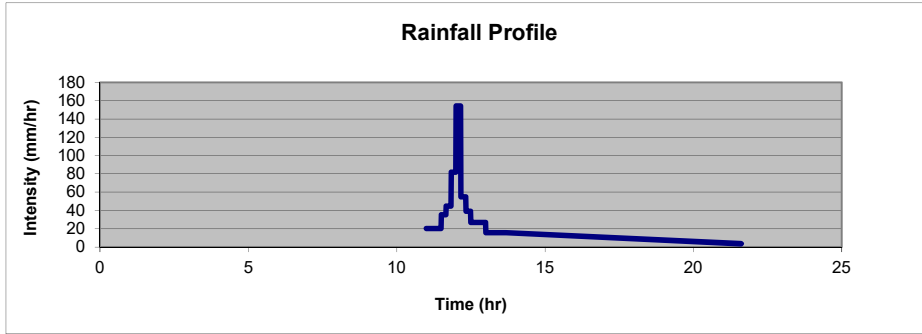
Project Description **Kohi - Existing Storage Volume 2 Catchment (A5&A6)**

Rainfall Depth (mm) **222**

- Notes:**
- Inputs
 - Typical inputs for CN are in 'Typical CN Values' Sheet
 - Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.5914	0.0888
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	Total		
Area (ha)	0.5914	0.0888	0.6802
Runoff (mm)	153.7	216.9	161.9
Peak Flow (m ³ /s)	0.180	0.034	0.214
Time (hr) at Peak Flow	12.20	12.20	12.20
Rainfall (mm/h) over tc	153.96	153.96	153.96
Runoff Coefficient - Peak	0.71	0.90	0.74
Runoff Coefficient - Volume	0.69	0.98	0.73



Beca Ltd



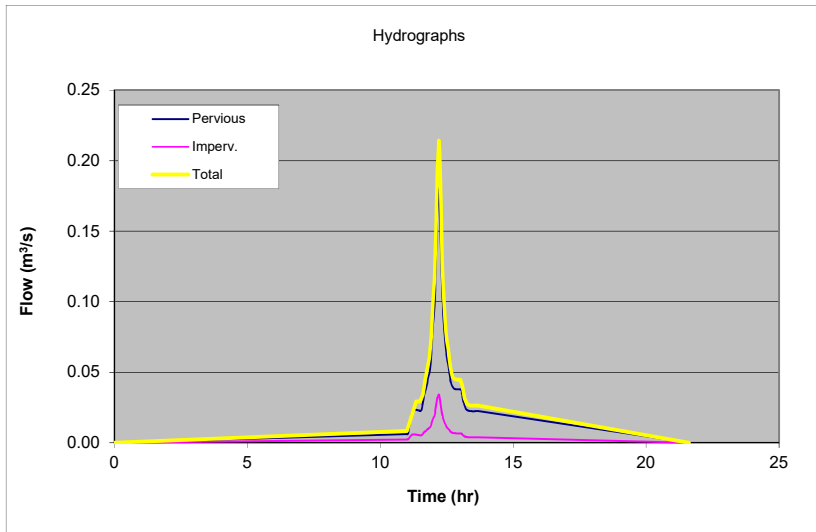
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Existing Storage Volume 2 Catchment (A5&A6)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m³/s)
0.000	0.000
11.001	0.008
11.347	0.029
11.491	0.029
11.601	0.034
11.694	0.045
11.776	0.053
11.850	0.060
11.918	0.075
11.981	0.099
12.040	0.116
12.096	0.152
12.150	0.194
12.201	0.214
12.232	0.208
12.264	0.184
12.297	0.154
12.331	0.129
12.365	0.112
12.400	0.100
12.437	0.088
12.474	0.078
12.513	0.072
12.553	0.067
12.594	0.060
12.637	0.054
12.682	0.049
12.729	0.047
12.778	0.045
12.830	0.045
12.886	0.045
12.945	0.045
13.010	0.045
13.082	0.041
13.163	0.031
13.260	0.027
13.386	0.026
13.690	0.026
21.610	0.000
-1.000	0.000

Calculation Sheet



JOB NO: 3124460

Hydrograph Routing - Storage Volume 2

Project Description Kōhi - Existing Storage Volume 2 Catchment (A5 & A6)

Inflow Hydrograph (A + B)

Time (hr)	Flow (m ³ /s)
0.001	0.000
3.547	0.003
6.276	0.005
7.148	0.006
7.782	0.006
8.298	0.006
8.742	0.007
9.135	0.007
9.490	0.007
9.817	0.008
10.119	0.008
10.402	0.008
10.668	0.008
10.920	0.008
11.160	0.018
11.389	0.029
11.609	0.035
11.820	0.075
12.023	0.196
12.219	0.360
12.433	0.151
12.655	0.052
12.886	0.045
13.126	0.036
13.376	0.026
13.639	0.026
13.915	0.026
14.206	0.025
14.515	0.024
14.846	0.023
15.203	0.021
15.591	0.020
16.021	0.019
16.506	0.017
17.071	0.015
17.765	0.013
18.718	0.010
21.703	0.000
24.000	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m ³)
26.110	0
26.360	1
26.610	3
26.860	7
27.110	14
27.360	24
27.610	39
27.860	58
28.110	83
28.360	115
28.610	155
28.641	161.8
28.673	168.7
28.704	175.7
28.735	182.7
28.766	189.6
28.798	196.6
28.829	203.5
28.860	210.5
-1.000	

Flow Rating Curve

RL (m)	Flow (m ³ /s)		
	Pipe	Overland	Total (m ³ /s)
26.110	0.000	0.000	0.000
26.360	0.059	0.000	0.059
26.610	0.083	0.000	0.083
26.860	0.102	0.000	0.102
27.110	0.118	0.000	0.118
27.360	0.132	0.000	0.132
27.610	0.145	0.000	0.145
27.860	0.156	0.000	0.156
28.110	0.167	0.000	0.167
28.360	0.177	0.000	0.177
28.610	0.187	0.000	0.187
28.641	0.188	0.005	0.193
28.673	0.189	0.030	0.219
28.704	0.190	0.087	0.277
28.735	0.191	0.187	0.378
28.766	0.192	0.337	0.529
28.798	0.193	0.555	0.748
28.829	0.195	0.835	1.030
28.860	0.196	1.188	1.384
-1.000			

Cd 0.670

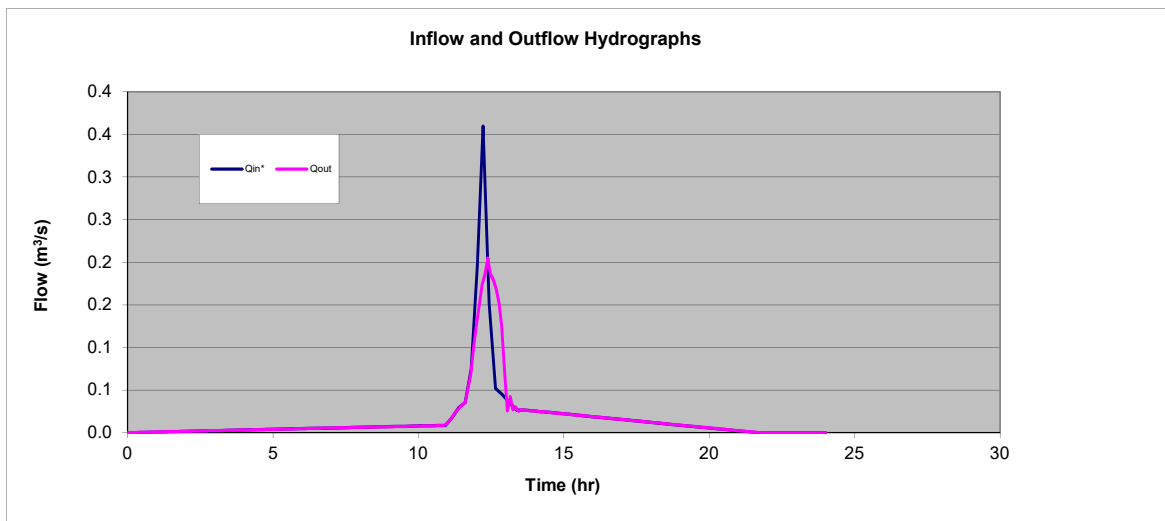
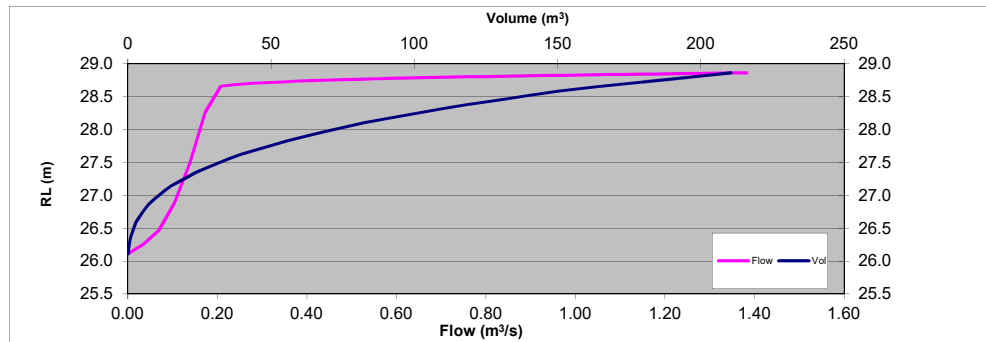
Pipe Diameter 0.225 m

Stability Coefficient (0.5-1.0)	0.60
Start time (hr)	0
Finish time (hr)	24
Extraction rate (m ³ /s)	0.00

- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:

Max. Inflow (m ³ /s)	0.360
Time at Max. Inflow (hr)	12.19
Max. Outflow (m ³ /s)	0.205
Time at Max. Outflow (hr)	12.38
Initial RL (m)	26.110
Max. RL (m)	28.656
Max. Volume (m ³)	165.0
Inflow Volume (m ³)	1346.7
Volumetric error	0.00%
Extraction Volume (m ³)	0.0



Calculation Sheet



JOB NO: 3124460

Hydrograph Routing - Storage Volume 2

Project Description **Kohi - Existing Storage Volume 2 Catchment (A5 & A6)**

Stability Coefficient (0.5-1.0) 0.60
 Start time (hr) 0
 Finish time (hr) 24
 Extraction rate (m³/s) 0.00

Inflow Hydrograph (A + B)

Time (hr)	Flow (m ³ /s)
0.001	0.000
3.547	0.003
6.276	0.005
7.148	0.006
7.782	0.006
8.298	0.006
8.742	0.007
9.135	0.007
9.490	0.007
9.817	0.008
10.119	0.008
10.402	0.008
10.668	0.008
10.920	0.008
11.160	0.018
11.389	0.029
11.609	0.035
11.820	0.075
12.023	0.196
12.219	0.360
12.433	0.151
12.655	0.052
12.886	0.045
13.126	0.036
13.376	0.026
13.639	0.026
13.915	0.026
14.206	0.025
14.515	0.024
14.846	0.023
15.203	0.021
15.591	0.020
16.021	0.019
16.506	0.017
17.071	0.015
17.765	0.013
18.718	0.010
21.703	0.000
24.000	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m ³)
26.110	0
26.360	1
26.610	3
26.860	7
27.110	14
27.360	24
27.610	39
27.860	58
28.110	83
28.360	115
28.610	155
28.641	161.8
28.673	168.7
28.704	175.7
28.735	182.7
28.766	189.6
28.798	196.6
28.829	203.5
28.860	210.5
-1.000	

Flow Rating Curve

RL (m)	Flow (m ³ /s)		
	Pipe	Overland	Total (m ³ /s)
26.110	0.000	0.000	0.000
26.360	0.059	0.000	0.059
26.610	0.083	0.000	0.083
26.860	0.102	0.000	0.102
27.110	0.118	0.000	0.118
27.360	0.132	0.000	0.132
27.610	0.145	0.000	0.145
27.860	0.156	0.000	0.156
28.110	0.167	0.000	0.167
28.360	0.177	0.000	0.177
28.610	0.187	0.000	0.187
28.641	0.188	0.005	0.193
28.673	0.189	0.030	0.219
28.704	0.190	0.087	0.277
28.735	0.191	0.187	0.378
28.766	0.192	0.337	0.529
28.798	0.193	0.555	0.748
28.829	0.195	0.835	1.030
28.860	0.196	1.188	1.384
-1.000			

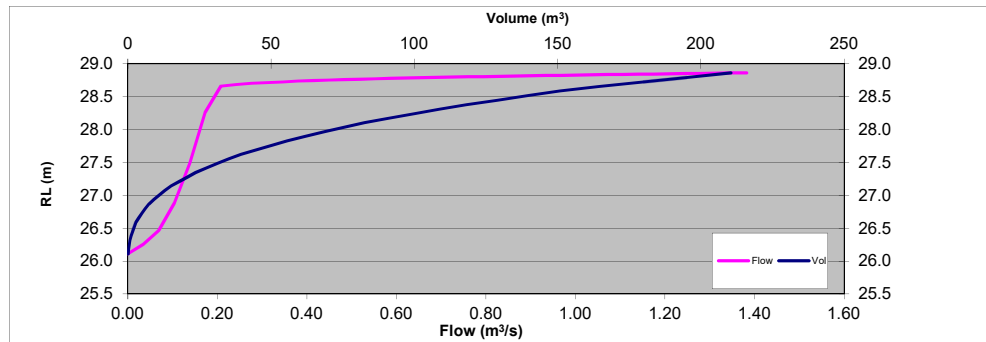
- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:

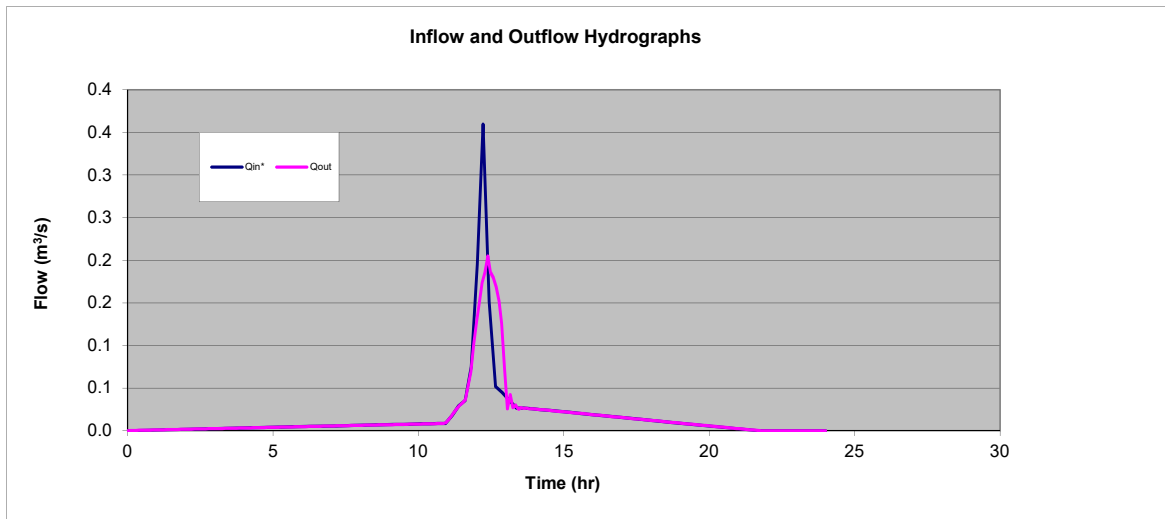
Max. Inflow (m³/s) 0.360
 Time at Max. Inflow (hr) 12.19
 Max. Outflow (m³/s) 0.205
 Time at Max. Outflow (hr) 12.38
 Initial RL (m) 26.110
 Max. RL (m) 28.656
 Max. Volume (m³) 165.0
 Inflow Volume (m³) 1346.7
 Volumetric error 0.00%
 Extraction Volume (m³) 0.0

Cd 0.670

Pipe Diameter 0.225 m



Inflow and Outflow Hydrographs



Calculation Sheet

Beca Ltd



JOB NO: 3124460-221

Hydrograph Combination - Existing Combined Piped Flow

 Project Description Combined Pipe Flow from SV1 & SV2

 Time Lag (min) Time Lag (min)

Hydrograph SV1 Piped Outflow

Time (hr)	Flow (m ³ /s)
0.000	0.000
3.547	0.017
5.017	0.024
6.144	0.030
6.094	0.035
6.032	0.039
6.089	0.042
6.088	0.046
10.033	0.049
10.042	0.052
11.217	0.112
11.765	0.229
12.288	0.486
12.515	0.478
12.747	0.379
12.984	0.170
13.227	0.124
13.474	0.111
13.728	0.106
13.988	0.106
14.255	0.102
14.530	0.097
14.812	0.095
15.104	0.090
15.406	0.086
15.718	0.082
16.043	0.077
16.382	0.072
16.737	0.068
17.109	0.062
17.503	0.057
17.923	0.051
18.374	0.045
18.864	0.038
19.406	0.031
20.022	0.022
20.752	0.012
21.703	0.000
24.000	0.000
-1.000	0.000

Hydrograph SV2 Piped Outflow

Time (hr)	Flow (m ³ /s)
0.001	0.000
3.576	0.003
5.057	0.004
6.093	0.005
7.151	0.006
7.5	0.006
9.757	0.007
9.099	0.007
10.012	0.008
10.725	0.008
11.306	0.025
11.857	0.086
12.384	0.188
12.610	0.176
12.840	0.133
13.075	0.029
13.315	0.029
13.561	0.027
13.813	0.026
14.070	0.025
14.335	0.024
14.608	0.023
14.888	0.022
15.177	0.021
15.477	0.020
15.787	0.019
16.109	0.018
16.445	0.017
16.796	0.016
17.166	0.015
17.557	0.014
17.973	0.012
18.420	0.011
18.906	0.009
19.444	0.007
20.054	0.005
20.778	0.003
21.722	0.000
24.000	0.000
-1.000	0.000

Hydrograph Total Pipe Outflow

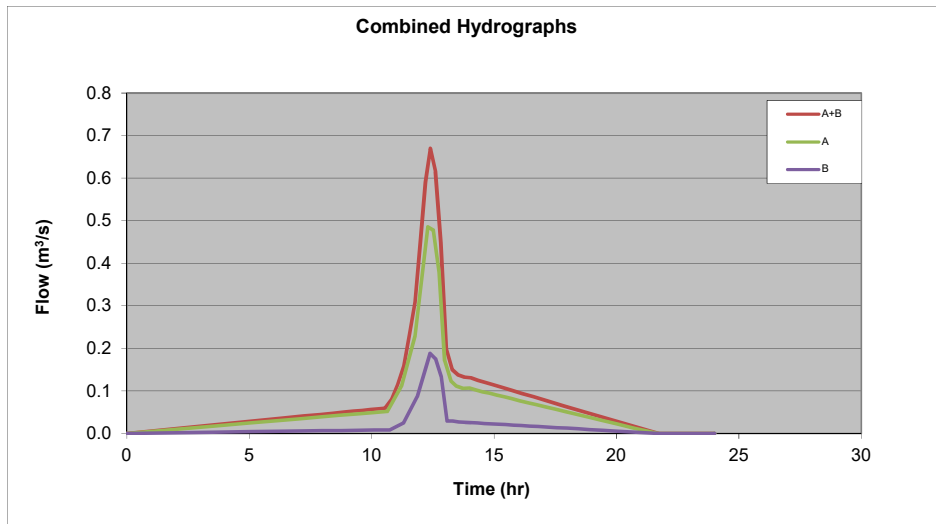
Time (hr)	Flow (m ³ /s)
0.002	0.000
3.547	0.020
6.331	0.036
7.221	0.041
6.086	0.044
6.094	0.047
9.947	0.050
9.048	0.052
9.010	0.054
9.043	0.056
10.252	0.058
10.540	0.059
10.812	0.080
11.069	0.115
11.314	0.159
11.548	0.235
11.771	0.309
11.986	0.449
12.194	0.591
12.394	0.670
12.604	0.616
12.823	0.448
13.050	0.198
13.286	0.150
13.532	0.137
13.790	0.132
14.062	0.130
14.348	0.125
14.652	0.119
14.978	0.114
15.328	0.108
15.711	0.102
16.134	0.094
16.611	0.086
17.166	0.076
17.848	0.065
18.786	0.049
21.722	0.000
24.000	0.000
-1.000	0.000

Notes:

- Input data should be in ascending order with time in the boxes provided. The maximum no. of values is 40. If a lesser no. of values is needed then terminate as a -1 for the x value.
- The Time Lag is relative to the hydrograph times.
- Volumetric error is generally due to the interpolation and reassignment of time values.

