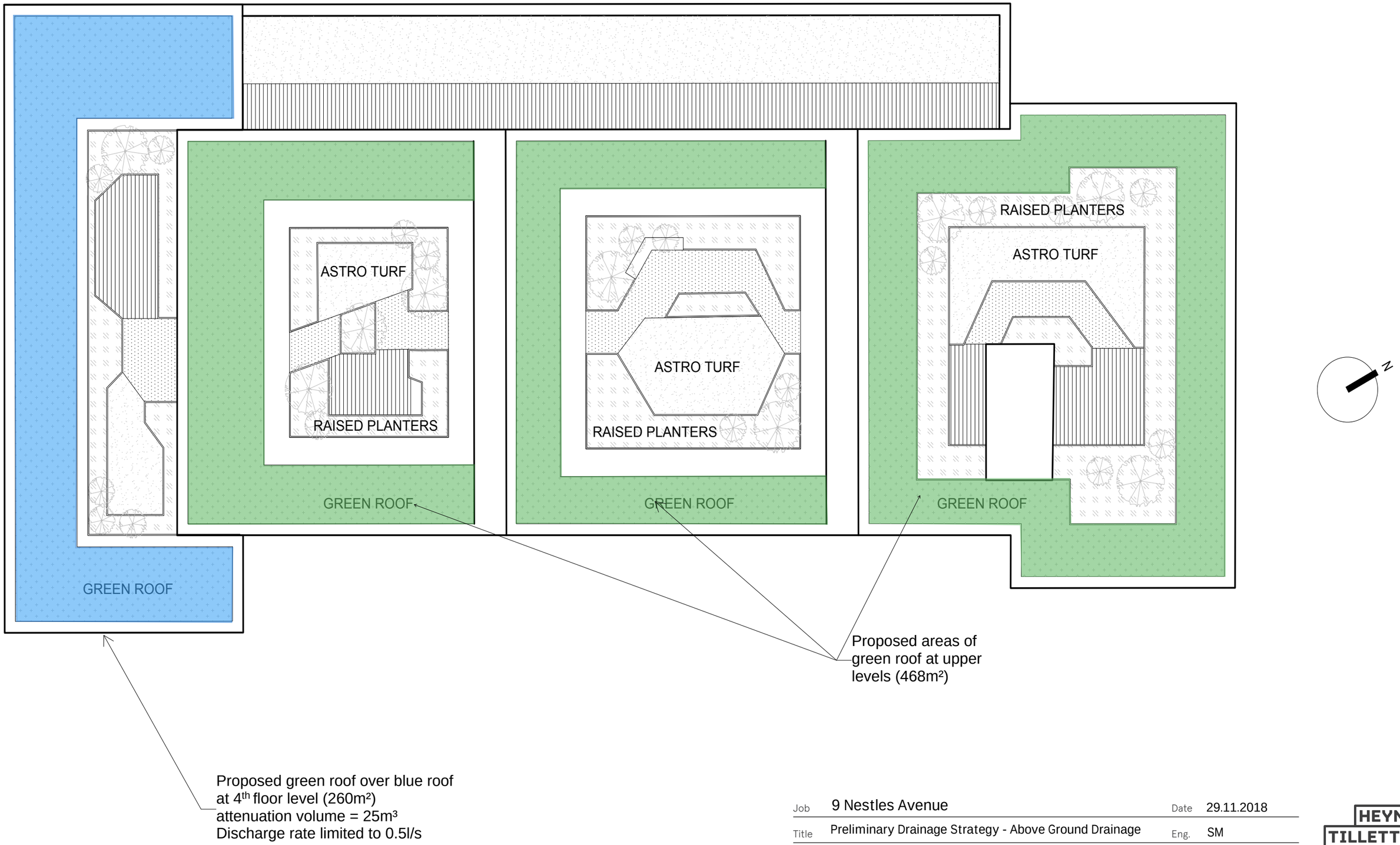

Job	9 Nestles Avenue	Date	29.11.2018
Title	Preliminary Drainage Strategy - Above Ground Drainage	Eng.	SM
Job No. 2066	Sheet SK002	Rev.	P1

HEYNE TILLETT STEEL

hts.uk.com

Appendix H

Surface Water Calculations

HEYNE TILLETT STEEL

FEH Mean Annual Flood

Input

Site Location	GB 510400 178800 TQ 10400 78800
Area (ha)	0.255
SAAR (mm)	639
URBEXT (1990)	0.3494
SPRHOST	48.680
BFIHOST	0.219
FARL	0.997

Results

QMED Rural (l/s) 0.7 QMED Urban (l/s) 0.9

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Summary of Results for 2 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
15 min Summer	31.261	0.821	21.8	FLOOD
30 min Summer	31.267	0.827	27.7	FLOOD
60 min Summer	31.273	0.833	34.0	FLOOD
120 min Summer	31.288	0.848	49.0	FLOOD
180 min Summer	31.297	0.857	57.7	FLOOD
240 min Summer	31.303	0.863	63.6	FLOOD
360 min Summer	31.310	0.870	71.1	FLOOD
480 min Summer	31.315	0.875	75.9	FLOOD
600 min Summer	31.318	0.878	79.5	FLOOD
720 min Summer	31.321	0.881	82.4	FLOOD
960 min Summer	31.326	0.886	87.0	FLOOD
1440 min Summer	31.332	0.892	93.5	FLOOD
2160 min Summer	31.340	0.900	101.2	FLOOD
2880 min Summer	31.347	0.907	107.9	FLOOD
4320 min Summer	31.359	0.919	120.2	FLOOD
5760 min Summer	31.370	0.930	131.5	FLOOD
7200 min Summer	30.440	0.000	0.0	O K
8640 min Summer	30.440	0.000	0.0	O K
10080 min Summer	30.440	0.000	0.0	O K
15 min Winter	31.261	0.821	21.8	FLOOD
30 min Winter	31.267	0.827	27.7	FLOOD

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	36.044	20.8	23
30 min Summer	22.899	26.7	38
60 min Summer	14.051	33.0	68
120 min Summer	10.110	48.0	128
180 min Summer	7.937	56.6	188
240 min Summer	6.560	62.5	248
360 min Summer	4.891	70.0	368
480 min Summer	3.917	74.9	488
600 min Summer	3.283	78.5	608
720 min Summer	2.835	81.3	728
960 min Summer	2.246	86.0	968
1440 min Summer	1.608	92.4	1448
2160 min Summer	1.160	100.1	2168
2880 min Summer	0.928	106.9	2888
4320 min Summer	0.689	119.1	4328
5760 min Summer	0.565	130.4	5768
7200 min Summer	-0.008	0.0	0
8640 min Summer	-0.007	0.0	0
10080 min Summer	-0.006	0.0	0
15 min Winter	36.044	20.8	23
30 min Winter	22.899	26.7	38

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Summary of Results for 2 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
60 min Winter	31.273	0.833	34.0	FLOOD
120 min Winter	31.288	0.848	49.0	FLOOD
180 min Winter	31.297	0.857	57.7	FLOOD
240 min Winter	31.303	0.863	63.6	FLOOD
360 min Winter	31.310	0.870	71.1	FLOOD
480 min Winter	31.315	0.875	75.9	FLOOD
600 min Winter	31.318	0.878	79.5	FLOOD
720 min Winter	31.321	0.881	82.4	FLOOD
960 min Winter	31.326	0.886	87.0	FLOOD
1440 min Winter	31.332	0.892	93.5	FLOOD
2160 min Winter	31.340	0.900	101.2	FLOOD
2880 min Winter	31.347	0.907	107.9	FLOOD
4320 min Winter	31.359	0.919	120.2	FLOOD
5760 min Winter	31.370	0.930	131.5	FLOOD
7200 min Winter	30.440	0.000	0.0	O K
8640 min Winter	30.440	0.000	0.0	O K
10080 min Winter	30.440	0.000	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	14.051	33.0	68
120 min Winter	10.110	48.0	128
180 min Winter	7.937	56.6	188
240 min Winter	6.560	62.5	248
360 min Winter	4.891	70.0	368
480 min Winter	3.917	74.9	488
600 min Winter	3.283	78.5	608
720 min Winter	2.835	81.3	728
960 min Winter	2.246	86.0	968
1440 min Winter	1.608	92.4	1448
2160 min Winter	1.160	100.1	2168
2880 min Winter	0.928	106.9	2888
4320 min Winter	0.689	119.1	4328
5760 min Winter	0.565	130.4	5768
7200 min Winter	-0.008	0.0	0
8640 min Winter	-0.007	0.0	0
10080 min Winter	-0.006	0.0	0

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
15 min Summer	31.292	0.852	53.1	FLOOD
30 min Summer	31.307	0.867	68.3	FLOOD
60 min Summer	31.323	0.883	84.4	FLOOD
120 min Summer	31.346	0.906	107.2	FLOOD
180 min Summer	31.359	0.919	120.4	FLOOD
240 min Summer	31.368	0.928	129.2	FLOOD
360 min Summer	31.379	0.939	140.2	FLOOD
480 min Summer	31.386	0.946	147.1	FLOOD
600 min Summer	31.391	0.951	152.0	FLOOD
720 min Summer	31.395	0.955	155.9	FLOOD
960 min Summer	31.401	0.961	161.9	FLOOD
1440 min Summer	31.410	0.970	170.8	FLOOD
2160 min Summer	31.419	0.979	180.5	FLOOD
2880 min Summer	31.427	0.987	188.5	FLOOD
4320 min Summer	31.442	1.002	203.0	FLOOD
5760 min Summer	31.455	1.015	216.2	FLOOD
7200 min Summer	30.440	0.000	0.0	O K
8640 min Summer	30.440	0.000	0.0	O K
10080 min Summer	30.440	0.000	0.0	O K
15 min Winter	31.292	0.852	53.1	FLOOD
30 min Winter	31.307	0.867	68.3	FLOOD

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	87.760	52.1	23
30 min Summer	56.360	67.2	38
60 min Summer	34.820	83.3	68
120 min Summer	22.135	106.2	128
180 min Summer	16.563	119.3	188
240 min Summer	13.330	128.1	248
360 min Summer	9.648	139.1	368
480 min Summer	7.589	145.9	488
600 min Summer	6.275	150.9	608
720 min Summer	5.363	154.8	728
960 min Summer	4.176	160.7	968
1440 min Summer	2.938	169.7	1448
2160 min Summer	2.070	179.4	2168
2880 min Summer	1.621	187.4	2888
4320 min Summer	1.164	201.9	4328
5760 min Summer	0.929	215.0	5768
7200 min Summer	-0.008	0.0	0
8640 min Summer	-0.007	0.0	0
10080 min Summer	-0.006	0.0	0
15 min Winter	87.760	52.1	23
30 min Winter	56.360	67.2	38