Results:

Max. Flow (m ³ /s) -A	0.486
Time (hr) at Max Flow	12.29
Max. Flow (m ³ /s) -B	0.188
Time (hr) at Max Flow	12.38
Max. Flow (m ³ /s)	0.670
Time (hr) at Max Flow	12.29
Volumetric Error	0.0%



Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

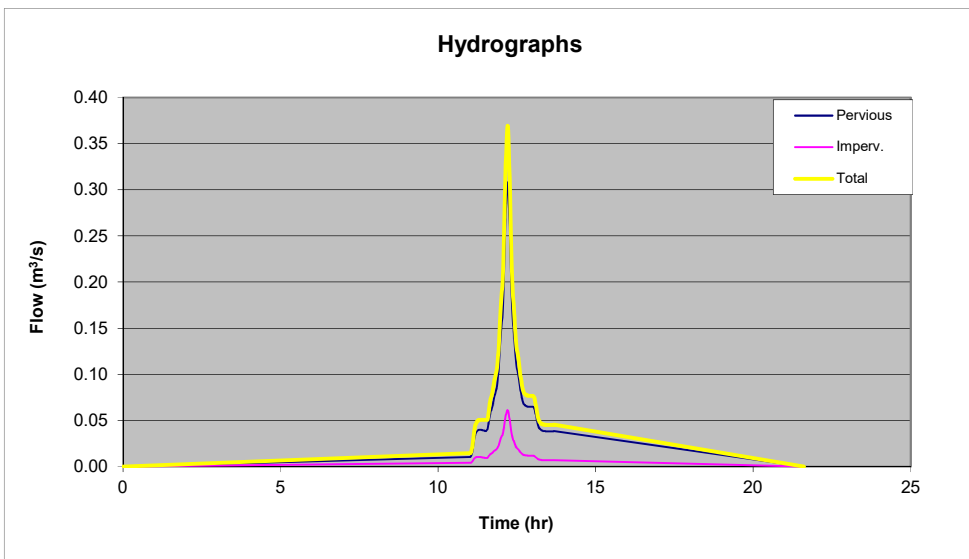
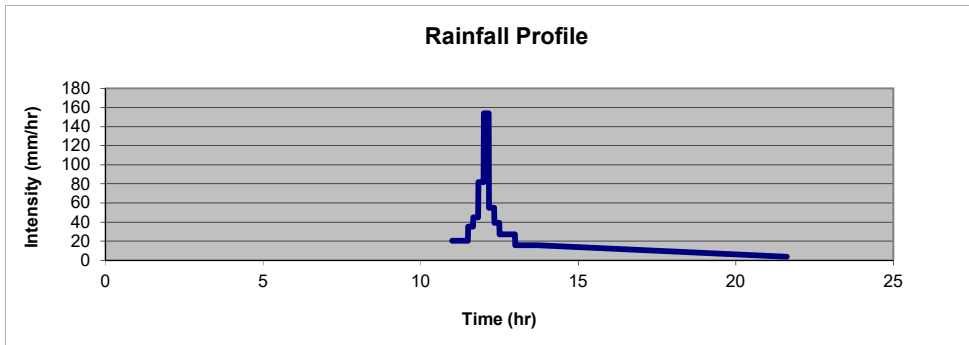
Project Description **Kohi - Catchment to No 17 John Rymer Place(A7 & A8)**

Rainfall Depth (mm) **222**

- Notes:**
- Inputs
 - Typical inputs for CN are in 'Typical CN Values' Sheet
 - Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	1.0124	0.1588
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	1.0124	0.1588	1.1712
Runoff (mm)	153.7	216.9	162.3
Peak Flow (m ³ /s)	0.308	0.061	0.369
Time (hr) at Peak Flow	12.20	12.20	12.20
Rainfall (mm/h) over tc	153.96	153.96	153.96
Runoff Coefficient - Peak	0.71	0.90	0.74
Runoff Coefficient - Volume	0.69	0.98	0.73



Calculation Sheet

Beca Ltd



JOB NO: 0

Hydrograph Combination

Project Description **Seperate Pipe Flow and Overflow at Outfall Manhole**

Time Lag (min)

Time Lag (min)

Inflow to Outfall Manhole

Time (hr)	Flow (m ³ /s)
0.002	0.000
3.547	0.020
6.331	0.036
7.221	0.041
7.867	0.044
8.394	0.047
8.847	0.050
9.248	0.052
9.610	0.054
9.943	0.056
10.252	0.058
10.540	0.059
10.812	0.080
11.069	0.115
11.314	0.159
11.548	0.235
11.771	0.309
11.986	0.449
12.194	0.591
12.394	0.670
12.604	0.616
12.823	0.448
13.050	0.198
13.286	0.150
13.532	0.137
13.790	0.132
14.062	0.130
14.348	0.125
14.652	0.119
14.978	0.114
15.328	0.108
15.711	0.102
16.134	0.094
16.611	0.086
17.166	0.076
17.848	0.065
18.786	0.049
21.722	0.000
24.000	0.000
-1.000	0.000

Pipe Outflow from Site

Limited to Pipe Capacity

Time (hr)	Flow (m ³ /s)
0.002	0.000
3.547	0.020
6.331	0.036
7.221	0.041
7.867	0.044
8.394	0.047
8.847	0.050
9.248	0.052
9.610	0.054
9.943	0.056
10.252	0.058
10.540	0.059
10.812	0.080
11.069	0.115
11.314	0.159
11.548	0.235
11.771	0.309
11.986	0.449
12.194	0.520
12.394	0.520
12.604	0.520
12.823	0.448
13.050	0.198
13.286	0.150
13.532	0.137
13.790	0.132
14.062	0.130
14.348	0.125
14.652	0.119
14.978	0.114
15.328	0.108
15.711	0.102
16.134	0.094
16.611	0.086
17.166	0.076
17.848	0.065
18.786	0.049
21.722	0.000
24.000	0.000
-1.000	0.000

Overflow from Outfall Manhole

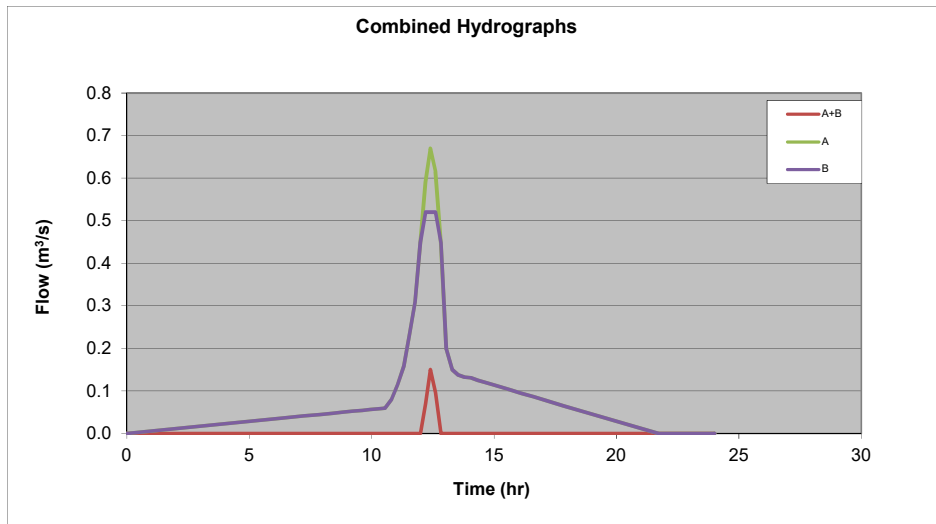
Time (hr)	Flow (m ³ /s)
0.002	0.000
3.547	0.000
6.331	0.000
7.221	0.000
7.867	0.000
8.394	0.000
8.847	0.000
9.248	0.000
9.610	0.000
9.943	0.000
10.252	0.000
10.540	0.000
10.812	0.000
11.069	0.000
11.314	0.000
11.548	0.000
11.771	0.000
11.986	0.000
12.194	0.071
12.394	0.150
12.604	0.096
12.823	0.000
13.050	0.000
13.286	0.000
13.532	0.000
13.790	0.000
14.062	0.000
14.348	0.000
14.652	0.000
14.978	0.000
15.328	0.000
15.711	0.000
16.134	0.000
16.611	0.000
17.166	0.000
17.848	0.000
18.786	0.000
21.722	0.000
24.000	0.000
-1.000	0.000

Notes:

- Input data should be in ascending order with time in the boxes provided. The maximum no. of values is 40. If a lesser no. of values is needed then terminate as a -1 for the x value.
- The Time Lag is relative to the hydrograph times.
- Volumetric error is generally due to the interpolation and reassignment of time values.

Results:

Max. Flow (m ³ /s) -A	0.670
Time (hr) at Max Flow	12.39
Max. Flow (m ³ /s) -B	0.520
Time (hr) at Max Flow	12.19
Max. Flow (m ³ /s)	1.190
Time (hr) at Max Flow	12.39
Volumetric Error	0.0%



Calculation Sheet

Beca Ltd



JOB NO: 0

Hydrograph Combination

 Project Description **Combined SV2 Overflow with Outfall Manhole**

 Time Lag (min)

 Time Lag (min)

Hydrograph SV2 Overflow

Time (hr)	Flow (m ³ /s)
0.001	0.000
3.576	0.000
5.057	0.000
6.193	0.000
7.151	0.000
7.995	0.000
8.757	0.000
9.459	0.000
10.112	0.000
10.725	0.000
11.306	0.000
11.857	0.000
12.384	0.017
12.610	0.000
12.840	0.000
13.075	0.000
13.315	0.000
13.561	0.000
13.813	0.000
14.070	0.000
14.335	0.000
14.608	0.000
14.888	0.000
15.177	0.000
15.477	0.000
15.787	0.000
16.109	0.000
16.445	0.000
16.796	0.000
17.166	0.000
17.557	0.000
17.973	0.000
18.420	0.000
18.906	0.000
19.444	0.000
20.054	0.000
20.778	0.000
21.722	0.000
24.000	0.000
-1.000	0.000

Outfall Overflow

Time (hr)	Flow (m ³ /s)
0.002	0.000
3.547	0.000
6.331	0.000
7.221	0.000
7.867	0.000
8.394	0.000
8.847	0.000
9.248	0.000
9.610	0.000
9.943	0.000
10.252	0.000
10.540	0.000
10.812	0.000
11.069	0.000
11.314	0.000
11.548	0.000
11.771	0.000
11.986	0.000
12.194	0.071
12.394	0.150
12.604	0.096
12.823	0.000
13.050	0.000
13.286	0.000
13.532	0.000
13.790	0.000
14.062	0.000
14.348	0.000
14.652	0.000
14.978	0.000
15.328	0.000
15.711	0.000
16.134	0.000
16.611	0.000
17.166	0.000
17.848	0.000
18.786	0.000
21.722	0.000
24.000	0.000
-1.000	0.000

Combined Overflow

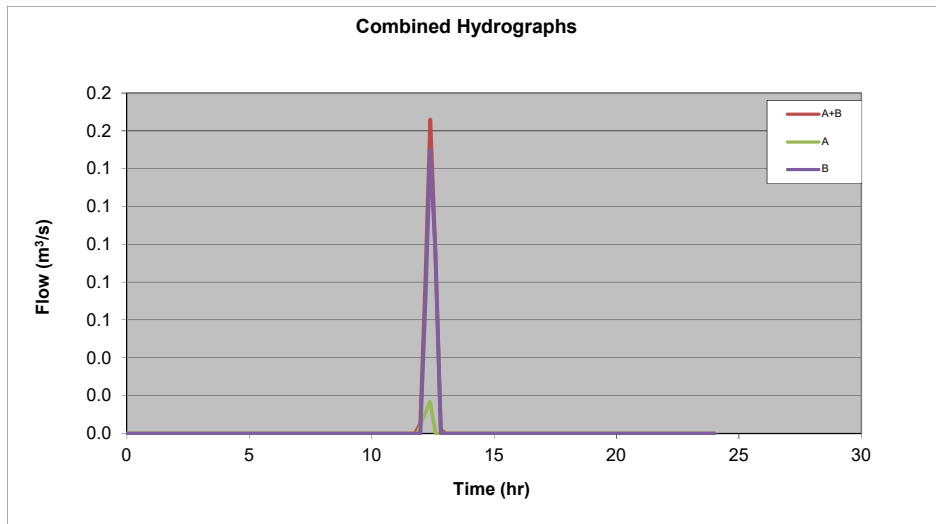
Time (hr)	Flow (m ³ /s)
0.003	0.000
3.547	0.000
6.331	0.000
7.221	0.000
7.867	0.000
8.394	0.000
8.847	0.000
9.248	0.000
9.610	0.000
9.943	0.000
10.252	0.000
10.540	0.000
10.812	0.000
11.069	0.000
11.314	0.000
11.548	0.000
11.771	0.000
11.986	0.005
12.194	0.081
12.394	0.166
12.604	0.096
12.823	0.002
13.050	0.000
13.286	0.000
13.532	0.000
13.790	0.000
14.062	0.000
14.348	0.000
14.652	0.000
14.978	0.000
15.328	0.000
15.711	0.000
16.134	0.000
16.611	0.000
17.166	0.000
17.848	0.000
18.786	0.000
21.722	0.000
24.000	0.000
-1.000	0.000

Notes:

- Input data should be in ascending order with time in the boxes provided. The maximum no. of values is 40. If a lesser no. of values is needed then terminate as a -1 for the x value.
- The Time Lag is relative to the hydrograph times.
- Volumetric error is generally due to the interpolation and reassignment of time values.

Results:

Max. Flow (m ³ /s) -A	0.017
Time (hr) at Max Flow	12.38
Max. Flow (m ³ /s) -B	0.150
Time (hr) at Max Flow	12.39
Max. Flow (m ³ /s)	0.166
Time (hr) at Max Flow	12.39
Volumetric Error	0.2%



Calculation Sheet

Beca Ltd



JOB NO: 0

Hydrograph Combination

 Project Description Total Overland Flow from Site to No 17

 Time Lag (min) 0 Time Lag (min) 0

Combined Overflow

Time (hr)	Flow (m ³ /s)
0.003	0.000
3.547	0.000
b1 (V)	0.000
7.221	0.000
7.867	0.000
8.394	0.000
8.847	0.000
9.248	0.000
9.610	0.000
9.943	0.000
10.252	0.000
10.540	0.000
10.812	0.000
11.069	0.000
11.314	0.000
11.548	0.000
11.771	0.000
11.986	0.005
12.194	0.081
12.394	0.166
12.604	0.096
12.823	0.002
13.050	0.000
13.286	0.000
13.532	0.000
13.790	0.000
14.062	0.000
14.348	0.000
14.652	0.000
14.978	0.000
15.328	0.000
15.711	0.000
16.134	0.000
16.611	0.000
17.166	0.000
17.848	0.000
18.786	0.000
21.722	0.000
24.000	0.000
-1.000	0.000

Hydrograph (A7& A8)

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.015
11.347	0.051
11.491	0.051
11.601	0.059
11.694	0.077
11.776	0.091
11.850	0.104
11.918	0.130
11.981	0.170
12.040	0.200
12.096	0.263
12.150	0.334
12.201	0.369
12.232	0.358
12.264	0.317
12.297	0.266
12.331	0.222
12.365	0.193
12.400	0.172
12.437	0.152
12.474	0.135
12.513	0.124
12.553	0.115
12.594	0.104
12.637	0.092
12.682	0.084
12.729	0.080
12.778	0.078
12.830	0.077
12.886	0.077
12.945	0.077
13.010	0.077
13.082	0.070
13.163	0.054
13.260	0.047
13.386	0.046
13.690	0.045
21.610	0.000
-1.000	0.000

Total Overland Flow

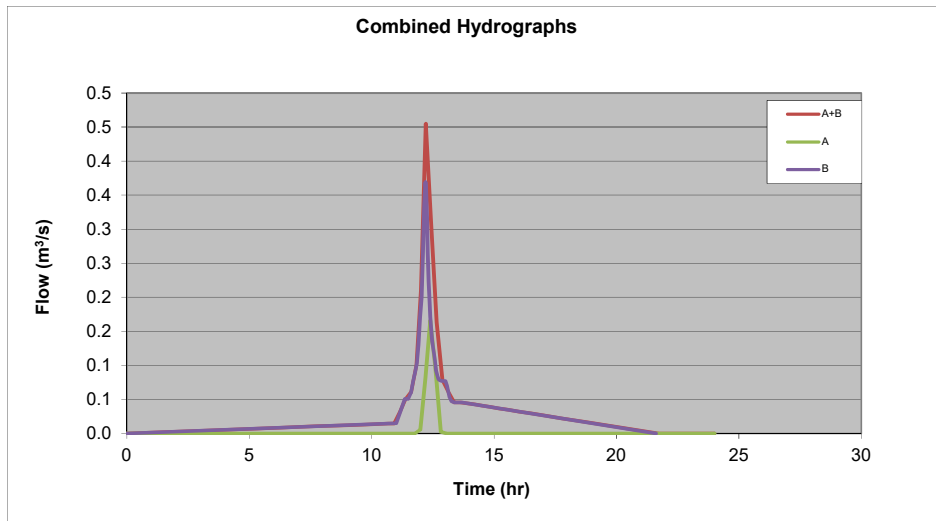
Time (hr)	Flow (m ³ /s)
0.001	0.000
3.547	0.005
6.866	0.008
7.148	0.010
7.782	0.010
8.298	0.011
8.742	0.012
9.135	0.012
9.490	0.013
9.817	0.013
10.119	0.014
10.402	0.014
10.668	0.014
10.920	0.015
11.160	0.031
11.389	0.051
11.609	0.061
11.820	0.100
12.023	0.210
12.219	0.455
12.434	0.306
12.656	0.163
12.887	0.078
13.128	0.061
13.379	0.046
13.642	0.045
13.918	0.044
14.210	0.042
14.520	0.041
14.851	0.039
15.209	0.037
15.598	0.034
16.029	0.032
16.515	0.029
17.081	0.026
17.776	0.022
18.731	0.017
21.722	0.000
24.000	0.000
-1.000	0.000

Notes:

- Input data should be in ascending order with time in the boxes provided. The maximum no. of values is 40. If a lesser no. of values is needed then terminate as a -1 for the x value.
- The Time Lag is relative to the hydrograph times.
- Volumetric error is generally due to the interpolation and reassignment of time values.