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
60 min Winter	31.323	0.883	84.4	FLOOD
120 min Winter	31.346	0.906	107.2	FLOOD
180 min Winter	31.359	0.919	120.4	FLOOD
240 min Winter	31.368	0.928	129.2	FLOOD
360 min Winter	31.379	0.939	140.2	FLOOD
480 min Winter	31.386	0.946	147.1	FLOOD
600 min Winter	31.391	0.951	152.0	FLOOD
720 min Winter	31.395	0.955	155.9	FLOOD
960 min Winter	31.401	0.961	161.9	FLOOD
1440 min Winter	31.410	0.970	170.8	FLOOD
2160 min Winter	31.419	0.979	180.5	FLOOD
2880 min Winter	31.427	0.987	188.5	FLOOD
4320 min Winter	31.442	1.002	203.0	FLOOD
5760 min Winter	31.455	1.015	216.2	FLOOD
7200 min Winter	30.440	0.000	0.0	O K
8640 min Winter	30.440	0.000	0.0	O K
10080 min Winter	30.440	0.000	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	34.820	83.3	68
120 min Winter	22.135	106.2	128
180 min Winter	16.563	119.3	188
240 min Winter	13.330	128.1	248
360 min Winter	9.648	139.1	368
480 min Winter	7.589	145.9	488
600 min Winter	6.275	150.9	608
720 min Winter	5.362	154.8	728
960 min Winter	4.176	160.7	968
1440 min Winter	2.938	169.7	1448
2160 min Winter	2.070	179.4	2168
2880 min Winter	1.621	187.4	2888
4320 min Winter	1.164	201.9	4328
5760 min Winter	0.929	215.0	5768
7200 min Winter	-0.008	0.0	0
8640 min Winter	-0.007	0.0	0
10080 min Winter	-0.006	0.0	0

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
15 min Summer	31.308	0.868	69.0	FLOOD
30 min Summer	31.329	0.889	89.6	FLOOD
60 min Summer	31.350	0.910	111.2	FLOOD
120 min Summer	31.379	0.939	140.3	FLOOD
180 min Summer	31.396	0.956	157.5	FLOOD
240 min Summer	31.408	0.968	169.3	FLOOD
360 min Summer	31.423	0.983	184.6	FLOOD
480 min Summer	31.433	0.993	194.1	FLOOD
600 min Summer	31.440	1.000	200.8	FLOOD
720 min Summer	31.445	1.005	205.9	FLOOD
960 min Summer	31.452	1.012	213.2	FLOOD
1440 min Summer	31.462	1.022	223.1	FLOOD
2160 min Summer	31.471	1.031	232.7	FLOOD
2880 min Summer	31.479	1.039	240.1	FLOOD
4320 min Summer	31.491	1.051	252.6	FLOOD
5760 min Summer	31.503	1.063	263.8	FLOOD
7200 min Summer	30.440	0.000	0.0	O K
8640 min Summer	30.440	0.000	0.0	O K
10080 min Summer	30.440	0.000	0.0	O K
15 min Winter	31.308	0.868	69.0	FLOOD
30 min Winter	31.329	0.889	89.6	FLOOD

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	114.000	68.0	23
30 min Summer	74.000	88.6	38
60 min Summer	45.900	110.1	68
120 min Summer	28.950	139.1	128
180 min Summer	21.673	156.4	188
240 min Summer	17.475	168.2	248
360 min Summer	12.700	183.4	368
480 min Summer	10.016	192.9	488
600 min Summer	8.290	199.6	608
720 min Summer	7.083	204.7	728
960 min Summer	5.501	212.0	968
1440 min Summer	3.837	221.9	1448
2160 min Summer	2.668	231.5	2168
2880 min Summer	2.065	238.9	2888
4320 min Summer	1.448	251.4	4328
5760 min Summer	1.134	262.6	5768
7200 min Summer	-0.008	0.0	0
8640 min Summer	-0.007	0.0	0
10080 min Summer	-0.006	0.0	0
15 min Winter	114.000	68.0	23
30 min Winter	74.000	88.6	38

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
60 min Winter	31.350	0.910	111.2	FLOOD
120 min Winter	31.379	0.939	140.3	FLOOD
180 min Winter	31.396	0.956	157.5	FLOOD
240 min Winter	31.408	0.968	169.3	FLOOD
360 min Winter	31.423	0.983	184.6	FLOOD
480 min Winter	31.433	0.993	194.1	FLOOD
600 min Winter	31.440	1.000	200.8	FLOOD
720 min Winter	31.445	1.005	205.9	FLOOD
960 min Winter	31.452	1.012	213.2	FLOOD
1440 min Winter	31.462	1.022	223.1	FLOOD
2160 min Winter	31.471	1.031	232.7	FLOOD
2880 min Winter	31.479	1.039	240.1	FLOOD
4320 min Winter	31.491	1.051	252.6	FLOOD
5760 min Winter	31.503	1.063	263.8	FLOOD
7200 min Winter	30.440	0.000	0.0	O K
8640 min Winter	30.440	0.000	0.0	O K
10080 min Winter	30.440	0.000	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	45.900	110.1	68
120 min Winter	28.950	139.1	128
180 min Winter	21.673	156.4	188
240 min Winter	17.475	168.2	248
360 min Winter	12.700	183.4	368
480 min Winter	10.016	192.9	488
600 min Winter	8.290	199.6	608
720 min Winter	7.083	204.7	728
960 min Winter	5.501	212.0	968
1440 min Winter	3.837	221.9	1448
2160 min Winter	2.668	231.5	2168
2880 min Winter	2.065	238.9	2888
4320 min Winter	1.448	251.4	4328
5760 min Winter	1.134	262.6	5768
7200 min Winter	-0.008	0.0	0
8640 min Winter	-0.007	0.0	0
10080 min Winter	-0.006	0.0	0

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Summary of Results for 2 year Return Period

Half Drain Time : 175 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	30.476	0.036	0.0	0.7	0.7	14.9	O K
30 min Summer	30.484	0.044	0.0	1.0	1.0	18.5	O K
60 min Summer	30.492	0.052	0.0	1.3	1.3	21.6	O K
120 min Summer	30.506	0.066	0.0	2.0	2.0	27.6	O K
180 min Summer	30.512	0.072	0.0	2.2	2.2	30.1	O K
240 min Summer	30.515	0.075	0.0	2.4	2.4	31.4	O K
360 min Summer	30.517	0.077	0.0	2.5	2.5	32.0	O K
480 min Summer	30.516	0.076	0.0	2.4	2.4	31.6	O K
600 min Summer	30.514	0.074	0.0	2.3	2.3	31.0	O K
720 min Summer	30.512	0.072	0.0	2.2	2.2	30.2	O K
960 min Summer	30.509	0.069	0.0	2.1	2.1	28.7	O K
1440 min Summer	30.502	0.062	0.0	1.8	1.8	26.1	O K
2160 min Summer	30.496	0.056	0.0	1.5	1.5	23.4	O K
2880 min Summer	30.491	0.051	0.0	1.3	1.3	21.5	O K
4320 min Summer	30.486	0.046	0.0	1.0	1.0	19.1	O K
5760 min Summer	30.482	0.042	0.0	0.9	0.9	17.6	O K
7200 min Summer	30.440	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	30.440	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	30.440	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	30.476	0.036	0.0	0.7	0.7	14.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	36.044	0.0	12.3	22
30 min Summer	22.899	0.0	16.3	36
60 min Summer	14.051	0.0	22.1	64
120 min Summer	10.110	0.0	32.4	106
180 min Summer	7.937	0.0	38.5	134
240 min Summer	6.560	0.0	42.5	166
360 min Summer	4.891	0.0	47.7	234
480 min Summer	3.917	0.0	51.0	302
600 min Summer	3.283	0.0	53.5	368
720 min Summer	2.835	0.0	55.4	434
960 min Summer	2.246	0.0	58.5	562
1440 min Summer	1.608	0.0	62.5	812
2160 min Summer	1.160	0.0	69.4	1188
2880 min Summer	0.928	0.0	73.9	1556
4320 min Summer	0.689	0.0	81.6	2292
5760 min Summer	0.565	0.0	91.0	3000
7200 min Summer	-0.008	0.0	-1.7	0
8640 min Summer	-0.007	0.0	-1.7	0
10080 min Summer	-0.006	0.0	-1.7	0
15 min Winter	36.044	0.0	12.3	22

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Summary of Results for 2 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	30.484	0.044	0.0	1.0	1.0	18.5	O K
60 min Winter	30.492	0.052	0.0	1.3	1.3	21.7	O K
120 min Winter	30.507	0.067	0.0	2.0	2.0	27.8	O K
180 min Winter	30.512	0.072	0.0	2.2	2.2	30.1	O K
240 min Winter	30.514	0.074	0.0	2.3	2.3	31.1	O K
360 min Winter	30.514	0.074	0.0	2.3	2.3	31.1	O K
480 min Winter	30.512	0.072	0.0	2.2	2.2	30.3	O K
600 min Winter	30.510	0.070	0.0	2.1	2.1	29.3	O K
720 min Winter	30.508	0.068	0.0	2.0	2.0	28.2	O K
960 min Winter	30.503	0.063	0.0	1.8	1.8	26.3	O K
1440 min Winter	30.496	0.056	0.0	1.5	1.5	23.4	O K
2160 min Winter	30.489	0.049	0.0	1.2	1.2	20.4	O K
2880 min Winter	30.484	0.044	0.0	1.0	1.0	18.5	O K
4320 min Winter	30.479	0.039	0.0	0.8	0.8	16.1	O K
5760 min Winter	30.475	0.035	0.0	0.6	0.6	14.6	O K
7200 min Winter	30.440	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	30.440	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	30.440	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	22.899	0.0	16.3	35
60 min Winter	14.051	0.0	22.1	62
120 min Winter	10.110	0.0	32.4	114
180 min Winter	7.937	0.0	38.5	140
240 min Winter	6.560	0.0	42.5	178
360 min Winter	4.891	0.0	47.7	252
480 min Winter	3.917	0.0	51.0	322
600 min Winter	3.283	0.0	53.5	390
720 min Winter	2.835	0.0	55.4	458
960 min Winter	2.246	0.0	58.5	590
1440 min Winter	1.608	0.0	62.5	852
2160 min Winter	1.160	0.0	69.4	1232
2880 min Winter	0.928	0.0	73.9	1592
4320 min Winter	0.689	0.0	81.7	2332
5760 min Winter	0.565	0.0	91.0	3056
7200 min Winter	-0.008	0.0	-1.7	0
8640 min Winter	-0.007	0.0	-1.7	0
10080 min Winter	-0.006	0.0	-1.7	0

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Summary of Results for 30 year Return Period

Half Drain Time : 171 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	30.525	0.085	0.0	2.8	2.8	35.5	O K
30 min Summer	30.546	0.106	0.0	3.6	3.6	44.1	O K
60 min Summer	30.563	0.123	0.0	3.8	3.8	51.5	O K
120 min Summer	30.583	0.143	0.0	3.8	3.8	59.8	O K
180 min Summer	30.590	0.150	0.0	3.8	3.8	62.5	O K
240 min Summer	30.591	0.151	0.0	3.8	3.8	63.3	O K
360 min Summer	30.589	0.149	0.0	3.8	3.8	62.2	O K
480 min Summer	30.583	0.143	0.0	3.8	3.8	59.6	O K
600 min Summer	30.576	0.136	0.0	3.8	3.8	56.7	O K
720 min Summer	30.568	0.128	0.0	3.8	3.8	53.7	O K
960 min Summer	30.556	0.116	0.0	3.8	3.8	48.4	O K
1440 min Summer	30.539	0.099	0.0	3.4	3.4	41.4	O K
2160 min Summer	30.524	0.084	0.0	2.8	2.8	35.1	O K
2880 min Summer	30.515	0.075	0.0	2.4	2.4	31.2	O K
4320 min Summer	30.503	0.063	0.0	1.8	1.8	26.5	O K
5760 min Summer	30.497	0.057	0.0	1.5	1.5	23.7	O K
7200 min Summer	30.440	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	30.440	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	30.440	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	30.525	0.085	0.0	2.8	2.8	35.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	87.760	0.0	33.7	21
30 min Summer	56.360	0.0	44.1	35
60 min Summer	34.820	0.0	57.1	62
120 min Summer	22.135	0.0	73.0	114
180 min Summer	16.563	0.0	82.1	144
240 min Summer	13.330	0.0	88.2	176
360 min Summer	9.648	0.0	95.9	244
480 min Summer	7.589	0.0	100.6	310
600 min Summer	6.275	0.0	104.0	376
720 min Summer	5.363	0.0	106.6	440
960 min Summer	4.176	0.0	110.6	564
1440 min Summer	2.938	0.0	116.4	808
2160 min Summer	2.070	0.0	124.8	1172
2880 min Summer	1.621	0.0	130.1	1532
4320 min Summer	1.164	0.0	139.3	2252
5760 min Summer	0.929	0.0	150.1	3000
7200 min Summer	-0.008	0.0	-1.7	0
8640 min Summer	-0.007	0.0	-1.7	0
10080 min Summer	-0.006	0.0	-1.7	0
15 min Winter	87.760	0.0	33.7	21