Results:

Max. Flow (m ³ /s) -A	0.166
Time (hr) at Max Flow	12.39
Max. Flow (m ³ /s) -B	0.369
Time (hr) at Max Flow	12.20
Max. Flow (m ³ /s)	0.455
Time (hr) at Max Flow	12.20
Volumetric Error	0.0%



Calculation Sheet

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

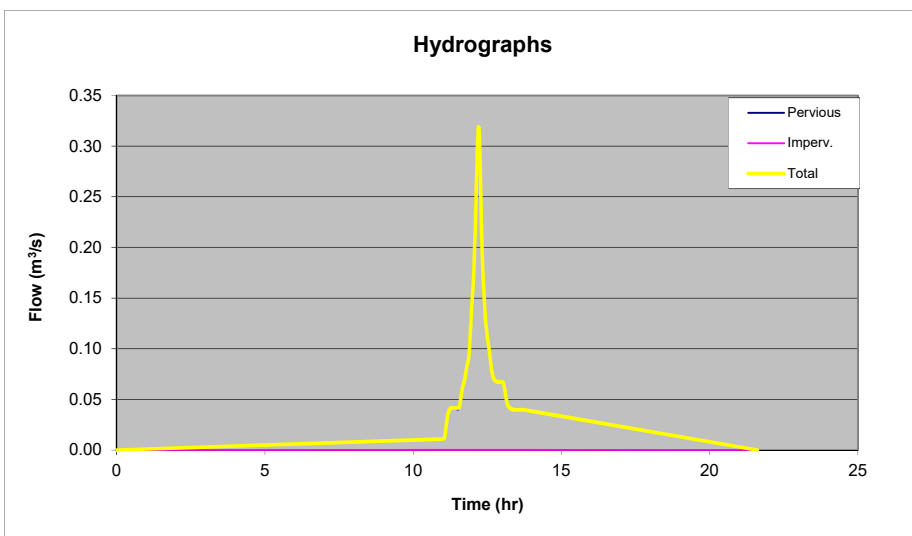
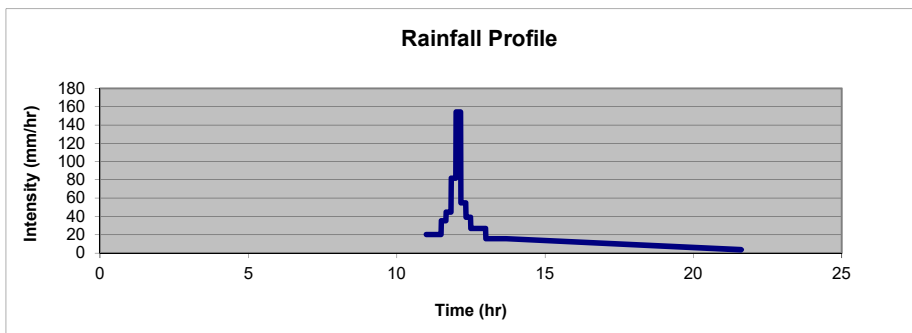
Project Description **Kohi - Overland Catchment Catchment (A9, A10, A11 & A12)**

Rainfall Depth (mm) **222**

- Notes:**
- Inputs
 - Typical inputs for CN are in 'Typical CN Values' Sheet
 - Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	1.0489	
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	Total		
Area (ha)	1.0489	0	1.0489
Runoff (mm)	153.7	216.9	153.7
Peak Flow (m ³ /s)	0.319	0.000	0.319
Time (hr) at Peak Flow	12.20	12.20	12.20
Rainfall (mm/h) over tc	153.96	153.96	153.96
Runoff Coefficient - Peak	0.71	0.00	0.71
Runoff Coefficient - Volume	0.69	0.98	0.69



**PROPOSED Q10
CALCULATIONS WITHOUT
CLIMATE CHANGE
ALLOWANCE**

Calculation Sheet

Job Number 3124460 Date 14.02.20
 Job Name Kohimarama Retirement Village
 Subject Proposed Stormwater Calc for a 10% AEP with No Climate Change
 By Conor O'Boyle Page No of

On-Site & Upstream Catchments	Total Area	Pervious Area	Impervious Area	% Impervious
A1	15318	2737	12581	82.13
A2	5596	560	5036	90.00
A8	1833	245	1588	86.63
On-Site & Upstream Catchments	Total Area	Pervious Area	Impervious Area	% Impervious
P1	275	145	130	0.47
P2	896	333	563	0.63
P3	439	256	184	0.42
P4	1341	643	698	0.52
P5	627	269	358	0.57
P6	996	484	512	0.51
P7	762	484	278	0.36
P8	1250	1250	0	0.00
P9	1922	876	1046	0.54
P10	2983	1650	1333	0.45
P11	1124	783	341	0.30
P12	1510	0	1510	1.00
P13	1003	0	1003	1.00
P14	1707	0	1707	1.00
P15	1558	0	1558	1.00
P16	927	0	927	1.00
P17	1202	0	1202	1.00
P18	2176	362	1814	0.83
P19	1443	1209	234	0.162
P20	5291	5067	224	0.042
P21	1824	1713	111	0.061
P22	2229	891.6	1337.4	0.6
P23	3366	1346.4	2019.6	0.6

Calculation Sheet

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kōhi - Attenuation Storage Catchment (P1-P19, P22, A1, A2 & A8)

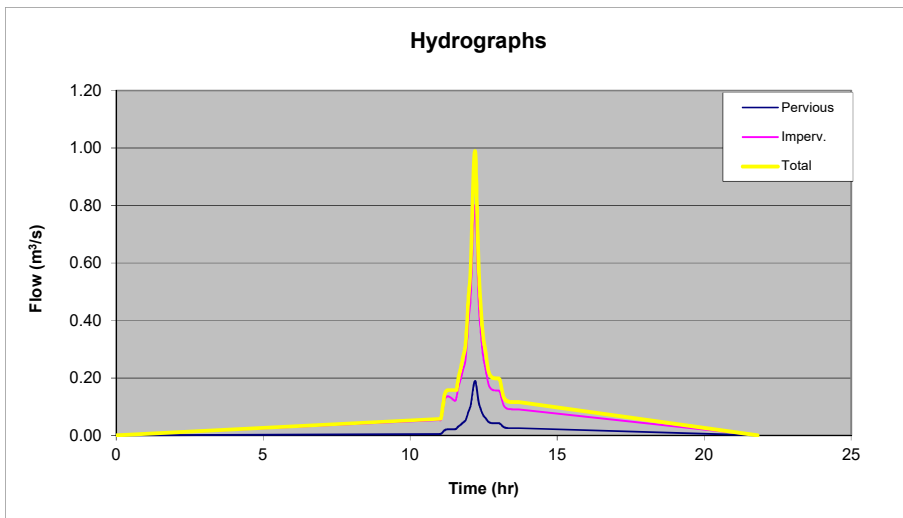
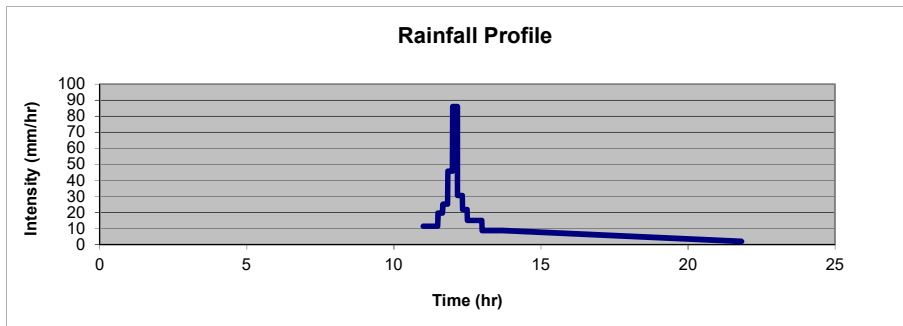
Rainfall Depth (mm) 124

Notes:

1. Inputs
2. Typical inputs for CN are in 'Typical CN Values' Sheet
3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	1.4069	3.7278
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	Pervious Area	Impervious Area	Total
Area (ha)	1.40688	3.72782	5.1347
Runoff (mm)	68.0	119.0	105.0
Peak Flow (m ³ /s)	0.190	0.801	0.990
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	86.03	86.03	86.03
Runoff Coefficient - Peak	0.56	0.90	0.81
Runoff Coefficient - Volume	0.55	0.96	0.85



Calculation Sheet

Beca Ltd



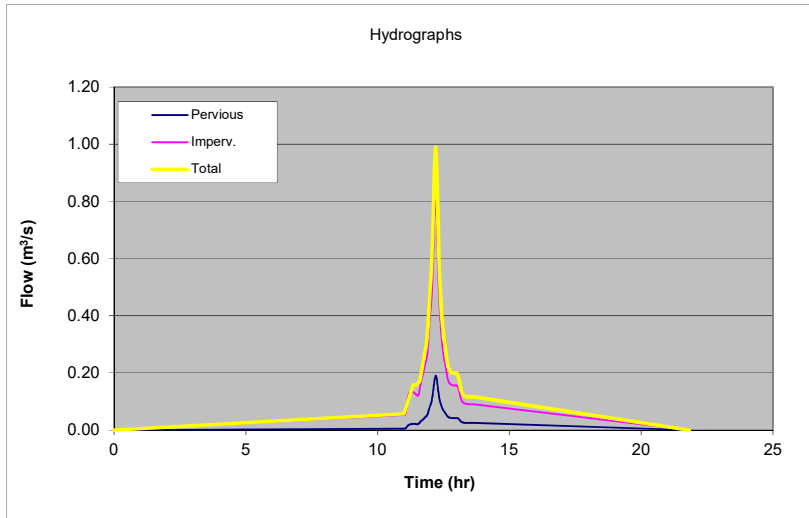
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Attenuation Storage Catchment (P1-P19, P22, A1, A2 & A8)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.058
11.347	0.158
11.491	0.158
11.601	0.173
11.694	0.223
11.776	0.262
11.850	0.294
11.918	0.365
11.981	0.474
12.040	0.553
12.096	0.718
12.150	0.904
12.201	0.990
12.232	0.956
12.264	0.843
12.297	0.705
12.331	0.587
12.365	0.509
12.400	0.451
12.437	0.398
12.474	0.354
12.513	0.324
12.553	0.301
12.594	0.271
12.637	0.240
12.682	0.219
12.729	0.208
12.778	0.203
12.830	0.200
12.886	0.199
12.945	0.199
13.010	0.198
13.082	0.180
13.163	0.140
13.260	0.122
13.386	0.117
13.690	0.116
21.822	0.000
-1.000	0.000

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

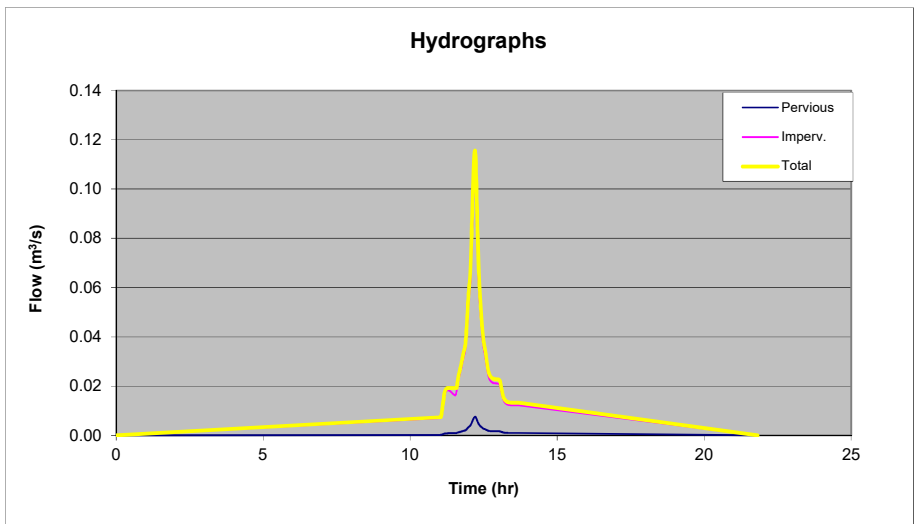
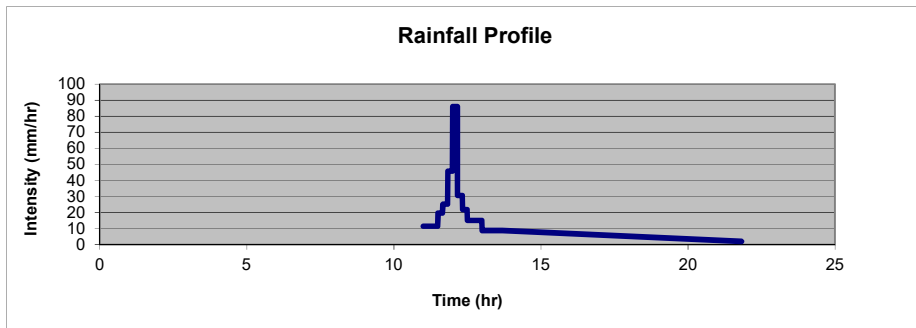
Project Description **Kohi - Attenuation Storage Catchment (A2Q10)**

Rainfall Depth (mm) **124**

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.056	0.5036
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

- Notes:**
- Inputs
 - Typical inputs for CN are in 'Typical CN Values' Sheet
 - Method based on ARC TP108

Outputs			Total
Area (ha)	0.056	0.5036	0.5596
Runoff (mm)	68.0	119.0	113.9
Peak Flow (m ³ /s)	0.008	0.108	0.116
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	86.03	86.03	86.03
Runoff Coefficient - Peak	0.56	0.90	0.87
Runoff Coefficient - Volume	0.55	0.96	0.92



Calculation Sheet

Beca Ltd



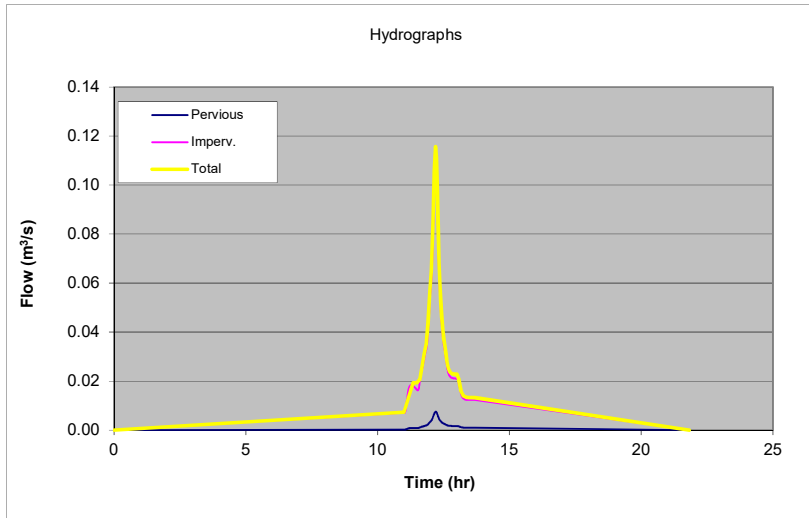
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Attenuation Storage Catchment (A2Q10)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m³/s)
0.000	0.000
11.001	0.007
11.347	0.019
11.491	0.019
11.601	0.021
11.694	0.027
11.776	0.031
11.850	0.035
11.918	0.043
11.981	0.056
12.040	0.065
12.096	0.085
12.150	0.106
12.201	0.116
12.232	0.112
12.264	0.098
12.297	0.082
12.331	0.068
12.365	0.059
12.400	0.052
12.437	0.046
12.474	0.041
12.513	0.037
12.553	0.035
12.594	0.031
12.637	0.028
12.682	0.025
12.729	0.024
12.778	0.023
12.830	0.023
12.886	0.023
12.945	0.023
13.010	0.023
13.082	0.021
13.163	0.016
13.260	0.014
13.386	0.013
13.690	0.013
21.822	0.000
-1.000	0.000

Calculation Sheet



$$Q = \frac{2}{3} C_d \sqrt{2g} b h^{3/2}$$

JOB NO: 3124460

Hydrograph Routing

Project Description Kohi - Attenuation Storage Catchment (P1-P19, P22, A1, A2 & A8)

Stability Coefficient (0.5-1.0)	1.00
Start time (hr)	0
Finish time (hr)	24
Extraction rate (m ³ /s)	0.00

Inflow Hydrograph

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.065
11.347	0.177
11.491	0.177
11.601	0.193
11.694	0.250
11.776	0.293
11.850	0.330
11.918	0.408
11.981	0.530
12.040	0.618
12.096	0.803
12.150	1.010
12.201	1.105
12.232	1.067
12.264	0.941
12.297	0.787
12.331	0.655
12.365	0.568
12.400	0.503
12.437	0.444
12.474	0.395
12.513	0.361
12.553	0.335
12.594	0.302
12.637	0.268
12.682	0.244
12.729	0.232
12.778	0.226
12.830	0.223
12.886	0.222
12.945	0.221
13.010	0.221
13.082	0.201
13.163	0.156
13.260	0.136
13.386	0.130
13.690	0.130
21.822	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m ³)
26.050	0
26.550	1.3
27.050	2.5
27.550	3.8
28.050	5.1
28.550	6.4
29.050	7.6
29.150	7.9
29.200	8.0
29.350	8.4
29.450	8.7
29.550	8.9
29.650	9.2
29.750	9.4
29.850	9.7
29.950	9.9
30.050	10.2
30.150	10.4
30.250	10.7
30.350	10.9
-1.000	

Flow Rating Curve

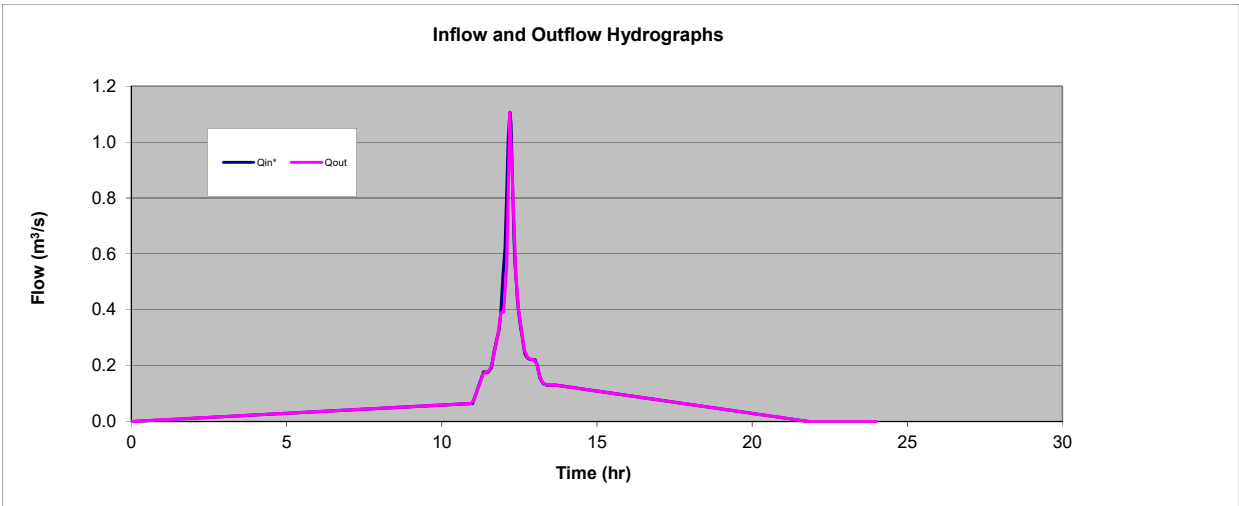
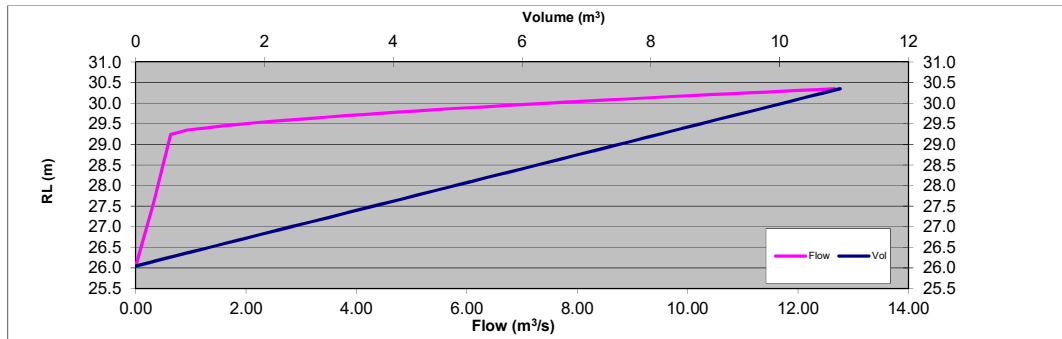
RL (m)	Flow (m ³ /s)		
	Pipe	Weir	Total
26.050	0.000	0.000	0.000
26.550	0.117	0.000	0.117
27.050	0.236	0.000	0.236
27.550	0.316	0.000	0.316
28.050	0.408	0.000	0.408
28.550	0.457	0.000	0.457
29.050	0.500	0.000	0.500
29.150	0.508	0.000	0.508
29.200	0.513	0.000	0.513
29.350	0.525	0.423	0.948
29.450	0.533	1.050	1.583
29.550	0.540	1.843	2.383
29.650	0.548	2.771	3.319
29.750	0.556	3.817	4.372
29.850	0.563	4.969	5.532
29.950	0.570	6.219	6.789
30.050	0.578	7.558	8.136
30.150	0.585	8.982	9.567
30.250	0.592	10.486	11.078
30.350	0.599	12.065	12.664
-1.000			

Weir RL (m) 29.23
Weir Length (m) 5.65
Outlet Pipe Dia (m) 0.352
Outlet Pipe Invert level (l) 26.50
Orifice Cd 0.670
Weir CD 0.6

- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:

Max. Inflow (m ³ /s)	1.105
Time at Max. Inflow (hr)	12.19
Max. Outflow (m ³ /s)	1.104
Time at Max. Outflow (hr)	12.19
Initial RL (m)	26.050
Max. RL (m)	29.375
Max. Volume (m ³)	8.5
Inflow Volume (m ³)	6119.5
Volumetric error	2.25%
Extraction Volume (m ³)	0.0



Calculation Sheet

Beca Ltd



JOB NO: 0

Hydrograph Combination

Project Description Separation of Flows in Manhole to Determine Flows into the Attenuation Tank

 Time Lag (min)

 Time Lag (min)

Hydrograph A

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.065
11.347	0.177
11.491	0.177
11.601	0.193
11.694	0.250
11.776	0.293
11.850	0.330
11.918	0.408
11.981	0.530
12.040	0.618
12.096	0.803
12.150	1.010
12.201	1.105
12.232	1.067
12.264	0.941
12.297	0.787
12.331	0.655
12.365	0.568
12.400	0.503
12.437	0.444
12.474	0.395
12.513	0.361
12.553	0.335
12.594	0.302
12.637	0.268
12.682	0.244
12.729	0.232
12.778	0.226
12.830	0.223
12.886	0.222
12.945	0.221
13.010	0.221
13.082	0.201
13.163	0.156
13.260	0.136
13.386	0.130
13.690	0.130
21.822	0.000
-1.000	0.000

Hydrograph B

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.065
11.347	0.177
11.491	0.177
11.601	0.193
11.694	0.250
11.776	0.293
11.850	0.330
11.918	0.408
11.981	0.462
12.040	0.462
12.096	0.462
12.150	0.462
12.201	0.462
12.232	0.462
12.264	0.462
12.297	0.462
12.331	0.462
12.365	0.462
12.400	0.462
12.437	0.444
12.474	0.395
12.513	0.361
12.553	0.335
12.594	0.302
12.637	0.268
12.682	0.244
12.729	0.232
12.778	0.226
12.830	0.223
12.886	0.222
12.945	0.221
13.010	0.221
13.082	0.201
13.163	0.156
13.260	0.136
13.386	0.130
13.690	0.130
21.822	0.000
-1.000	0.000

Hydrograph A+B+C

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.000
11.347	0.000
11.491	0.000
11.601	0.000
11.694	0.000
11.776	0.000
11.850	0.000
11.918	0.000
11.981	-0.068
12.040	-0.157
12.096	-0.341
12.150	-0.548
12.201	-0.644
12.232	-0.606
12.264	-0.480
12.297	-0.326
12.331	-0.194
12.365	-0.107
12.400	-0.042
12.437	0.000
12.474	0.000
12.513	0.000
12.553	0.000
12.594	0.000
12.637	0.000
12.682	0.000
12.729	0.000
12.778	0.000
12.830	0.000
12.886	0.000
12.945	0.000
13.010	0.000
13.082	0.000
13.163	0.000
13.260	0.000
13.386	0.000
13.690	0.000
21.822	0.000
-1.000	0.000

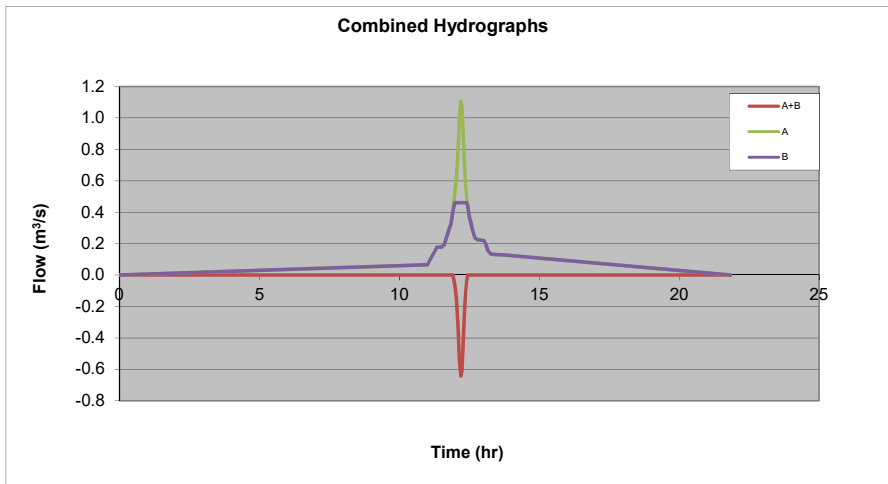
Notes:

- Input data should be in ascending order with time in the boxes provided. The maximum no. of values is 40. If a lesser no. of values is needed then terminate as a -1 for the x value.
- The Time Lag is relative to the hydrograph times.
- Volumetric error is generally due to the interpolation and reassignment of time values.