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	30.546	0.106	0.0	3.6	3.6	44.2	O K
60 min Winter	30.564	0.124	0.0	3.8	3.8	51.7	O K
120 min Winter	30.584	0.144	0.0	3.8	3.8	60.0	O K
180 min Winter	30.588	0.148	0.0	3.8	3.8	62.0	O K
240 min Winter	30.589	0.149	0.0	3.8	3.8	62.3	O K
360 min Winter	30.583	0.143	0.0	3.8	3.8	59.9	O K
480 min Winter	30.574	0.134	0.0	3.8	3.8	55.9	O K
600 min Winter	30.564	0.124	0.0	3.8	3.8	51.9	O K
720 min Winter	30.555	0.115	0.0	3.8	3.8	48.1	O K
960 min Winter	30.542	0.102	0.0	3.5	3.5	42.7	O K
1440 min Winter	30.525	0.085	0.0	2.8	2.8	35.6	O K
2160 min Winter	30.511	0.071	0.0	2.2	2.2	29.6	O K
2880 min Winter	30.502	0.062	0.0	1.8	1.8	26.0	O K
4320 min Winter	30.492	0.052	0.0	1.3	1.3	21.8	O K
5760 min Winter	30.486	0.046	0.0	1.1	1.1	19.3	O K
7200 min Winter	30.440	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	30.440	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	30.440	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	56.360	0.0	44.1	35
60 min Winter	34.820	0.0	57.1	62
120 min Winter	22.135	0.0	73.0	116
180 min Winter	16.563	0.0	82.1	148
240 min Winter	13.330	0.0	88.2	186
360 min Winter	9.648	0.0	95.9	260
480 min Winter	7.589	0.0	100.6	330
600 min Winter	6.275	0.0	104.0	398
720 min Winter	5.362	0.0	106.6	460
960 min Winter	4.176	0.0	110.6	586
1440 min Winter	2.938	0.0	116.4	836
2160 min Winter	2.070	0.0	124.8	1208
2880 min Winter	1.621	0.0	130.1	1564
4320 min Winter	1.164	0.0	139.3	2296
5760 min Winter	0.929	0.0	150.1	3048
7200 min Winter	-0.008	0.0	-1.7	0
8640 min Winter	-0.007	0.0	-1.7	0
10080 min Winter	-0.006	0.0	-1.7	0

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Summary of Results for 100 year Return Period

Half Drain Time : 198 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	30.550	0.110	0.0	3.7	3.7	45.9	O K
30 min Summer	30.579	0.139	0.0	3.8	3.8	58.3	O K
60 min Summer	30.606	0.166	0.0	3.8	3.8	69.4	O K
120 min Summer	30.635	0.195	0.0	3.8	3.8	81.6	O K
180 min Summer	30.645	0.205	0.0	3.8	3.8	85.6	O K
240 min Summer	30.648	0.208	0.0	3.8	3.8	86.8	O K
360 min Summer	30.646	0.206	0.0	3.8	3.8	86.0	O K
480 min Summer	30.639	0.199	0.0	3.8	3.8	83.0	O K
600 min Summer	30.630	0.190	0.0	3.8	3.8	79.3	O K
720 min Summer	30.620	0.180	0.0	3.8	3.8	75.3	O K
960 min Summer	30.601	0.161	0.0	3.8	3.8	67.3	O K
1440 min Summer	30.570	0.130	0.0	3.8	3.8	54.3	O K
2160 min Summer	30.543	0.103	0.0	3.5	3.5	43.0	O K
2880 min Summer	30.529	0.089	0.0	3.0	3.0	37.2	O K
4320 min Summer	30.513	0.073	0.0	2.3	2.3	30.6	O K
5760 min Summer	30.504	0.064	0.0	1.9	1.9	26.9	O K
7200 min Summer	30.440	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	30.440	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	30.440	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	30.550	0.110	0.0	3.7	3.7	46.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	114.000	0.0	44.7	21
30 min Summer	74.000	0.0	58.9	35
60 min Summer	45.900	0.0	75.8	64
120 min Summer	28.950	0.0	96.0	122
180 min Summer	21.673	0.0	108.0	168
240 min Summer	17.475	0.0	116.2	198
360 min Summer	12.700	0.0	126.7	260
480 min Summer	10.016	0.0	133.3	328
600 min Summer	8.290	0.0	137.9	394
720 min Summer	7.083	0.0	141.4	460
960 min Summer	5.501	0.0	146.4	588
1440 min Summer	3.837	0.0	152.8	828
2160 min Summer	2.668	0.0	161.2	1172
2880 min Summer	2.065	0.0	166.1	1532
4320 min Summer	1.448	0.0	173.8	2252
5760 min Summer	1.134	0.0	183.4	2992
7200 min Summer	-0.008	0.0	-1.7	0
8640 min Summer	-0.007	0.0	-1.7	0
10080 min Summer	-0.006	0.0	-1.7	0
15 min Winter	114.000	0.0	44.7	21

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	30.580	0.140	0.0	3.8	3.8	58.4	O K
60 min Winter	30.606	0.166	0.0	3.8	3.8	69.5	O K
120 min Winter	30.635	0.195	0.0	3.8	3.8	81.7	O K
180 min Winter	30.645	0.205	0.0	3.8	3.8	85.5	O K
240 min Winter	30.645	0.205	0.0	3.8	3.8	85.9	O K
360 min Winter	30.641	0.201	0.0	3.8	3.8	83.8	O K
480 min Winter	30.630	0.190	0.0	3.8	3.8	79.3	O K
600 min Winter	30.617	0.177	0.0	3.8	3.8	73.9	O K
720 min Winter	30.604	0.164	0.0	3.8	3.8	68.4	O K
960 min Winter	30.579	0.139	0.0	3.8	3.8	58.2	O K
1440 min Winter	30.547	0.107	0.0	3.6	3.6	44.5	O K
2160 min Winter	30.525	0.085	0.0	2.8	2.8	35.4	O K
2880 min Winter	30.513	0.073	0.0	2.3	2.3	30.4	O K
4320 min Winter	30.500	0.060	0.0	1.7	1.7	24.9	O K
5760 min Winter	30.492	0.052	0.0	1.3	1.3	21.7	O K
7200 min Winter	30.440	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	30.440	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	30.440	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	74.000	0.0	58.9	35
60 min Winter	45.900	0.0	75.8	62
120 min Winter	28.950	0.0	96.0	120
180 min Winter	21.673	0.0	108.0	174
240 min Winter	17.475	0.0	116.2	204
360 min Winter	12.700	0.0	126.7	274
480 min Winter	10.016	0.0	133.3	348
600 min Winter	8.290	0.0	138.0	420
720 min Winter	7.083	0.0	141.4	488
960 min Winter	5.501	0.0	146.4	616
1440 min Winter	3.837	0.0	152.8	840
2160 min Winter	2.668	0.0	161.2	1196
2880 min Winter	2.065	0.0	166.1	1560
4320 min Winter	1.448	0.0	173.9	2292
5760 min Winter	1.134	0.0	183.4	3040
7200 min Winter	-0.008	0.0	-1.7	0
8640 min Winter	-0.007	0.0	-1.7	0
10080 min Winter	-0.006	0.0	-1.7	0

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Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 227 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	30.595	0.155	0.0	3.8	3.8	64.7	O K
30 min Summer	30.638	0.198	0.0	3.8	3.8	82.8	O K
60 min Summer	30.679	0.239	0.0	3.8	3.8	99.9	O K
120 min Summer	30.726	0.286	0.0	3.8	3.8	119.6	O K
180 min Summer	31.015	0.575	0.0	5.1	5.1	125.8	Flood Risk
240 min Summer	31.215	0.775	0.0	5.9	5.9	126.0	Flood Risk
360 min Summer	31.171	0.731	0.0	5.7	5.7	126.0	Flood Risk
480 min Summer	30.739	0.299	0.0	3.8	3.8	125.1	O K
600 min Summer	30.729	0.289	0.0	3.8	3.8	120.8	O K
720 min Summer	30.718	0.278	0.0	3.8	3.8	116.2	O K
960 min Summer	30.694	0.254	0.0	3.8	3.8	106.3	O K
1440 min Summer	30.647	0.207	0.0	3.8	3.8	86.7	O K
2160 min Summer	30.594	0.154	0.0	3.8	3.8	64.5	O K
2880 min Summer	30.561	0.121	0.0	3.8	3.8	50.7	O K
4320 min Summer	30.534	0.094	0.0	3.2	3.2	39.2	O K
5760 min Summer	30.521	0.081	0.0	2.6	2.6	33.7	O K
7200 min Summer	30.440	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	30.440	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	30.440	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	30.595	0.155	0.0	3.8	3.8	64.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	159.600	0.0	63.7	22
30 min Summer	103.600	0.0	83.6	36
60 min Summer	64.260	0.0	106.7	66
120 min Summer	40.530	0.0	135.0	124
180 min Summer	30.343	0.0	151.8	170
240 min Summer	24.465	0.0	163.3	186
360 min Summer	17.780	0.0	178.1	254
480 min Summer	14.023	0.0	187.3	354
600 min Summer	11.606	0.0	193.8	420
720 min Summer	9.917	0.0	198.6	490
960 min Summer	7.702	0.0	205.6	626
1440 min Summer	5.372	0.0	214.9	882
2160 min Summer	3.735	0.0	226.1	1236
2880 min Summer	2.890	0.0	233.1	1564
4320 min Summer	2.028	0.0	244.2	2256
5760 min Summer	1.588	0.0	257.0	2992
7200 min Summer	-0.012	0.0	-2.4	0
8640 min Summer	-0.010	0.0	-2.4	0
10080 min Summer	-0.008	0.0	-2.4	0
15 min Winter	159.600	0.0	63.7	22