Results:

Max. Flow (m ³ /s) -A	1.105
Time (hr) at Max Flow	12.20
Max. Flow (m ³ /s) -B	0.462
Time (hr) at Max Flow	11.98
Max. Flow (m ³ /s)	1.567
Time (hr) at Max Flow	12.20
Volumetric Error	0.0%

0.000



Calculation Sheet

Hydrograph Routing

Project Description Kohi - Attenuation Storage Catchment (P1-P19, P22, A1, A2 & A8)

Stability Coefficient (0.5-1.0)	0.50
Start time (hr)	0
Finish time (hr)	24
Extraction rate (m ³ /s)	0.00

Inflow Hydrograph

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.000
11.347	0.000
11.491	0.000
11.601	0.000
11.694	0.000
11.776	0.000
11.850	0.000
11.918	0.000
11.981	0.068
12.040	0.157
12.096	0.341
12.150	0.548
12.201	0.644
12.232	0.606
12.264	0.480
12.297	0.326
12.331	0.194
12.365	0.107
12.400	0.042
12.437	0.000
12.474	0.000
12.513	0.000
12.553	0.000
12.594	0.000
12.637	0.000
12.682	0.000
12.729	0.000
12.778	0.000
12.830	0.000
12.886	0.000
12.945	0.000
13.010	0.000
13.082	0.000
13.163	0.000
13.260	0.000
13.386	0.000
13.690	0.000
21.822	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m ³)
27.200	0
27.400	117
27.600	235
27.800	352
28.000	470
28.050	499
28.150	558
28.400	704
28.600	822
28.800	939
29.000	1057
29.200	1174
29.400	1301
29.500	1373
29.600	1389
29.650	1399
29.700	1410
29.750	1416
29.800	1421
29.850	1428
-1.000	

Flow Rating Curve

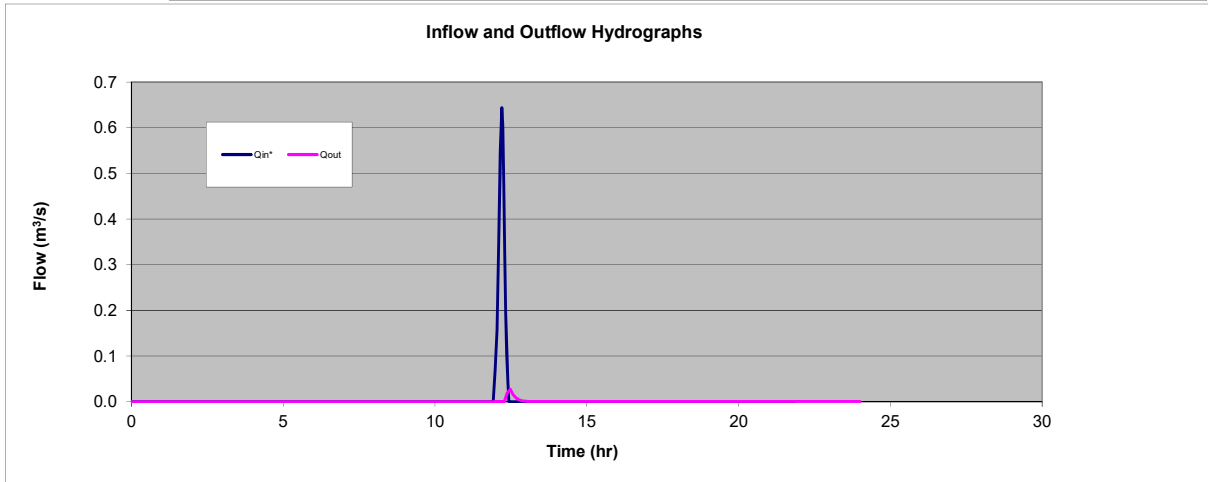
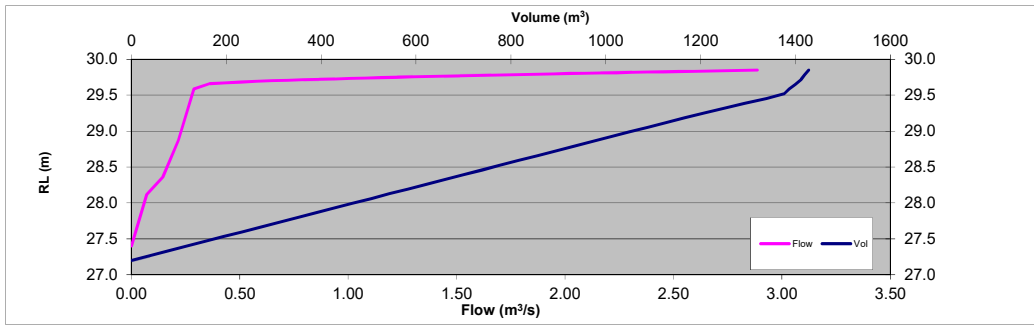
RL (m)	Flow (m ³ /s)		
	Orifice	Overflow	Total
27.200	0.000	0.000	0.000
27.400	0.000	0.000	0.000
27.600	0.000	0.000	0.000
27.800	0.000	0.000	0.000
28.000	0.000	0.000	0.000
28.050	0.000	0.000	0.000
28.150	0.102	0.000	0.102
28.400	0.152	0.000	0.152
28.600	0.183	0.000	0.183
28.800	0.209	0.000	0.209
29.000	0.232	0.000	0.232
29.200	0.253	0.000	0.253
29.400	0.272	0.000	0.272
29.500	0.281	0.000	0.281
29.600	0.290	0.000	0.290
29.650	0.294	0.000	0.294
29.700	0.299	0.322	0.621
29.750	0.303	0.911	1.214
29.800	0.307	1.673	1.980
29.850	0.311	2.576	2.887
-1.000			

Tank Outflow Weir Level	28.10
tank Outflow Pipe RL	27.79
Orifice Cd	0.670
Tank Outflow Diameter	0.311
Wall Length	16
Weir RL	29.65
Weir CD	0.600

- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:

Max. Inflow (m ³ /s)	0.644
Time at Max. Inflow (hr)	12.19
Max. Outflow (m ³ /s)	0.027
Time at Max. Outflow (hr)	12.48
Initial RL (m)	27.200
Max. RL (m)	28.076
Max. Volume (m ³)	514.2
Inflow Volume (m ³)	520.3
Volumetric error	0.00%
Extraction Volume (m ³)	0.0



Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

Project Description: Direct Overland Flow to No 17 - P21

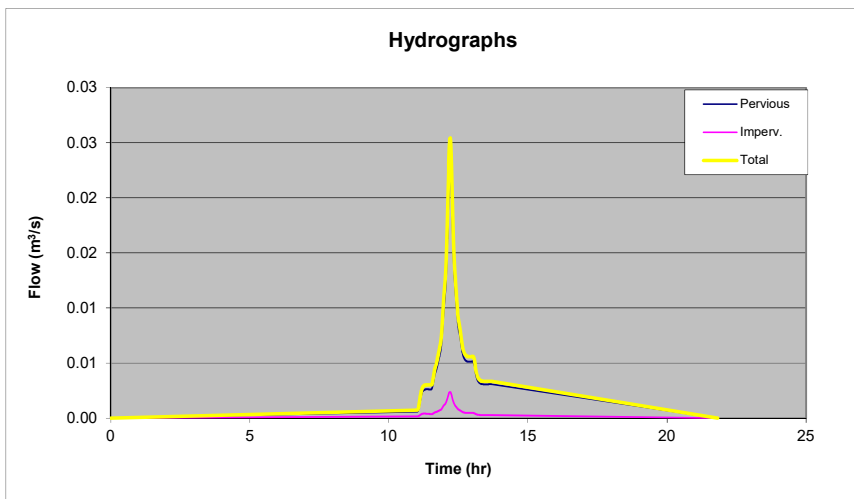
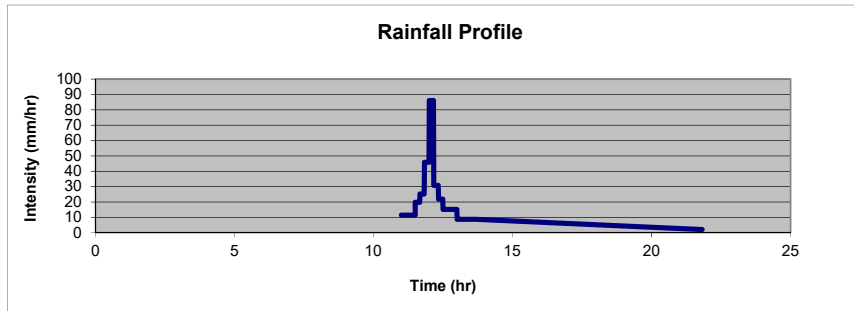
Rainfall Depth (mm): 124

Notes:

1. Inputs
2. Typical inputs for CN are in 'Typical CN Values' Sheet
3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.1713	0.0111
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	0.1713	0.0111	0.1824
Runoff (mm)	68.0	119.0	71.1
Peak Flow (m ³ /s)	0.023	0.002	0.025
Time (hr) at Peak Flow	12.21	12.20	12.21
Rainfall (mm/h) over tc	86.03	86.03	86.03
Runoff Coefficient - Peak	0.56	0.90	0.58
Runoff Coefficient - Volume	0.55	0.96	0.57



Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

Project Description: Direct Overland Flow to No 27-45 - P20

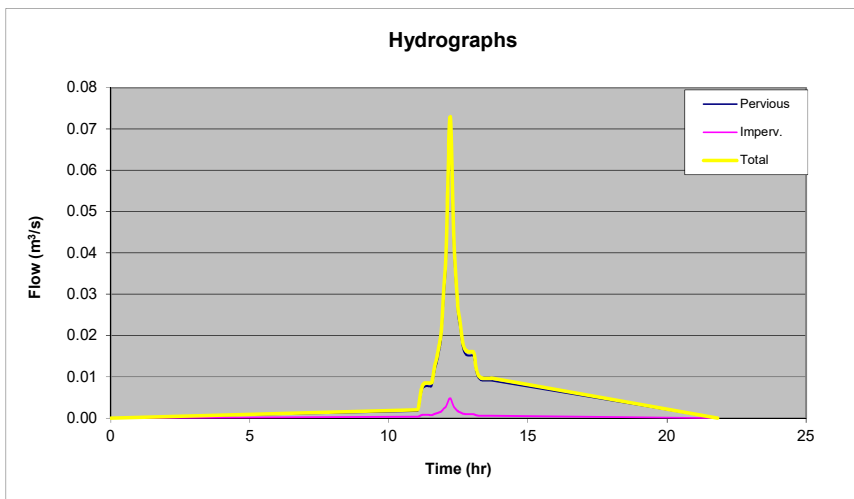
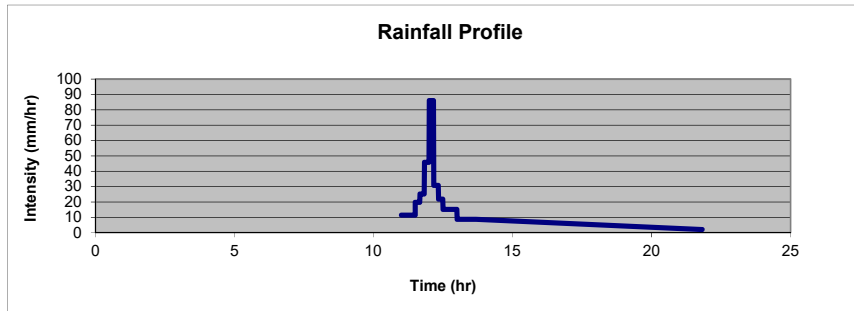
Rainfall Depth (mm): 124

Notes:

1. Inputs
2. Typical inputs for CN are in 'Typical CN Values' Sheet
3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.5067	0.0224
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	0.5067	0.0224	0.5291
Runoff (mm)	68.0	119.0	70.2
Peak Flow (m ³ /s)	0.068	0.005	0.073
Time (hr) at Peak Flow	12.21	12.20	12.21
Rainfall (mm/h) over tc	86.03	86.03	86.03
Runoff Coefficient - Peak	0.56	0.90	0.58
Runoff Coefficient - Volume	0.55	0.96	0.57



**PROPOSED Q10
CALCULATIONS WITH
CLIMATE CHANGE
ALLOWANCE**

Calculation Sheet

Job Number 3124460 Date 14.02.20
 Job Name Kohimarama Retirement Village
 Subject Proposed Stormwater Calc for a 10% AEP with Climate Change
 By Conor O'Boyle Page No of

On-Site & Upstream Catchments	Total Area	Pervious Area	Impervious Area	% Impervious
A1	15318	2737	12581	82.13
A2	5596	560	5036	90.00
A8	1833	245	1588	86.63
On-Site & Upstream Catchments	Total Area	Pervious Area	Impervious Area	% Impervious
P1	275	145	130	0.47
P2	896	333	563	0.63
P3	439	256	184	0.42
P4	1341	643	698	0.52
P5	627	269	358	0.57
P6	996	484	512	0.51
P7	762	484	278	0.36
P8	1250	1250	0	0.00
P9	1922	876	1046	0.54
P10	2983	1650	1333	0.45
P11	1124	783	341	0.30
P12	1510	0	1510	1.00
P13	1003	0	1003	1.00
P14	1707	0	1707	1.00
P15	1558	0	1558	1.00
P16	927	0	927	1.00
P17	1202	0	1202	1.00
P18	2176	362	1814	0.83
P19	1443	1209	234	0.162
P20	5291	5067	224	0.042
P21	1824	1713	111	0.061
P22	2229	891.6	1337.4	0.6
P23	3366	1346.4	2019.6	0.6

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

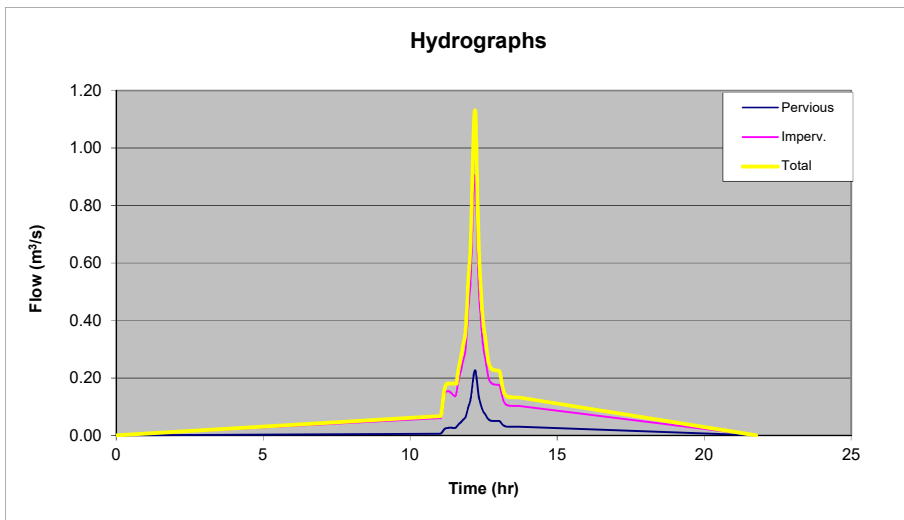
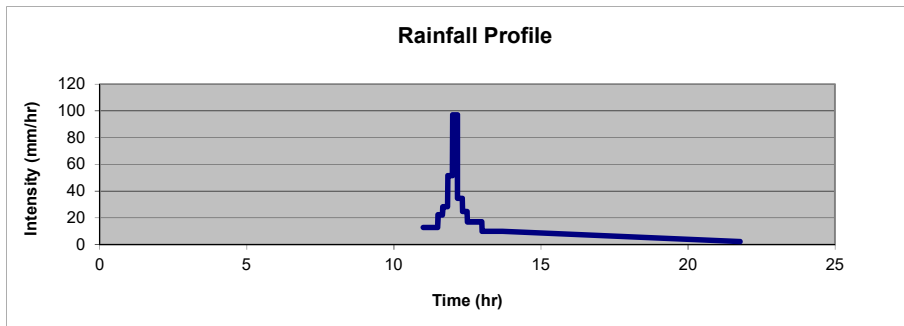
Project Description **Kohi - Attenuation Storage Catchment (P1-P19, P22, A1, A2 & A8)**

Rainfall Depth (mm) 140

Notes:
 1. Inputs
 2. Typical inputs for CN are in 'Typical CN Values' Sheet
 3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	1.4069	3.7278
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	Pervious Area	Impervious Area	Total
Area (ha)	1.40688	3.72782	5.1347
Runoff (mm)	81.3	135.0	120.3
Peak Flow (m ³ /s)	0.227	0.905	1.132
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	97.13	97.13	97.13
Runoff Coefficient - Peak	0.60	0.90	0.82
Runoff Coefficient - Volume	0.58	0.96	0.86



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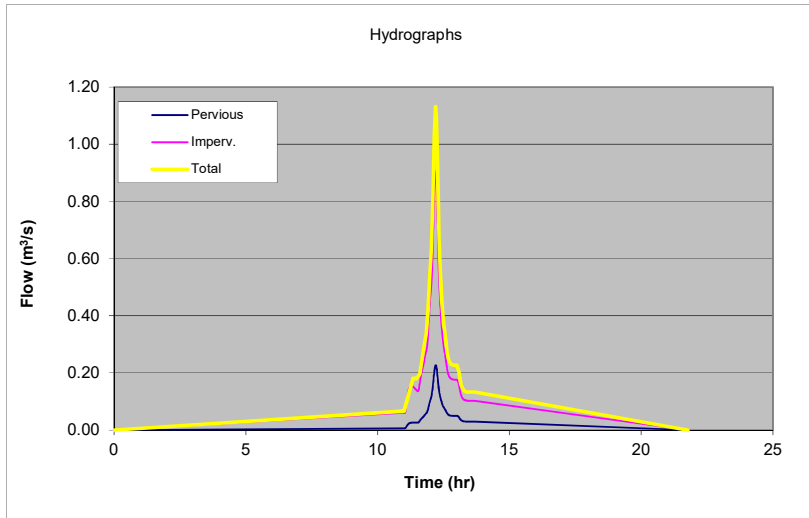
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Attenuation Storage Catchment (P1-P19, P22, A1, A2 & A8)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m³/s)
0.000	0.000
11.001	0.067
11.347	0.181
11.491	0.181
11.601	0.198
11.694	0.256
11.776	0.300
11.850	0.337
11.918	0.418
11.981	0.542
12.040	0.633
12.096	0.822
12.150	1.033
12.201	1.132
12.232	1.093
12.264	0.963
12.297	0.806
12.331	0.671
12.365	0.582
12.400	0.515
12.437	0.454
12.474	0.404
12.513	0.370
12.553	0.343
12.594	0.309
12.637	0.274
12.682	0.250
12.729	0.238
12.778	0.231
12.830	0.228
12.886	0.227
12.945	0.227
13.010	0.226
13.082	0.206
13.163	0.159
13.260	0.139
13.386	0.133
13.690	0.133
21.770	0.000
-1.000	0.000

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

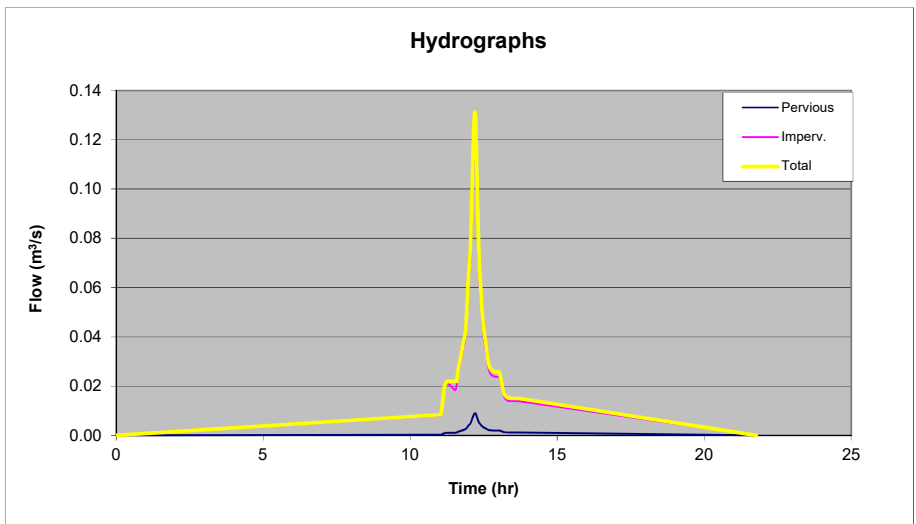
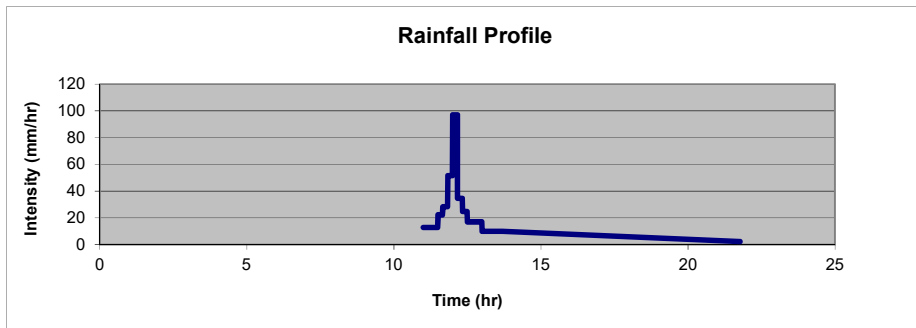
Project Description **Kohi - Attenuation Storage Catchment (A2Q10)**

Rainfall Depth (mm) 140

- Notes:**
- Inputs
 - Typical inputs for CN are in 'Typical CN Values' Sheet
 - Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.056	0.5036
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	0.056	0.5036	0.5596
Runoff (mm)	81.3	135.0	129.6
Peak Flow (m ³ /s)	0.009	0.122	0.131
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	97.13	97.13	97.13
Runoff Coefficient - Peak	0.60	0.90	0.87
Runoff Coefficient - Volume	0.58	0.96	0.93



Calculation Sheet

Beca Ltd



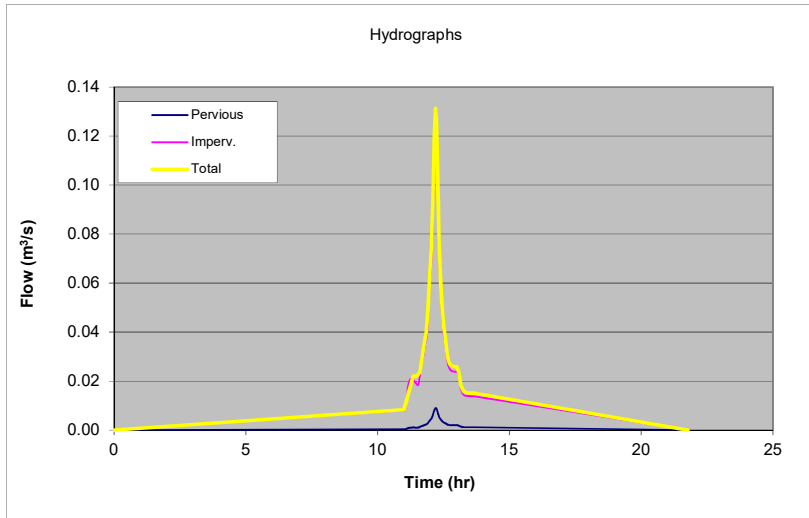
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Attenuation Storage Catchment (A2Q10)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m³/s)
0.000	0.000
11.001	0.008
11.347	0.022
11.491	0.022
11.601	0.024
11.694	0.030
11.776	0.036
11.850	0.040
11.918	0.049
11.981	0.064
12.040	0.074
12.096	0.096
12.150	0.120
12.201	0.131
12.232	0.127
12.264	0.111
12.297	0.093
12.331	0.077
12.365	0.067
12.400	0.059
12.437	0.052
12.474	0.046
12.513	0.042
12.553	0.039
12.594	0.035
12.637	0.031
12.682	0.029
12.729	0.027
12.778	0.026
12.830	0.026
12.886	0.026
12.945	0.026
13.010	0.026
13.082	0.023
13.163	0.018
13.260	0.016
13.386	0.015
13.690	0.015
21.770	0.000
-1.000	0.000

Calculation Sheet



$$Q = \frac{2}{3} C_d \sqrt{2g} b h^{3/2}$$

JOB NO: 3124460

Hydrograph Routing

Project Description Kohi - Attenuation Storage Catchment (P1-P19, P22, A1, A2 & A8)

Stability Coefficient (0.5-1.0)	1.00
Start time (hr)	0
Finish time (hr)	24
Extraction rate (m ³ /s)	0.00

Inflow Hydrograph
Depth/ Volume Relationship
Flow Rating Curve

Time (hr)	Flow (m ³ /s)	H above IL
0.000	0.000	
11.001	0.075	
11.347	0.203	
11.491	0.203	
11.601	0.222	
11.694	0.286	
11.776	0.336	
11.850	0.377	
11.918	0.467	
11.981	0.606	
12.040	0.707	
12.096	0.918	
12.150	1.154	
12.201	1.263	
12.232	1.219	
12.264	1.075	
12.297	0.899	
12.331	0.748	
12.365	0.649	
12.400	0.575	
12.437	0.506	
12.474	0.451	
12.513	0.412	
12.553	0.382	
12.594	0.345	
12.637	0.306	
12.682	0.279	
12.729	0.265	
12.778	0.258	
12.830	0.255	
12.886	0.253	
12.945	0.253	
13.010	0.252	
13.082	0.229	
13.163	0.177	
13.260	0.155	
13.386	0.148	
13.690	0.148	
21.770	0.000	
-1.000	0.000	

RL (m)	Volume (m ³)
26.050	0
26.550	1.3
27.050	2.5
27.550	3.8
28.050	5.1
28.550	6.4
29.050	7.6
29.150	7.9
29.200	8.0
29.350	8.4
29.450	8.7
29.550	8.9
29.650	9.2
29.750	9.4
29.850	9.7
29.950	9.9
30.050	10.2
30.150	10.4
30.250	10.7
30.350	10.9
-1.000	

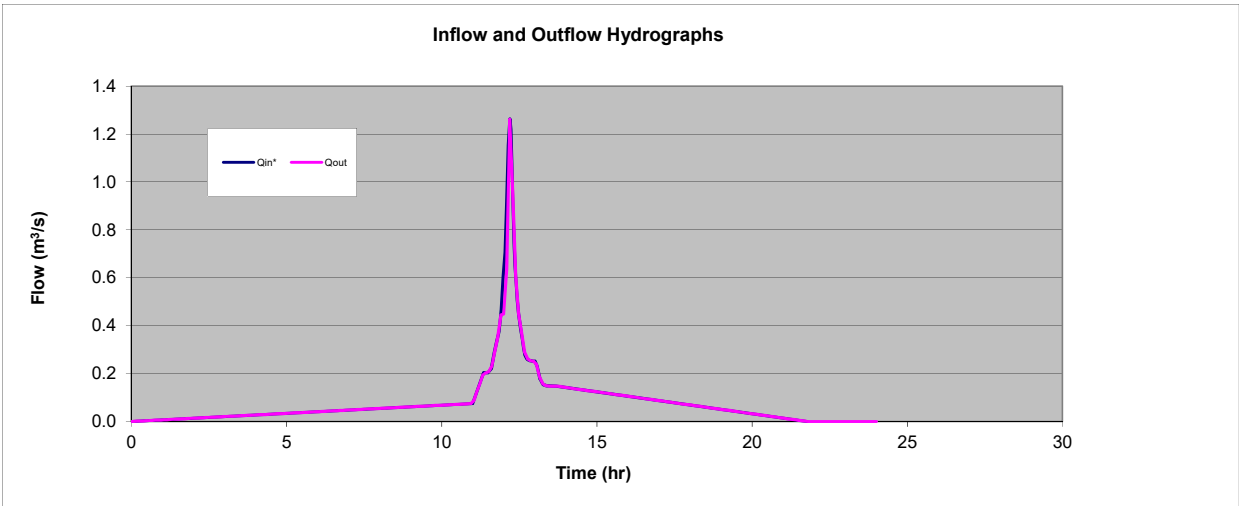
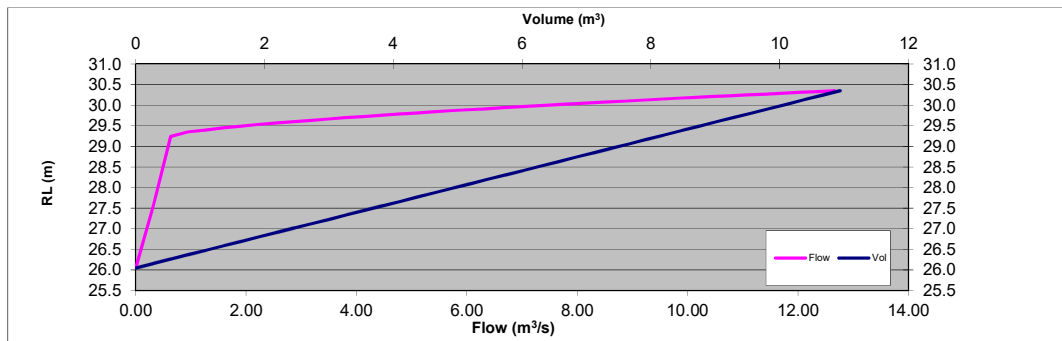
RL (m)	Flow (m ³ /s)		
	Pipe	Weir	Total
26.050	0.000	0.000	0.000
26.550	0.117	0.000	0.117
27.050	0.236	0.000	0.236
27.550	0.316	0.000	0.316
28.050	0.408	0.000	0.408
28.550	0.457	0.000	0.457
29.050	0.500	0.000	0.500
29.150	0.508	0.000	0.508
29.200	0.513	0.000	0.513
29.350	0.525	0.423	0.948
29.450	0.533	1.050	1.583
29.550	0.540	1.843	2.383
29.650	0.548	2.771	3.319
29.750	0.556	3.817	4.372
29.850	0.563	4.969	5.532
29.950	0.570	6.219	6.789
30.050	0.578	7.558	8.136
30.150	0.585	8.982	9.567
30.250	0.592	10.486	11.078
30.350	0.599	12.065	12.664
-1.000			

Weir RL (m)	29.23
Weir Length (m)	5.65
Outlet Pipe Dia (m)	0.352
Outlet Pipe Invert level (l 26.50	
Orifice Cd	0.670
Weir CD	0.6

- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:

Max. Inflow (m ³ /s)	1.263
Time at Max. Inflow (hr)	12.19
Max. Outflow (m ³ /s)	1.262
Time at Max. Outflow (hr)	12.19
Initial RL (m)	26.050
Max. RL (m)	29.399
Max. Volume (m ³)	8.5
Inflow Volume (m ³)	6990.9
Volumetric error	2.27%
Extraction Volume (m ³)	0.0



Calculation Sheet

Beca Ltd



JOB NO: 0

Hydrograph Combination

Project Description Separation of Flows in Manhole to Determine Flows into the Attenuation Tank

 Time Lag (min)

 Time Lag (min)

Hydrograph A

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.075
11.347	0.203
11.491	0.203
11.601	0.222
11.694	0.286
11.776	0.336
11.850	0.377
11.918	0.467
11.981	0.606
12.040	0.707
12.096	0.918
12.150	1.154
12.201	1.263
12.232	1.219
12.264	1.075
12.297	0.899
12.331	0.748
12.365	0.649
12.400	0.575
12.437	0.506
12.474	0.451
12.513	0.412
12.553	0.382
12.594	0.345
12.637	0.306
12.682	0.279
12.729	0.265
12.778	0.258
12.830	0.255
12.886	0.253
12.945	0.253
13.010	0.252
13.082	0.229
13.163	0.177
13.260	0.155
13.386	0.148
13.690	0.148
21.770	0.000
-1.000	0.000

Hydrograph B

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.075
11.347	0.203
11.491	0.203
11.601	0.222
11.694	0.286
11.776	0.336
11.850	0.377
11.918	0.462
11.981	0.462
12.040	0.462
12.096	0.462
12.150	0.462
12.201	0.462
12.232	0.462
12.264	0.462
12.297	0.462
12.331	0.462
12.365	0.462
12.400	0.462
12.437	0.462
12.474	0.451
12.513	0.412
12.553	0.382
12.594	0.345
12.637	0.306
12.682	0.279
12.729	0.265
12.778	0.258
12.830	0.255
12.886	0.253
12.945	0.253
13.010	0.252
13.082	0.229
13.163	0.177
13.260	0.155
13.386	0.148
13.690	0.148
21.770	0.000
-1.000	0.000

Hydrograph A+B+C

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.000
11.347	0.000
11.491	0.000
11.601	0.000
11.694	0.000
11.776	0.000
11.850	0.000
11.918	-0.006
11.981	-0.145
12.040	-0.245
12.096	-0.456
12.150	-0.692
12.201	-0.801
12.232	-0.758
12.264	-0.613
12.297	-0.438
12.331	-0.287
12.365	-0.187
12.400	-0.113
12.437	-0.045
12.474	0.000
12.513	0.000
12.553	0.000
12.594	0.000
12.637	0.000
12.682	0.000
12.729	0.000
12.778	0.000
12.830	0.000
12.886	0.000
12.945	0.000
13.010	0.000
13.082	0.000
13.163	0.000
13.260	0.000
13.386	0.000
13.690	0.000
21.770	0.000
-1.000	0.000

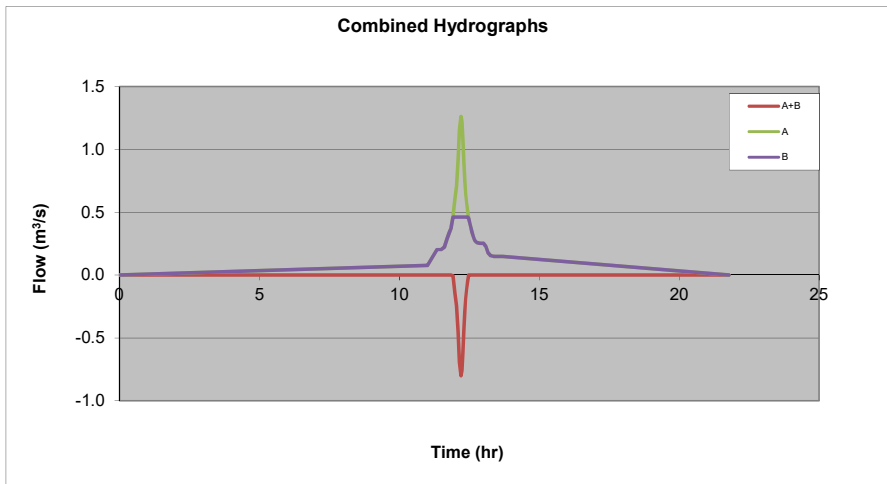
Notes:

- Input data should be in ascending order with time in the boxes provided. The maximum no. of values is 40. If a lesser no. of values is needed then terminate as a -1 for the x value.
- The Time Lag is relative to the hydrograph times.
- Volumetric error is generally due to the interpolation and reassignment of time values.

Results:

Max. Flow (m ³ /s) -A	1.263
Time (hr) at Max Flow	12.20
Max. Flow (m ³ /s) -B	0.462
Time (hr) at Max Flow	11.92
Max. Flow (m ³ /s)	1.724
Time (hr) at Max Flow	12.20
Volumetric Error	0.0%

0.000



Calculation Sheet

Hydrograph Routing

Project Description Kohi - Attenuation Storage Catchment (P1-P19, P22, A1, A2 & A8)

Stability Coefficient (0.5-1.0)	0.50
Start time (hr)	0
Finish time (hr)	24
Extraction rate (m ³ /s)	0.00

Inflow Hydrograph

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.000
11.347	0.000
11.491	0.000
11.601	0.000
11.694	0.000
11.776	0.000
11.850	0.000
11.918	0.006
11.981	0.145
12.040	0.245
12.096	0.456
12.150	0.692
12.201	0.801
12.232	0.758
12.264	0.613
12.297	0.438
12.331	0.287
12.365	0.187
12.400	0.113
12.437	0.045
12.474	0.000
12.513	0.000
12.553	0.000
12.594	0.000
12.637	0.000
12.682	0.000
12.729	0.000
12.778	0.000
12.830	0.000
12.886	0.000
12.945	0.000
13.010	0.000
13.082	0.000
13.163	0.000
13.260	0.000
13.386	0.000
13.690	0.000
21.770	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m ³)
27.200	0
27.400	117
27.600	235
27.800	352
28.000	470
28.050	499
28.150	558
28.400	704
28.600	822
28.800	939
29.000	1057
29.200	1174
29.400	1301
29.500	1373
29.600	1389
29.650	1399
29.700	1410
29.750	1416
29.800	1421
29.850	1428
-1.000	

Flow Rating Curve

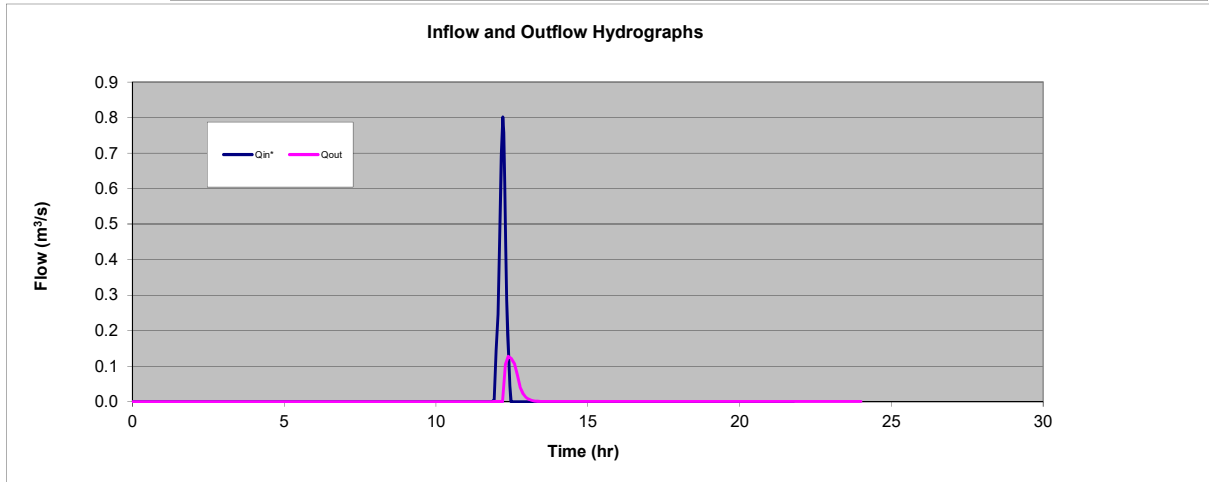
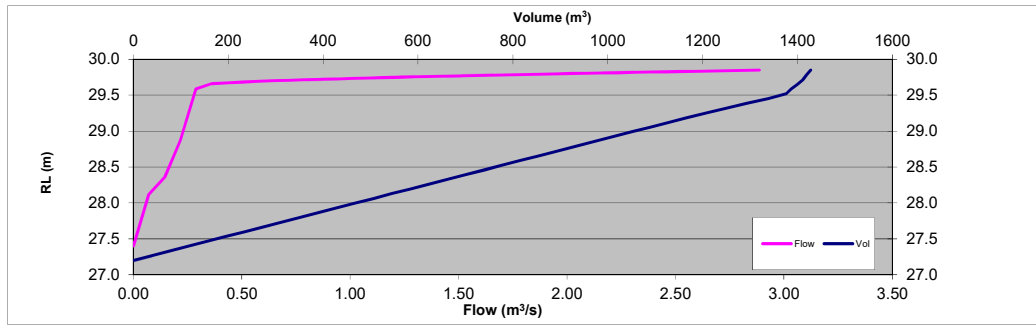
RL (m)	Flow (m ³ /s)		
	Orifice	Overflow	Total
27.200	0.000	0.000	0.000
27.400	0.000	0.000	0.000
27.600	0.000	0.000	0.000
27.800	0.000	0.000	0.000
28.000	0.000	0.000	0.000
28.050	0.000	0.000	0.000
28.150	0.102	0.000	0.102
28.400	0.152	0.000	0.152
28.600	0.183	0.000	0.183
28.800	0.209	0.000	0.209
29.000	0.232	0.000	0.232
29.200	0.253	0.000	0.253
29.400	0.272	0.000	0.272
29.500	0.281	0.000	0.281
29.600	0.290	0.000	0.290
29.650	0.294	0.000	0.294
29.700	0.299	0.322	0.621
29.750	0.303	0.911	1.214
29.800	0.307	1.673	1.980
29.850	0.311	2.576	2.887
-1.000			