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	30.638	0.198	0.0	3.8	3.8	82.9	O K
60 min Winter	30.679	0.239	0.0	3.8	3.8	99.9	O K
120 min Winter	30.726	0.286	0.0	3.8	3.8	119.5	O K
180 min Winter	31.182	0.742	0.0	5.8	5.8	126.0	Flood Risk
240 min Winter	31.190	0.750	0.0	5.8	5.8	126.0	Flood Risk
360 min Winter	31.058	0.618	0.0	5.3	5.3	125.9	Flood Risk
480 min Winter	30.734	0.294	0.0	3.8	3.8	122.9	O K
600 min Winter	30.720	0.280	0.0	3.8	3.8	117.2	O K
720 min Winter	30.705	0.265	0.0	3.8	3.8	110.9	O K
960 min Winter	30.671	0.231	0.0	3.8	3.8	96.6	O K
1440 min Winter	30.610	0.170	0.0	3.8	3.8	71.1	O K
2160 min Winter	30.553	0.113	0.0	3.7	3.7	47.4	O K
2880 min Winter	30.533	0.093	0.0	3.1	3.1	38.9	O K
4320 min Winter	30.514	0.074	0.0	2.3	2.3	30.8	O K
5760 min Winter	30.504	0.064	0.0	1.8	1.8	26.6	O K
7200 min Winter	30.440	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	30.440	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	30.440	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	103.600	0.0	83.6	36
60 min Winter	64.260	0.0	106.7	64
120 min Winter	40.530	0.0	135.0	120
180 min Winter	30.343	0.0	151.8	170
240 min Winter	24.465	0.0	163.3	194
360 min Winter	17.780	0.0	178.1	274
480 min Winter	14.023	0.0	187.3	370
600 min Winter	11.606	0.0	193.8	448
720 min Winter	9.917	0.0	198.7	524
960 min Winter	7.702	0.0	205.7	668
1440 min Winter	5.372	0.0	214.9	914
2160 min Winter	3.735	0.0	226.1	1232
2880 min Winter	2.890	0.0	233.1	1584
4320 min Winter	2.028	0.0	244.3	2292
5760 min Winter	1.588	0.0	257.0	3000
7200 min Winter	-0.012	0.0	-2.4	0
8640 min Winter	-0.010	0.0	-2.4	0
10080 min Winter	-0.008	0.0	-2.4	0

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Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 266 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	30.575	0.135	0.0	3.2	3.2	45.1	O K
30 min Summer	30.620	0.180	0.0	3.3	3.3	60.2	O K
60 min Summer	30.665	0.225	0.0	3.3	3.3	75.1	O K
120 min Summer	30.717	0.277	0.0	3.3	3.3	92.5	O K
180 min Summer	30.735	0.295	0.0	3.3	3.3	98.7	O K
240 min Summer	30.739	0.299	0.0	3.3	3.3	99.9	O K
360 min Summer	30.729	0.289	0.0	3.3	3.3	96.8	O K
480 min Summer	30.715	0.275	0.0	3.3	3.3	92.0	O K
600 min Summer	30.700	0.260	0.0	3.3	3.3	86.9	O K
720 min Summer	30.685	0.245	0.0	3.3	3.3	81.9	O K
960 min Summer	30.656	0.216	0.0	3.3	3.3	72.2	O K
1440 min Summer	30.607	0.167	0.0	3.3	3.3	55.9	O K
2160 min Summer	30.554	0.114	0.0	3.2	3.2	38.1	O K
2880 min Summer	30.520	0.080	0.0	3.1	3.1	26.6	O K
4320 min Summer	30.486	0.046	0.0	2.6	2.6	15.5	O K
5760 min Summer	30.471	0.031	0.0	2.2	2.2	10.3	O K
7200 min Summer	30.440	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	30.440	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	30.440	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	30.575	0.135	0.0	3.2	3.2	45.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	159.600	0.0	54.9	38
30 min Summer	103.600	0.0	72.1	51
60 min Summer	64.260	0.0	90.0	72
120 min Summer	40.530	0.0	114.2	126
180 min Summer	30.343	0.0	128.5	182
240 min Summer	24.465	0.0	138.3	240
360 min Summer	17.780	0.0	150.9	302
480 min Summer	14.023	0.0	158.7	362
600 min Summer	11.606	0.0	164.2	426
720 min Summer	9.917	0.0	168.4	492
960 min Summer	7.702	0.0	174.2	622
1440 min Summer	5.372	0.0	182.0	880
2160 min Summer	3.735	0.0	189.3	1240
2880 min Summer	2.890	0.0	194.7	1588
4320 min Summer	2.028	0.0	203.8	2288
5760 min Summer	1.588	0.0	211.7	3000
7200 min Summer	-0.012	0.0	-1.4	0
8640 min Summer	-0.010	0.0	-1.4	0
10080 min Summer	-0.008	0.0	-1.4	0
15 min Winter	159.600	0.0	54.9	38

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	30.620	0.180	0.0	3.3	3.3	60.2	O K
60 min Winter	30.665	0.225	0.0	3.3	3.3	75.1	O K
120 min Winter	30.717	0.277	0.0	3.3	3.3	92.6	O K
180 min Winter	30.736	0.296	0.0	3.3	3.3	98.9	O K
240 min Winter	30.740	0.300	0.0	3.3	3.3	100.3	O K
360 min Winter	30.728	0.288	0.0	3.3	3.3	96.3	O K
480 min Winter	30.711	0.271	0.0	3.3	3.3	90.5	O K
600 min Winter	30.691	0.251	0.0	3.3	3.3	84.1	O K
720 min Winter	30.672	0.232	0.0	3.3	3.3	77.5	O K
960 min Winter	30.634	0.194	0.0	3.3	3.3	64.8	O K
1440 min Winter	30.572	0.132	0.0	3.2	3.2	44.0	O K
2160 min Winter	30.512	0.072	0.0	3.0	3.0	24.1	O K
2880 min Winter	30.486	0.046	0.0	2.6	2.6	15.4	O K
4320 min Winter	30.463	0.023	0.0	2.0	2.0	7.7	O K
5760 min Winter	30.452	0.012	0.0	1.6	1.6	4.1	O K
7200 min Winter	30.440	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	30.440	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	30.440	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	103.600	0.0	72.1	51
60 min Winter	64.260	0.0	90.1	74
120 min Winter	40.530	0.0	114.2	124
180 min Winter	30.343	0.0	128.5	180
240 min Winter	24.465	0.0	138.2	234
360 min Winter	17.780	0.0	150.9	324
480 min Winter	14.023	0.0	158.7	376
600 min Winter	11.606	0.0	164.2	450
720 min Winter	9.917	0.0	168.3	522
960 min Winter	7.702	0.0	174.2	662
1440 min Winter	5.372	0.0	182.0	920
2160 min Winter	3.735	0.0	189.3	1256
2880 min Winter	2.890	0.0	194.7	1588
4320 min Winter	2.028	0.0	203.8	2292
5760 min Winter	1.588	0.0	211.8	3000
7200 min Winter	-0.012	0.0	-1.4	0
8640 min Winter	-0.010	0.0	-1.4	0
10080 min Winter	-0.008	0.0	-1.4	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 510000 179000 TQ 10000 79000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.950
Cv (Winter)	0.950
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Green Roof