Tank Outflow Weir Level	28.10
tank Outflow Pipe RL	27.79
Orifice Cd	0.670
Tank Outflow Diameter	0.311
Wall Length	16
Weir RL	29.65
Weir CD	0.600

- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:

Max. Inflow (m ³ /s)	0.801
Time at Max. Inflow (hr)	12.19
Max. Outflow (m ³ /s)	0.128
Time at Max. Outflow (hr)	12.38
Initial RL (m)	27.200
Max. RL (m)	28.277
Max. Volume (m ³)	632.4
Inflow Volume (m ³)	713.0
Volumetric error	0.00%
Extraction Volume (m ³)	0.0



Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

Project Description: Direct Overland Flow to No 17 - P21

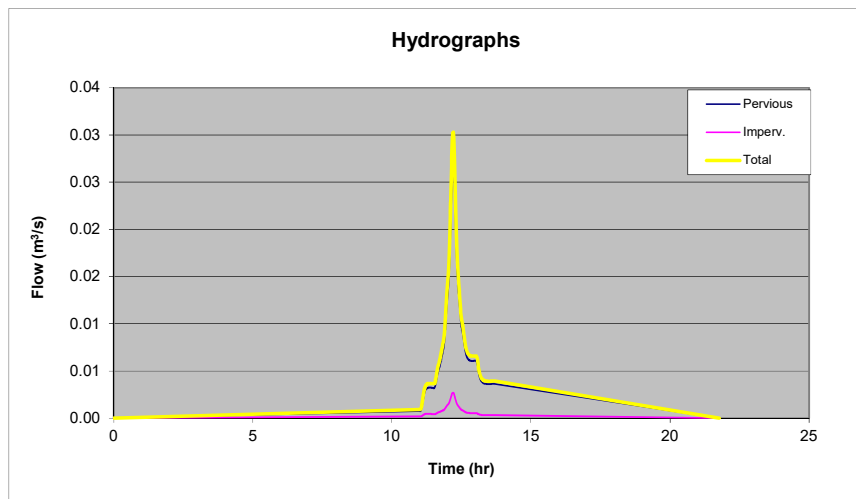
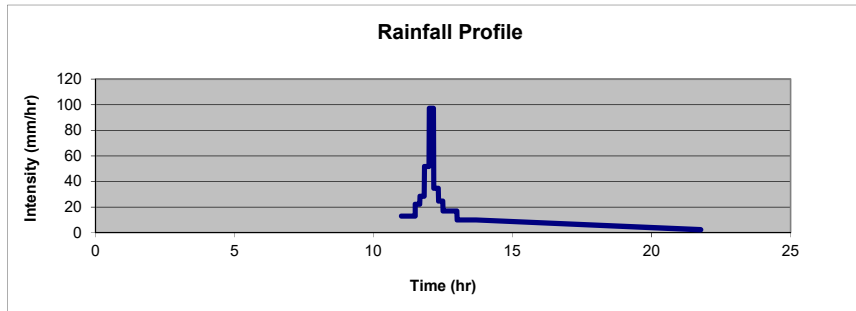
Rainfall Depth (mm): 140

Notes:

1. Inputs
2. Typical inputs for CN are in 'Typical CN Values' Sheet
3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.1713	0.0111
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	0.1713	0.0111	0.1824
Runoff (mm)	81.3	135.0	84.5
Peak Flow (m ³ /s)	0.028	0.003	0.030
Time (hr) at Peak Flow	12.21	12.20	12.21
Rainfall (mm/h) over tc	97.13	97.13	97.13
Runoff Coefficient - Peak	0.60	0.90	0.62
Runoff Coefficient - Volume	0.58	0.96	0.60



Hydrograph Combination

Project Description Subdivision Example

Time Lag (min) 0

Time Lag (min) 0

Direct Overland Flow

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.001
11.351	0.004
11.495	0.004
11.607	0.005
11.700	0.006
11.783	0.007
11.857	0.008
11.926	0.011
11.990	0.014
12.050	0.016
12.107	0.022
12.161	0.028
12.212	0.030
12.243	0.029
12.275	0.025
12.308	0.021
12.341	0.018
12.375	0.016
12.410	0.014
12.446	0.012
12.483	0.011
12.522	0.010
12.561	0.010
12.602	0.009
12.645	0.008
12.689	0.007
12.736	0.007
12.785	0.007
12.837	0.007
12.892	0.007
12.951	0.007
13.015	0.007
13.087	0.006
13.167	0.005
13.263	0.004
13.388	0.004
13.690	0.004
21.770	0.000
-1.000	0.000

Tank Overflow

Time (hr)	Flow (m ³ /s)
0.000	0.000
3.575	0.000
5.056	0.000
6.192	0.000
7.150	0.000
7.994	0.000
8.757	0.000
9.458	0.000
10.111	0.000
10.725	0.000
11.305	0.000
11.857	0.000
12.384	0.128
12.610	0.097
12.840	0.027
13.075	0.006
13.315	0.001
13.561	0.000
13.812	0.000
14.070	0.000
14.335	0.000
14.607	0.000
14.888	0.000
15.177	0.000
15.476	0.000
15.786	0.000
16.108	0.000
16.444	0.000
16.796	0.000
17.166	0.000
17.557	0.000
17.973	0.000
18.420	0.000
18.906	0.000
19.444	0.000
20.054	0.000
20.778	0.000
21.722	0.000
24.000	0.000
-1.000	0.000

Hydrograph A+B+C

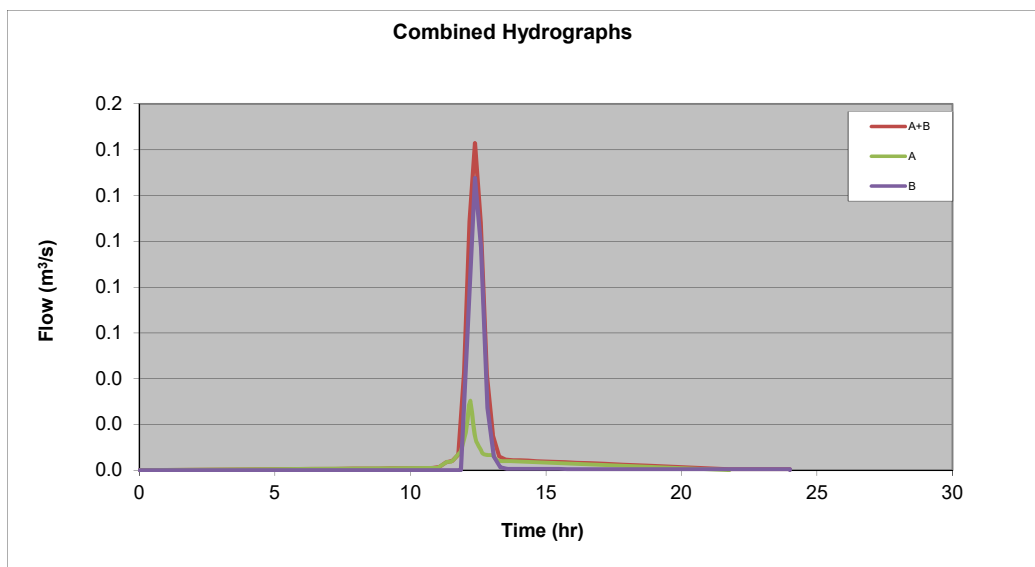
Time (hr)	Flow (m ³ /s)
0.001	0.000
3.575	0.000
6.347	0.001
7.233	0.001
7.877	0.001
8.402	0.001
8.852	0.001
9.251	0.001
9.612	0.001
9.944	0.001
10.251	0.001
10.538	0.001
10.809	0.001
11.065	0.001
11.309	0.003
11.542	0.004
11.764	0.007
11.979	0.043
12.185	0.109
12.384	0.143
12.595	0.108
12.814	0.042
13.041	0.015
13.277	0.006
13.524	0.005
13.782	0.004
14.054	0.004
14.340	0.004
14.645	0.004
14.971	0.004
15.322	0.004
15.705	0.003
16.128	0.003
16.606	0.003
17.162	0.003
17.844	0.002
18.783	0.002
21.722	0.000
24.000	0.000
-1.000	0.000

Notes:

- Input data should be in ascending order with time in the boxes provided. The maximum no. of values is 40. If a lesser no. of values is needed then terminate as a -1 for the x value.
- The Time Lag is relative to the hydrograph times.
- Volumetric error is generally due to the interpolation and reassignment of time values.

Results:

Max. Flow (m ³ /s) -A	0.030
Time (hr) at Max Flow	12.21
Max. Flow (m ³ /s) -B	0.128
Time (hr) at Max Flow	12.38
Max. Flow (m ³ /s)	0.143
Time (hr) at Max Flow	12.38
Volumetric Error	0.1%



Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

Project Description: Direct Overland Flow to No 27-45 - P20

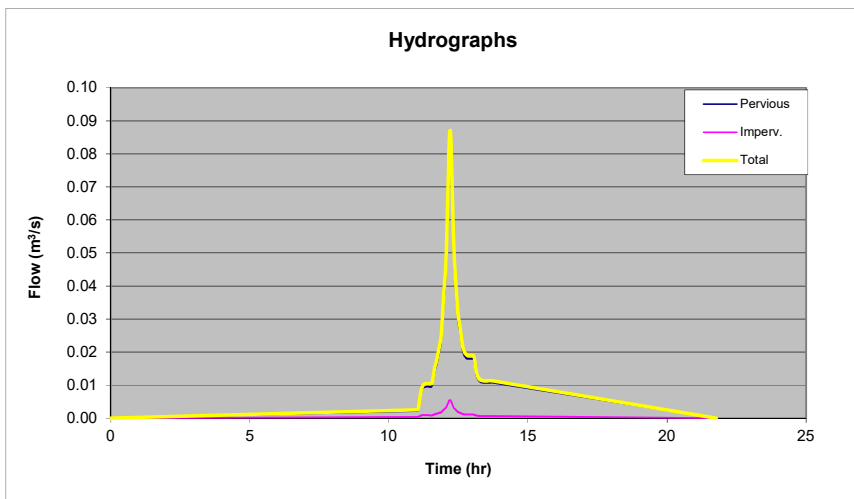
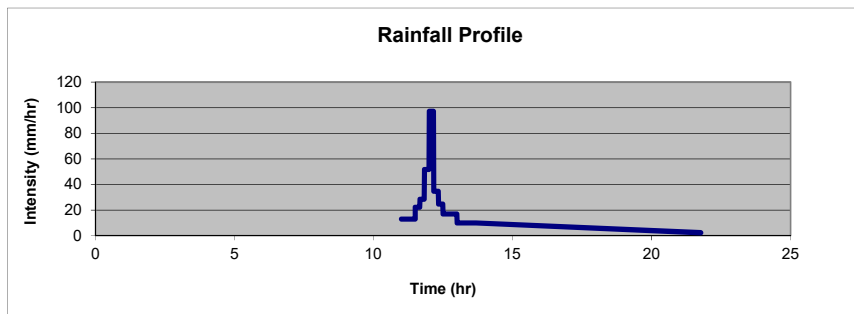
Rainfall Depth (mm): 140

Notes:

1. Inputs
2. Typical inputs for CN are in 'Typical CN Values' Sheet
3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.5067	0.0224
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	0.5067	0.0224	0.5291
Runoff (mm)	81.3	135.0	83.5
Peak Flow (m ³ /s)	0.082	0.005	0.087
Time (hr) at Peak Flow	12.21	12.20	12.21
Rainfall (mm/h) over tc	97.13	97.13	97.13
Runoff Coefficient - Peak	0.60	0.90	0.61
Runoff Coefficient - Volume	0.58	0.96	0.60



**PROPOSED Q100
CALCULATIONS WITHOUT
CLIMATE CHANGE
ALLOWANCE**

Calculation Sheet

Job Number 3124460 Date 14.02.20
 Job Name Kohimarama Retirement Village
 Subject Proposed Stormwater Calc for a 100% AEP with No Climate Change
 By Conor O'Boyle Page No of

On-Site & Upstream Catchments	Total Area	Pervious Area	Impervious Area	% Impervious
A1	15318	2737	12581	82.13
A2	5596	560	5036	90.00
A8	1833	245	1588	86.63
On-Site & Upstream Catchments	Total Area	Pervious Area	Impervious Area	% Impervious
P1	275	145	130	0.47
P2	896	333	563	0.63
P3	439	256	184	0.42
P4	1341	643	698	0.52
P5	627	269	358	0.57
P6	996	484	512	0.51
P7	762	484	278	0.36
P8	1250	1250	0	0.00
P9	1922	876	1046	0.54
P10	2983	1650	1333	0.45
P11	1124	783	341	0.30
P12	1510	0	1510	1.00
P13	1003	0	1003	1.00
P14	1707	0	1707	1.00
P15	1558	0	1558	1.00
P16	927	0	927	1.00
P17	1202	0	1202	1.00
P18	2176	362	1814	0.83
P19	1443	1209	234	0.162
P20	5291	5067	224	0.042
P21	1824	1713	111	0.061
P22	2229	891.6	1337.4	0.6
P23	3366	1346.4	2019.6	0.6

Calculation Sheet

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

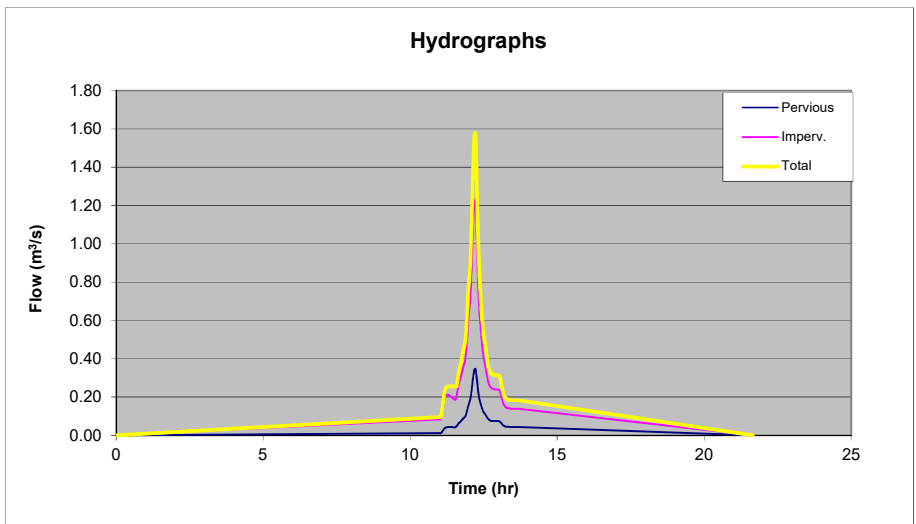
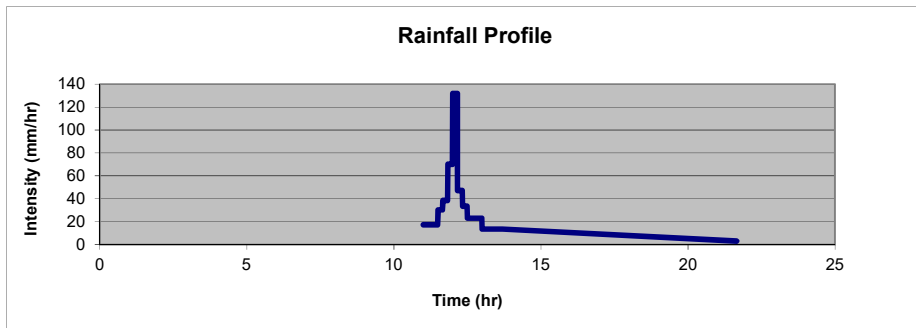
Project Description **Kohi - Attenuation Storage Catchment (P1-P19, P22, A1, A2 & A8)**

Rainfall Depth (mm) 190

Notes:
 1. Inputs
 2. Typical inputs for CN are in 'Typical CN Values' Sheet
 3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	1.4069	3.7278
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	Pervious Area	Impervious Area	Total
Area (ha)	1.40688	3.72782	5.1347
Runoff (mm)	124.8	185.0	168.5
Peak Flow (m ³ /s)	0.348	1.231	1.579
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	131.81	131.81	131.81
Runoff Coefficient - Peak	0.68	0.90	0.84
Runoff Coefficient - Volume	0.66	0.97	0.89



Calculation Sheet

Beca Ltd



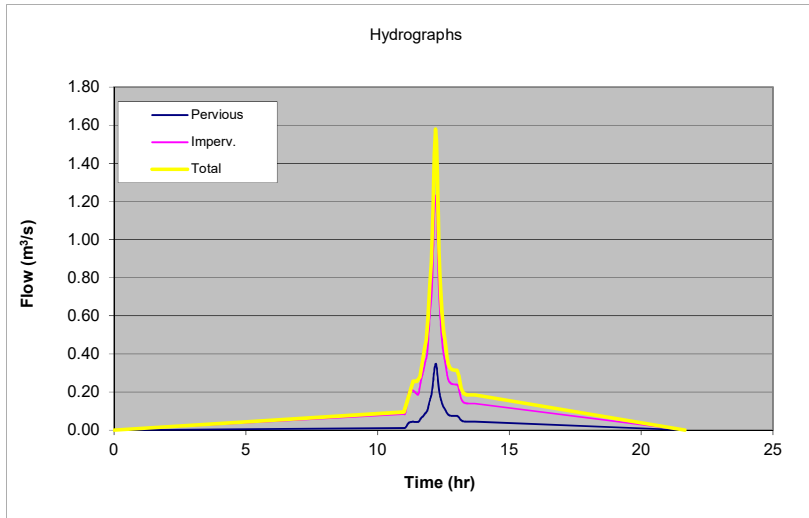
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Attenuation Storage Catchment (P1-P19, P22, A1, A2 & A8)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.096
11.347	0.256
11.491	0.256
11.601	0.278
11.694	0.359
11.776	0.422
11.850	0.473
11.918	0.586
11.981	0.760
12.040	0.886
12.096	1.149
12.150	1.444
12.201	1.579
12.232	1.524
12.264	1.343
12.297	1.123
12.331	0.935
12.365	0.810
12.400	0.717
12.437	0.632
12.474	0.562
12.513	0.514
12.553	0.477
12.594	0.430
12.637	0.381
12.682	0.347
12.729	0.330
12.778	0.321
12.830	0.317
12.886	0.315
12.945	0.315
13.010	0.314
13.082	0.286
13.163	0.221
13.260	0.192
13.386	0.185
13.690	0.184
21.657	0.000
-1.000	0.000

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

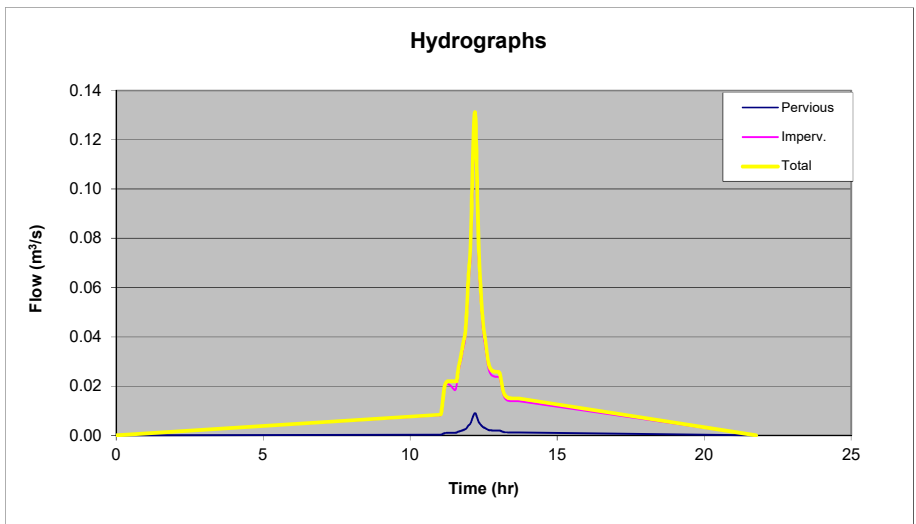
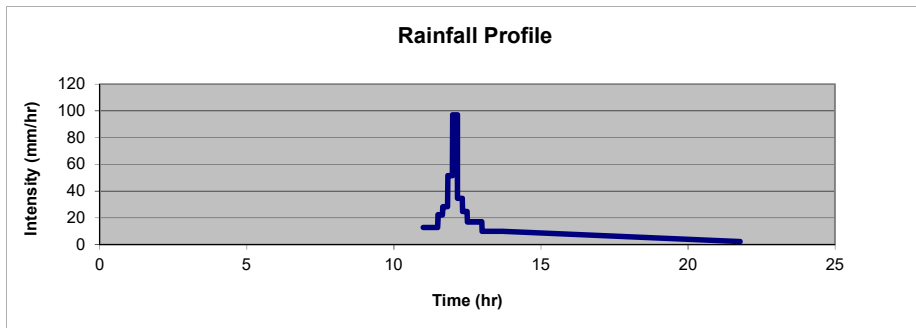
Project Description **Kohi - Attenuation Storage Catchment (A2Q10)**

Rainfall Depth (mm) 140

- Notes:**
- Inputs
 - Typical inputs for CN are in 'Typical CN Values' Sheet
 - Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.056	0.5036
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	0.056	0.5036	0.5596
Runoff (mm)	81.3	135.0	129.6
Peak Flow (m ³ /s)	0.009	0.122	0.131
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	97.13	97.13	97.13
Runoff Coefficient - Peak	0.60	0.90	0.87
Runoff Coefficient - Volume	0.58	0.96	0.93



Calculation Sheet

Beca Ltd



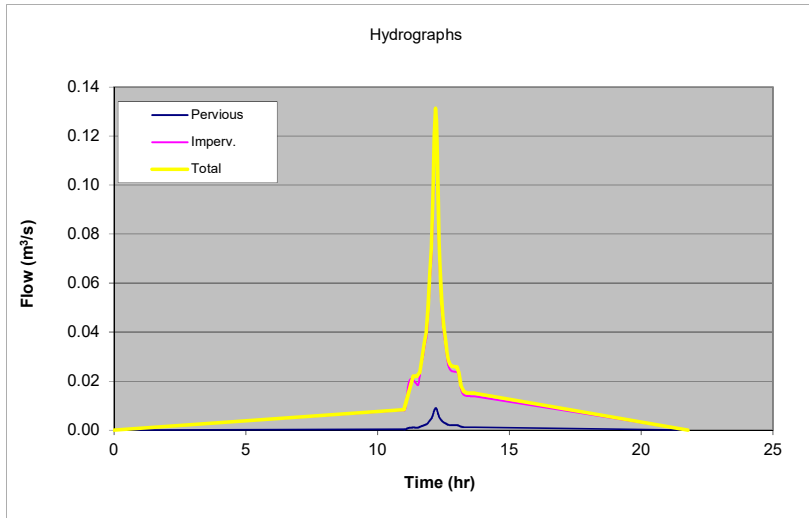
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Attenuation Storage Catchment (A2Q10)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.008
11.347	0.022
11.491	0.022
11.601	0.024
11.694	0.030
11.776	0.036
11.850	0.040
11.918	0.049
11.981	0.064
12.040	0.074
12.096	0.096
12.150	0.120
12.201	0.131
12.232	0.127
12.264	0.111
12.297	0.093
12.331	0.077
12.365	0.067
12.400	0.059
12.437	0.052
12.474	0.046
12.513	0.042
12.553	0.039
12.594	0.035
12.637	0.031
12.682	0.029
12.729	0.027
12.778	0.026
12.830	0.026
12.886	0.026
12.945	0.026
13.010	0.026
13.082	0.023
13.163	0.018
13.260	0.016
13.386	0.015
13.690	0.015
21.770	0.000
-1.000	0.000

Calculation Sheet



$$Q = \frac{2}{3} C_d \sqrt{2g} b h^{3/2}$$

JOB NO: 3124460

Hydrograph Routing

Project Description Kohi - Attenuation Storage Catchment (P1-P19, P22, A1, A2 & A8)

Stability Coefficient (0.5-1.0)	1.00
Start time (hr)	0
Finish time (hr)	24
Extraction rate (m ³ /s)	0.00

Inflow Hydrograph

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.104
11.347	0.278
11.491	0.278
11.601	0.302
11.694	0.389
11.776	0.457
11.850	0.513
11.918	0.635
11.981	0.824
12.040	0.960
12.096	1.245
12.150	1.564
12.201	1.710
12.232	1.651
12.264	1.455
12.297	1.216
12.331	1.012
12.365	0.877
12.400	0.777
12.437	0.684
12.474	0.609
12.513	0.556
12.553	0.516
12.594	0.465
12.637	0.413
12.682	0.376
12.729	0.357
12.778	0.348
12.830	0.343
12.886	0.341
12.945	0.340
13.010	0.340
13.082	0.309
13.163	0.239
13.260	0.208
13.386	0.200
13.690	0.199
21.657	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m ³)
26.050	0
26.550	1.3
27.050	2.5
27.550	3.8
28.050	5.1
28.550	6.4
29.050	7.6
29.150	7.9
29.200	8.0
29.350	8.4
29.450	8.7
29.550	8.9
29.650	9.2
29.750	9.4
29.850	9.7
29.950	9.9
30.050	10.2
30.150	10.4
30.250	10.7
30.350	10.9
-1.000	

Flow Rating Curve

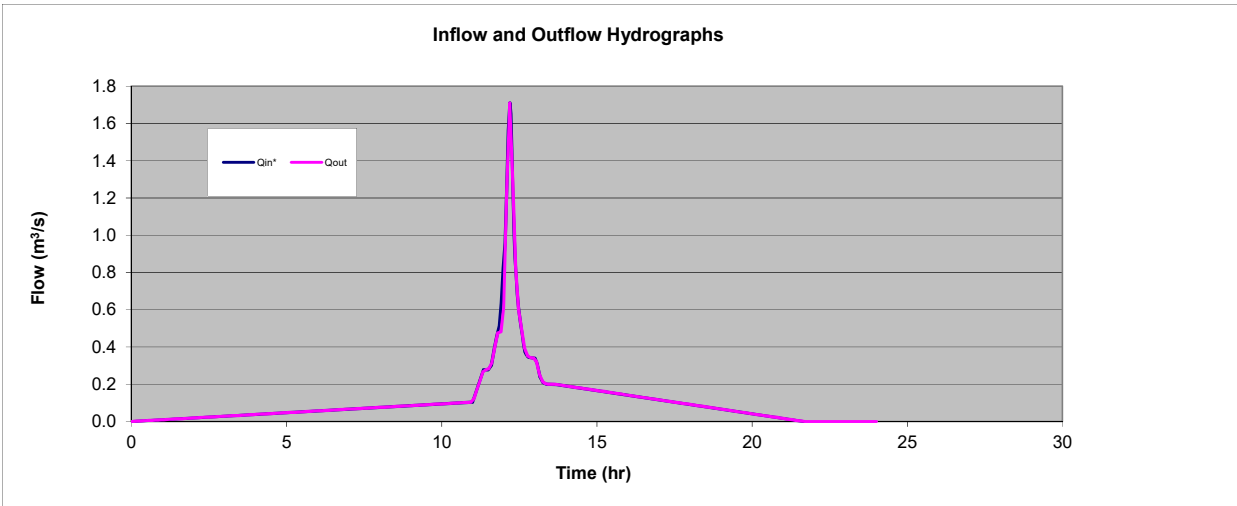
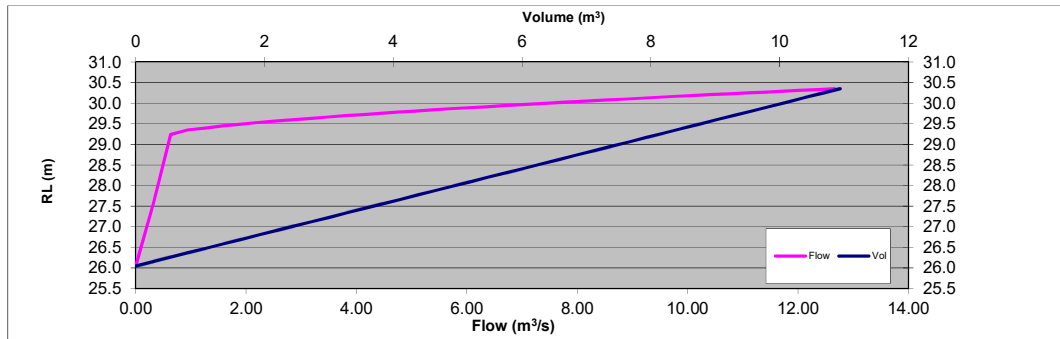
RL (m)	Flow (m ³ /s)		
	Pipe	Weir	Total
26.050	0.000	0.000	0.000
26.550	0.117	0.000	0.117
27.050	0.236	0.000	0.236
27.550	0.316	0.000	0.316
28.050	0.408	0.000	0.408
28.550	0.457	0.000	0.457
29.050	0.500	0.000	0.500
29.150	0.508	0.000	0.508
29.200	0.513	0.000	0.513
29.350	0.525	0.423	0.948
29.450	0.533	1.050	1.583
29.550	0.540	1.843	2.383
29.650	0.548	2.771	3.319
29.750	0.556	3.817	4.372
29.850	0.563	4.969	5.532
29.950	0.570	6.219	6.789
30.050	0.578	7.558	8.136
30.150	0.585	8.982	9.567
30.250	0.592	10.486	11.078
30.350	0.599	12.065	12.664
-1.000			

Weir RL (m)	29.23
Weir Length (m)	5.65
Outlet Pipe Dia (m)	0.352
Outlet Pipe Invert level (l)	26.50
Orifice Cd	0.670
Weir CD	0.6

- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:

Max. Inflow (m ³ /s)	1.710
Time at Max. Inflow (hr)	12.19
Max. Outflow (m ³ /s)	1.710
Time at Max. Outflow (hr)	12.19
Initial RL (m)	26.050
Max. RL (m)	29.466
Max. Volume (m ³)	8.7
Inflow Volume (m ³)	9463.9
Volumetric error	1.40%
Extraction Volume (m ³)	0.0



Beca Infrastructure Ltd



JOB NO:

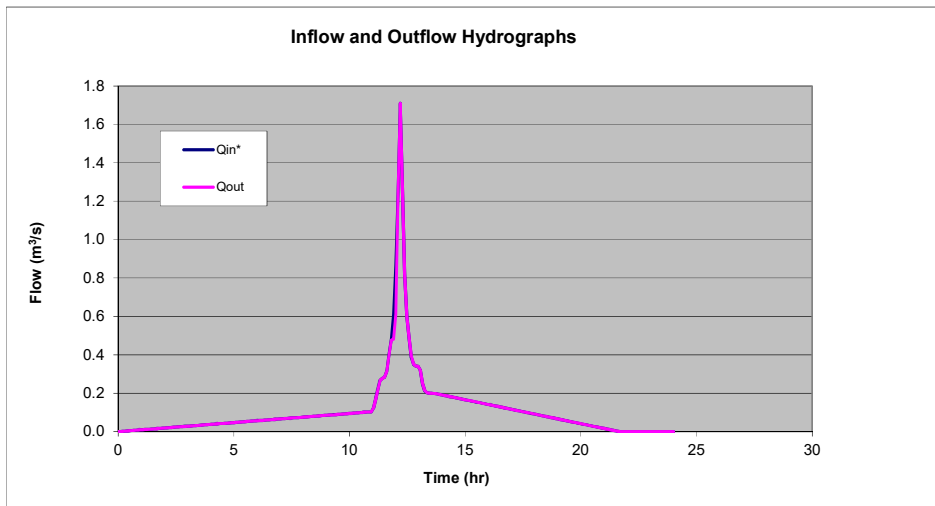
Hydrograph Routing

Project Description

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 7.05%

Time (hr)	Flow (m ³ /s)
0.000	0.000
3.520	0.033
4.977	0.047
6.096	0.058
7.039	0.067
7.870	0.074
8.621	0.082
9.312	0.088
9.955	0.094
10.559	0.100
11.130	0.167
11.673	0.366
12.192	1.710
12.421	0.738
12.655	0.408
12.894	0.342
13.138	0.262
13.388	0.202
13.644	0.199
13.906	0.194
14.175	0.187
14.452	0.180
14.737	0.173
15.031	0.166
15.335	0.158
15.650	0.150
15.978	0.142
16.320	0.133
16.677	0.124
17.053	0.115
17.450	0.105
17.873	0.095
18.328	0.083
18.822	0.071
19.369	0.057
19.989	0.042
20.725	0.023
21.684	0.000
24.000	0.000
-1.000	0.000



Calculation Sheet

Beca Ltd



JOB NO: 0

Hydrograph Combination

Project Description Separation of Flows in Manhole to Determine Flows into the Attenuation Tank

 Time Lag (min)

 Time Lag (min)

Hydrograph A

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.104
11.347	0.278
11.491	0.278
11.601	0.302
11.694	0.389
11.776	0.457
11.850	0.513
11.918	0.635
11.981	0.824
12.040	0.960
12.096	1.245
12.150	1.564
12.201	1.710
12.232	1.651
12.264	1.455
12.297	1.216
12.331	1.012
12.365	0.877
12.400	0.777
12.437	0.684
12.474	0.609
12.513	0.556
12.553	0.516
12.594	0.465
12.637	0.413
12.682	0.376
12.729	0.357
12.778	0.348
12.830	0.343
12.886	0.341
12.945	0.340
13.010	0.340
13.082	0.309
13.163	0.239
13.260	0.208
13.386	0.200
13.690	0.199
21.657	0.000
-1.000	0.000

Hydrograph B

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.104
11.347	0.278
11.491	0.278
11.601	0.302
11.694	0.389
11.776	0.457
11.850	0.462
11.918	0.462
11.981	0.462
12.040	0.462
12.096	0.462
12.150	0.462
12.201	0.462
12.232	0.462
12.264	0.462
12.297	0.462
12.331	0.462
12.365	0.462
12.400	0.462
12.437	0.462
12.474	0.462
12.513	0.462
12.553	0.462
12.594	0.462
12.637	0.413
12.682	0.376
12.729	0.357
12.778	0.348
12.830	0.343
12.886	0.341
12.945	0.340
13.010	0.340
13.082	0.309
13.163	0.239
13.260	0.208
13.386	0.200
13.690	0.199
21.657	0.000
-1.000	0.000

Hydrograph A+B+C

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.000
11.347	0.000
11.491	0.000
11.601	0.000
11.694	0.000
11.776	0.000
11.850	-0.052
11.918	-0.174
11.981	-0.362
12.040	-0.498
12.096	-0.783
12.150	-1.102
12.201	-1.249
12.232	-1.189
12.264	-0.993
12.297	-0.755
12.331	-0.551
12.365	-0.416
12.400	-0.315
12.437	-0.223
12.474	-0.147
12.513	-0.095
12.553	-0.055
12.594	-0.004
12.637	0.000
12.682	0.000
12.729	0.000
12.778	0.000
12.830	0.000
12.886	0.000
12.945	0.000
13.010	0.000
13.082	0.000
13.163	0.000
13.260	0.000
13.386	0.000
13.690	0.000
21.657	0.000
-1.000	0.000

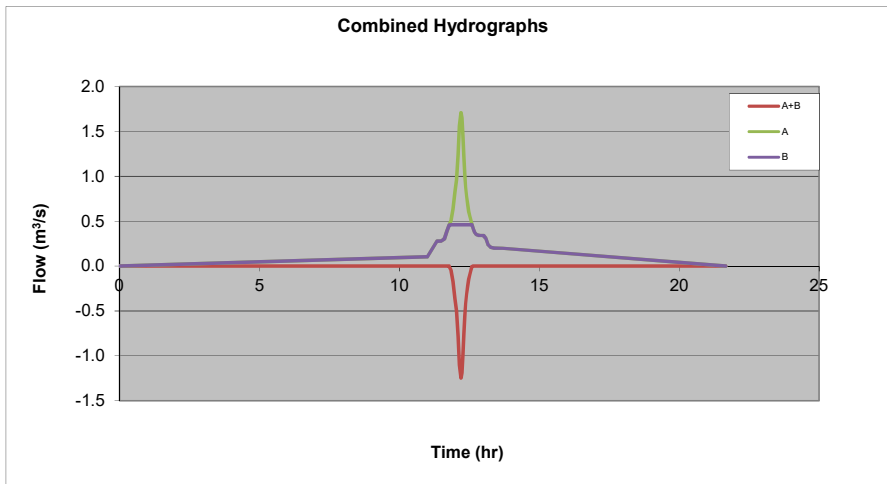
Notes:

- Input data should be in ascending order with time in the boxes provided. The maximum no. of values is 40. If a lesser no. of values is needed then terminate as a -1 for the x value.
- The Time Lag is relative to the hydrograph times.
- Volumetric error is generally due to the interpolation and reassignment of time values.

Results:

Max. Flow (m ³ /s) -A	1.710
Time (hr) at Max Flow	12.20
Max. Flow (m ³ /s) -B	0.462
Time (hr) at Max Flow	11.85
Max. Flow (m ³ /s)	2.172
Time (hr) at Max Flow	12.20
Volumetric Error	0.0%

0.000



Calculation Sheet

Hydrograph Routing

Project Description Kohi - Attenuation Storage Catchment (P1-P19, P22, A1, A2 & A8)

Stability Coefficient (0.5-1.0)	0.50
Start time (hr)	0
Finish time (hr)	24
Extraction rate (m ³ /s)	0.00

Inflow Hydrograph

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.000
11.347	0.000
11.491	0.000
11.601	0.000
11.694	0.000
11.776	0.000
11.850	0.052
11.918	0.174
11.981	0.362
12.040	0.498
12.096	0.783
12.150	1.102
12.201	1.249
12.232	1.189
12.264	0.993
12.297	0.755
12.331	0.551
12.365	0.416
12.400	0.315
12.437	0.223
12.474	0.147
12.513	0.095
12.553	0.055
12.594	0.004
12.637	0.000
12.682	0.000
12.729	0.000
12.778	0.000
12.830	0.000
12.886	0.000
12.945	0.000
13.010	0.000
13.082	0.000
13.163	0.000
13.260	0.000
13.386	0.000
13.690	0.000
21.657	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m ³)
27.200	0
27.400	117
27.600	235
27.800	352
28.000	470
28.050	499
28.150	558
28.400	704
28.600	822
28.800	939
29.000	1057
29.200	1174
29.400	1301
29.500	1373
29.600	1389
29.650	1399
29.700	1410
29.750	1416
29.800	1421
29.850	1428
-1.000	

Flow Rating Curve

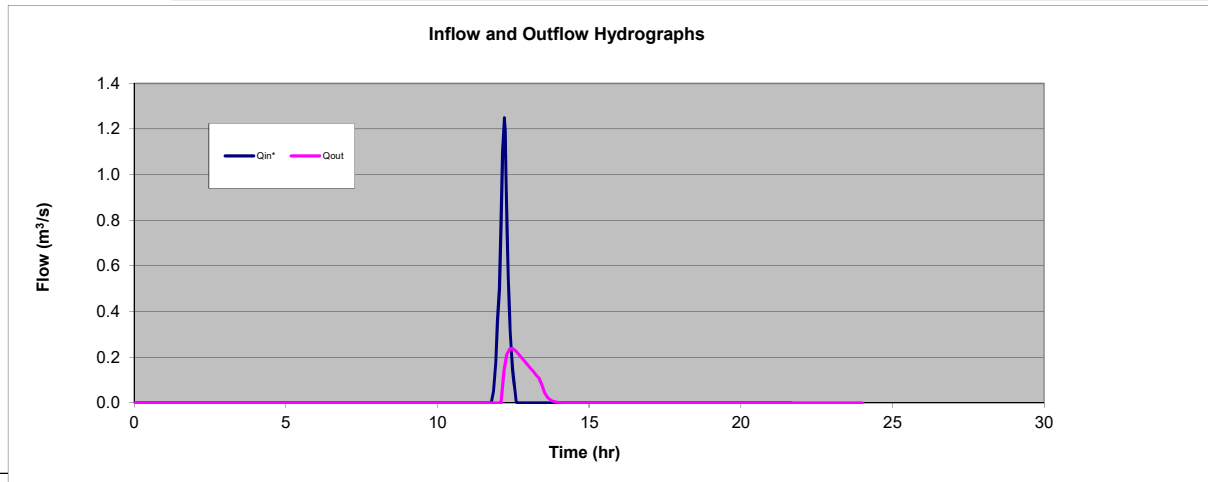
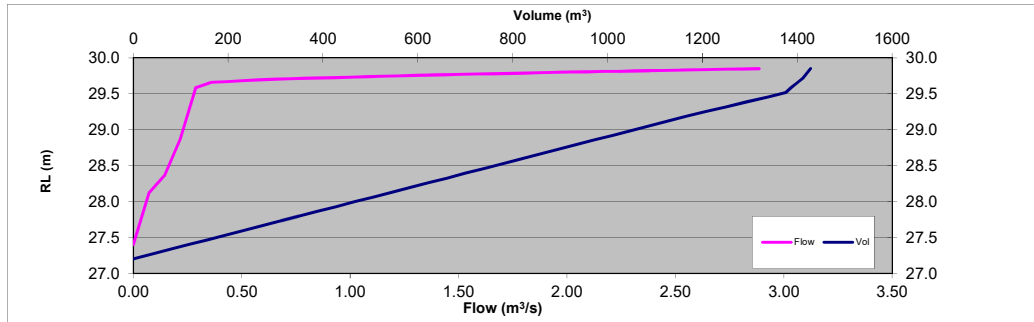
RL (m)	Orifice	Flow (m ³ /s)	
		Overflow	Total
27.200	0.000	0.000	0.000
27.400	0.000	0.000	0.000
27.600	0.000	0.000	0.000
27.800	0.000	0.000	0.000
28.000	0.000	0.000	0.000
28.050	0.000	0.000	0.000
28.150	0.102	0.000	0.102
28.400	0.152	0.000	0.152
28.600	0.183	0.000	0.183
28.800	0.209	0.000	0.209
29.000	0.232	0.000	0.232
29.200	0.253	0.000	0.253
29.400	0.272	0.000	0.272
29.500	0.281	0.000	0.281
29.600	0.290	0.000	0.290
29.650	0.294	0.000	0.294
29.700	0.299	0.322	0.621
29.750	0.303	0.911	1.214
29.800	0.307	1.673	1.980
29.850	0.311	2.576	2.887
-1.000			

Tank Outflow Weir Level	28.10
tank Outflow Pipe RL	27.79
Orifice Cd	0.670
Tank Outflow Diameter	0.311
Wall Length	16
Weir RL	29.65
Weir CD	0.600

- Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
- If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coeff. towards 1.0. A value close to 0.5 has better accuracy.
- Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
- Extraction rate applies to external pumping or infiltration.

Results:

Max. Inflow (m ³ /s)	1.249
Time at Max. Inflow (hr)	12.19
Max. Outflow (m ³ /s)	0.238
Time at Max. Outflow (hr)	12.48
Initial RL (m)	27.200
Max. RL (m)	29.058
Max. Volume (m ³)	1090.5
Inflow Volume (m ³)	1359.0
Volumetric error	0.00%
Extraction Volume (m ³)	0.0



Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

Project Description: Direct Overland Flow to No 17 - P21

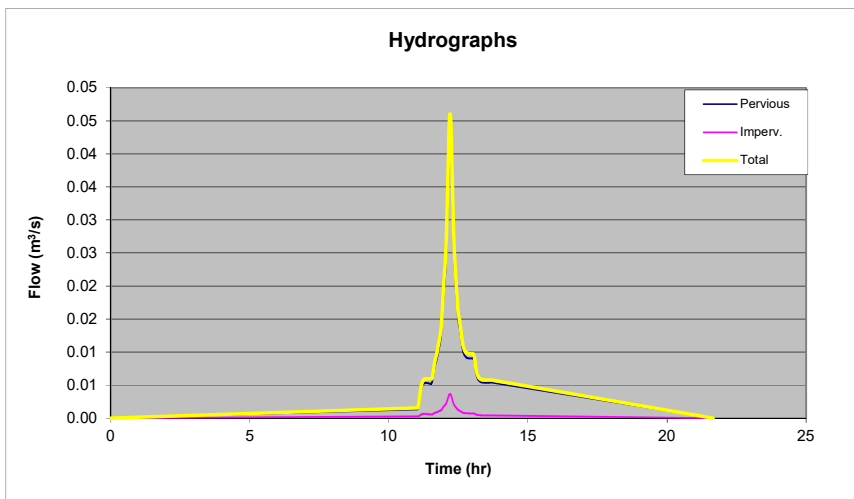
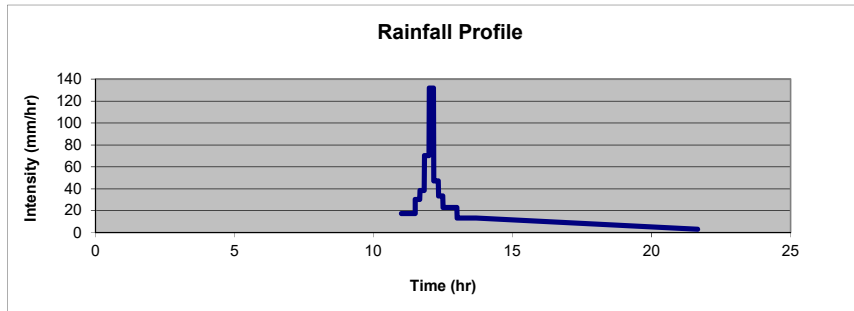
Rainfall Depth (mm): 190

Notes:

1. Inputs
2. Typical inputs for CN are in 'Typical CN Values' Sheet
3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.1713	0.0111
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	0.1713	0.0111	0.1824
Runoff (mm)	124.8	185.0	128.5
Peak Flow (m ³ /s)	0.042	0.004	0.046
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	131.81	131.81	131.81
Runoff Coefficient - Peak	0.68	0.90	0.69
Runoff Coefficient - Volume	0.66	0.97	0.68



Hydrograph Combination

Project Description Combined Total Overland Flow to No 17

Time Lag (min)

Time Lag (min)

Direct Overland Flow

Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.002
11.347	0.006
11.491	0.006
11.601	0.007
11.694	0.009
11.776	0.011
11.850	0.013
11.918	0.016
11.981	0.021
12.040	0.025
12.096	0.032
12.150	0.041
12.201	0.046
12.232	0.045
12.264	0.040
12.297	0.033
12.331	0.028
12.365	0.024
12.400	0.022
12.437	0.019
12.474	0.017
12.513	0.016
12.553	0.015
12.594	0.013
12.637	0.012
12.682	0.011
12.729	0.010
12.778	0.010
12.830	0.010
12.886	0.010
12.945	0.010
13.010	0.010
13.082	0.009
13.163	0.007
13.260	0.006
13.386	0.006
13.690	0.006
21.657	0.000
-1.000	0.000

Tank Overflow

Time (hr)	Flow (m ³ /s)
0.000	0.000
3.603	0.000
5.095	0.000
6.240	0.000
7.205	0.000
8.056	0.000
8.825	0.000
9.532	0.000
10.190	0.000
10.808	0.000
11.393	0.000
11.949	0.000
12.480	0.238
12.704	0.209
12.932	0.173
13.165	0.136
13.403	0.091
13.647	0.021
13.896	0.004
14.152	0.001
14.415	0.000
14.685	0.000
14.963	0.000
15.250	0.000
15.547	0.000
15.854	0.000
16.174	0.000
16.507	0.000
16.856	0.000
17.222	0.000
17.610	0.000
18.023	0.000
18.466	0.000
18.948	0.000
19.481	0.000
20.087	0.000
20.805	0.000
21.741	0.000
24.000	0.000
-1.000	0.000

Hydrograph A+B+C

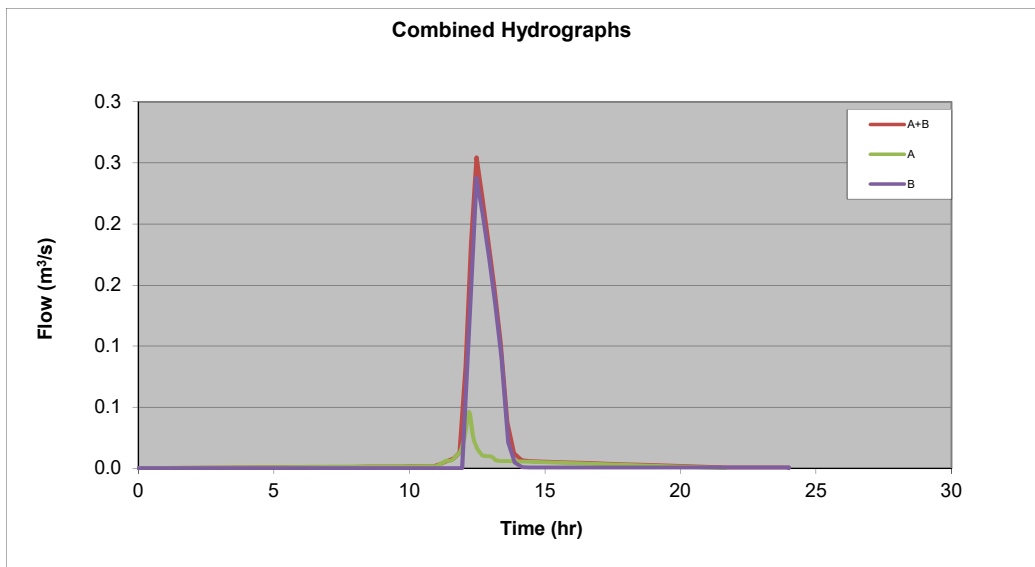
Time (hr)	Flow (m ³ /s)
0.001	0.000
3.603	0.001
6.396	0.001
7.289	0.001
7.938	0.001
8.467	0.001
8.921	0.001
9.323	0.001
9.687	0.001
10.021	0.001
10.330	0.001
10.620	0.002
10.893	0.002
11.151	0.003
11.396	0.006
11.631	0.008
11.856	0.013
12.071	0.084
12.279	0.185
12.480	0.255
12.689	0.221
12.906	0.187
13.131	0.149
13.366	0.104
13.610	0.038
13.866	0.012
14.136	0.007
14.420	0.006
14.722	0.006
15.045	0.005
15.394	0.005
15.773	0.005
16.193	0.004
16.667	0.004
17.218	0.004
17.895	0.003
18.826	0.003
21.741	0.000
24.000	0.000
-1.000	0.000

Notes:

- Input data should be in ascending order with time in the boxes provided. The maximum no. of values is 40. If a lesser no. of values is needed then terminate as a -1 for the x value.
- The Time Lag is relative to the hydrograph times.
- Volumetric error is generally due to the interpolation and reassignment of time values.

Results:

Max. Flow (m ³ /s) -A	0.046
Time (hr) at Max Flow	12.20
Max. Flow (m ³ /s) -B	0.238
Time (hr) at Max Flow	12.48
Max. Flow (m ³ /s)	0.255
Time (hr) at Max Flow	12.48
Volumetric Error	0.0%



Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

Project Description: Direct Overland Flow to No 27-45 - P20

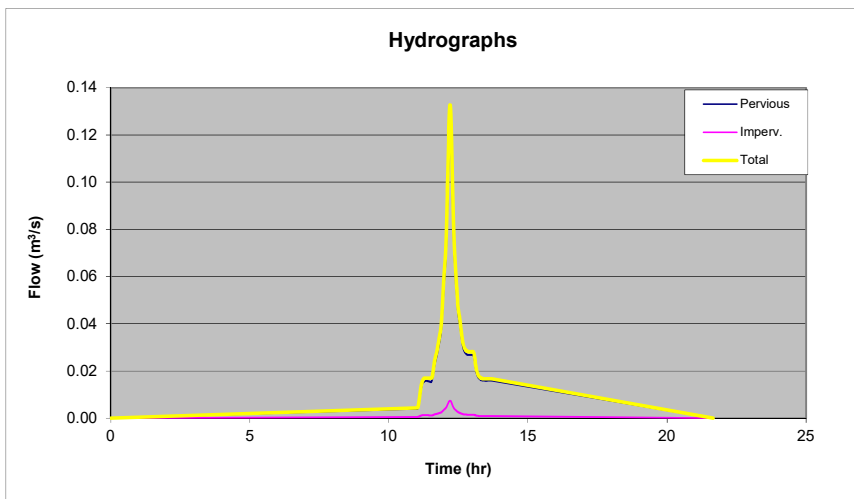
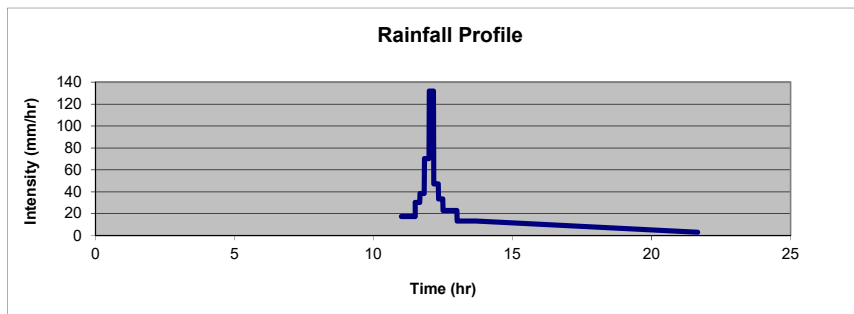
Rainfall Depth (mm): 190

Notes:

1. Inputs
2. Typical inputs for CN are in 'Typical CN Values' Sheet
3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.5067	0.0224
Runoff No (CN)	74	98
Initial Loss (I _a -mm)	5	0
Time of Concentration (t _c -min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	0.5067	0.0224	0.5291
Runoff (mm)	124.8	185.0	127.3
Peak Flow (m ³ /s)	0.125	0.007	0.133
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over t _c	131.81	131.81	131.81
Runoff Coefficient - Peak	0.68	0.90	0.69
Runoff Coefficient - Volume	0.66	0.97	0.67



**PROPOSED Q100
CALCULATIONS WITH
CLIMATE CHANGE
ALLOWANCE**

Calculation Sheet

Job Number 3124460 Date 14.02.2020
 Job Name Kohimarama Retirement Village
 Subject Proposed Stormwater Calc for a 1% AEP with Climate Change
 By Conor O'Boyle Page No of

On-Site & Upstream Catchments	Total Area	Pervious Area	Impervious Area	% Impervious
A1	15318	2737	12581	82.13
A2	5596	560	5036	90.00
A8	1833	245	1588	86.63
On-Site & Upstream Catchments	Total Area	Pervious Area	Impervious Area	% Impervious
P1	275	145	130	0.47
P2	896	333	563	0.63
P3	439	256	184	0.42
P4	1341	643	698	0.52
P5	627	269	358	0.57
P6	996	484	512	0.51
P7	762	484	278	0.36
P8	1250	1250	0	0.00
P9	1922	876	1046	0.54
P10	2983	1650	1333	0.45
P11	1124	783	341	0.30
P12	1510	0	1510	1.00
P13	1003	0	1003	1.00
P14	1707	0	1707	1.00
P15	1558	0	1558	1.00
P16	927	0	927	1.00
P17	1202	0	1202	1.00
P18	2176	362	1814	0.83
P19	1443	1209	234	0.162
P20	5291	5067	224	0.042
P21	1824	1713	111	0.061
P22	2229	891.6	1337.4	0.6
P23	3366	1346.4	2019.6	0.6

Calculation Sheet

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

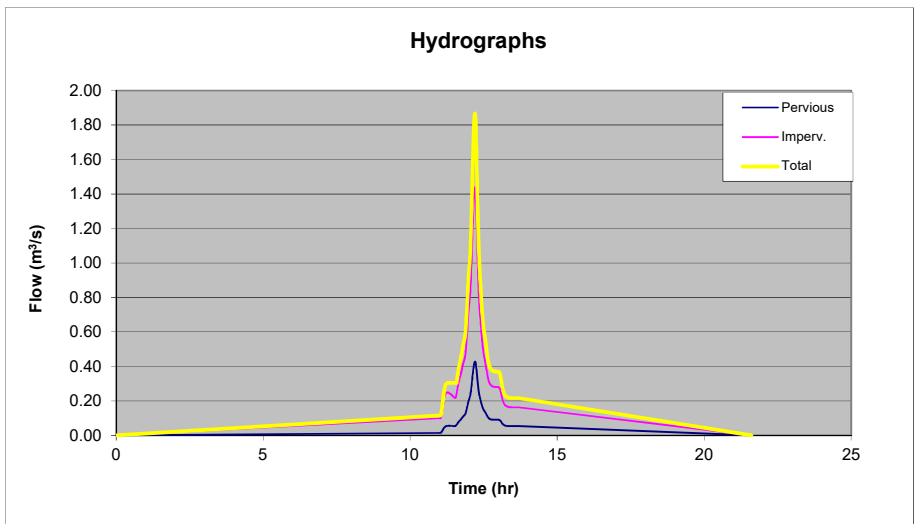
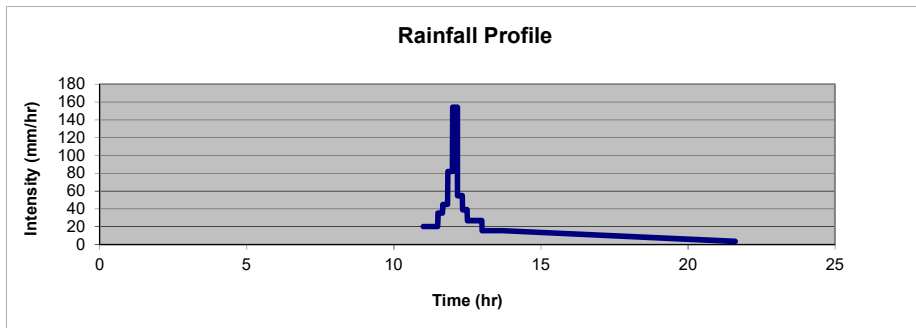
Project Description **Kohi - Attenuation Storage Catchment (P1-P19, P22, A1, A2 & A8)**

Rainfall Depth (mm) **222**

Notes:
 1. Inputs
 2. Typical inputs for CN
 are in 'Typical CN Values' Sheet
 3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	1.4069	3.7278
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs	Pervious Area	Impervious Area	Total
Area (ha)	1.40688	3.72782	5.1347
Runoff (mm)	153.8	216.9	199.6
Peak Flow (m ³ /s)	0.428	1.440	1.867
Time (hr) at Peak Flow	12.20	12.20	12.20
Rainfall (mm/h) over tc	154.01	154.01	154.01
Runoff Coefficient - Peak	0.71	0.90	0.85
Runoff Coefficient - Volume	0.69	0.98	0.90



Beca Ltd



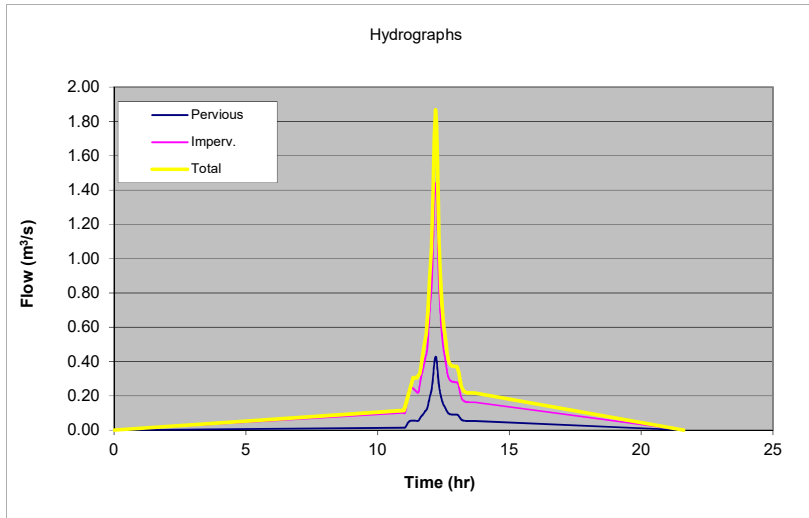
JOB NO: 3124460

Hydrographs- SCS Method:

Project Description Kohi - Attenuation Storage Catchment (P1-P19, P22, A1, A2 & A8)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m ³ /s)
0.000	0.000
11.001	0.115
11.347	0.305
11.491	0.305
11.601	0.330
11.694	0.426
11.776	0.500
11.850	0.561
11.918	0.695
11.981	0.901
12.040	1.049
12.096	1.360
12.150	1.708
12.201	1.867
12.232	1.802
12.264	1.588
12.297	1.328
12.331	1.104
12.365	0.957
12.400	0.847
12.437	0.746
12.474	0.664
12.513	0.607
12.553	0.563
12.594	0.507
12.637	0.450
12.682	0.410
12.729	0.390
12.778	0.379
12.830	0.374
12.886	0.372
12.945	0.371
13.010	0.370
13.082	0.337
13.163	0.260
13.260	0.227
13.386	0.218
13.690	0.217
21.610	0.000
-1.000	0.000

Beca Ltd



JOB NO: 3124460

Hydrographs- SCS Method:

Project Description **Kohi - Attenuation Storage Catchment (A2Q10)**

Rainfall Depth (mm) 140

- Notes:**
- Inputs
 - Typical inputs for CN are in 'Typical CN Values' Sheet
 - Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.056	0.5036
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	0.056	0.5036	0.5596
Runoff (mm)	81.3	135.0	129.6
Peak Flow (m ³ /s)	0.009	0.122	0.131
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	97.13	97.13	97.13
Runoff Coefficient - Peak	0.60	0.90	0.87
Runoff Coefficient - Volume	0.58	0.96	0.93