Area (m³) 468 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.008504	32	36	0.001717	64	68	0.000347	96	100	0.000070
4	8	0.006963	36	40	0.001406	68	72	0.000284	100	104	0.000057
8	12	0.005701	40	44	0.001151	72	76	0.000232	104	108	0.000047
12	16	0.004667	44	48	0.000942	76	80	0.000190	108	112	0.000038
16	20	0.003821	48	52	0.000772	80	84	0.000156	112	116	0.000031
20	24	0.003129	52	56	0.000632	84	88	0.000128	116	120	0.000026
24	28	0.002562	56	60	0.000517	88	92	0.000104			
28	32	0.002097	60	64	0.000423	92	96	0.000085			

Time Area Diagram

Total Area (ha) 0.105

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.053	4	8	0.052

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

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Heyne Tillett Steel		Page 4
4 Pear Tree Court London EC1R 0DS	2006 - 9 Nestles Avenue Proposed Surface Water Drainage Network	
Date 29/11/2018 15:11 File 2006 - 9 NESTLES AVENUE...	Designed by AGH Checked by CL	
XP Solutions	Source Control 2018.1.1	

Model Details

Storage is Online Cover Level (m) 31.240

Cellular Storage Structure

Invert Level (m) 30.440 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	352.0	0.0	0.301	0.0	0.0
0.300	352.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0089-3300-0850-3300
Design Head (m)	0.850
Design Flow (l/s)	3.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	89
Invert Level (m)	30.390
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.850	3.3
Flush-Flo™	0.252	3.3
Kick-Flo®	0.545	2.7
Mean Flow over Head Range	-	2.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.7	1.200	3.9	3.000	5.9	7.000	8.8
0.200	3.3	1.400	4.2	3.500	6.4	7.500	9.1
0.300	3.3	1.600	4.4	4.000	6.8	8.000	9.4
0.400	3.2	1.800	4.7	4.500	7.2	8.500	9.7
0.500	2.9	2.000	4.9	5.000	7.5	9.000	10.0
0.600	2.8	2.200	5.1	5.500	7.9	9.500	10.2
0.800	3.2	2.400	5.3	6.000	8.2		
1.000	3.6	2.600	5.5	6.500	8.5		

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BLUE ROOF STORAGE AND OUTFLOW SUMMARY

PRIVATE & CONFIDENTIAL - NOT FOR DISTRIBUTION

abg creative geosynthetic engineering

Project Name:	9 Nestles Avenue, Hayes, UB3 4SA - Roof 1
Prepared for:	Heyne Tillett Steel, London
Date:	29/11/2018
ABG Project ID:	16080 Calculator version: 1.18
Prepared by:	Andrew Keer, andrew@abgltd.com, 07525-808700
Notes/description:	Combined amenity terrace & green roof/lawn, surface finish - sedum mat/lawn turf - TBC. Pedestrian/amenity access only. Warm/inverted roof construction, with zero falls - TBC.

Input Parameters - Rainfall Information (Flood Estimation Handbook 2013)

Return period:	100 years	*As supplied by Client*
Allowance for Climate Change:	40 %	*As supplied by Client*
OS grid reference selected for FEH data:	TQ 10400 78800	

Input Parameters - Roof Information

Catchment area:	260 m^2	*As supplied by Client*
Storage area:	260 m^2	*As supplied by Client*
Maximum allowable runoff:	0.5 l/s	*As supplied by Client*

Output - Rainfall Calculation

Duration	Time to Empty	Restricted Outflow (l/s)
15 mins	9 hours and 0 minutes	0.3
30 mins	11 hours and 40 minutes	0.4
1 hour	13 hours and 50 minutes	0.4
2 hours	16 hours and 0 minutes	0.4
4 hours	17 hours and 30 minutes	0.5
6 hours	17 hours and 40 minutes	0.5
10 hours	16 hours and 40 minutes	0.5
24 hours	11 hours and 10 minutes	0.3
48 hours	2 hours and 40 minutes	0.1

Total storage required: 21.3 m^3
Half empty time: 5 hours and 40 minutes.

Output - Recommended Blue Roof System

System Name:	ABG blueroof VF HD 108mm/129mm
Description:	The blue roof depth of 129mm, includes for a 25mm reservoir board. 2 no. control positions TBC by design team, and also with the structural engineer's deflection analysis.
Total storage capacity:	25.2 m^3
Number of Blue Roof outlets:	2

Notes:

1. This document contains an estimate which has been prepared by ABG Ltd and is illustrative only and not a detailed design.
2. Further details on the theories used in this estimate are available upon request from ABG. The values given are indicative and correspond to nominal results obtained in our laboratories and testing institutes. In line with our policy of continuous improvement the right is reserved to make changes without notice at any time.
3. This estimate is specific to the characteristics of ABG products and is not applicable to other products.
4. The copyright in this document belongs to ABG Ltd.
5. The estimate given in this report is based on the stated parameters as per the brief. If these parameters are not correct or have changed, ABG should be contacted to provide a revised estimate.
6. No guarantee or liability can be drawn from the information in this report.
7. Final determination of the suitability of any information is the sole responsibility of the user. ABG will be pleased to discuss the use of this or any other product but responsibility for selection of a material and its application in any specific project remains with the user.

Blue Roof Estimate

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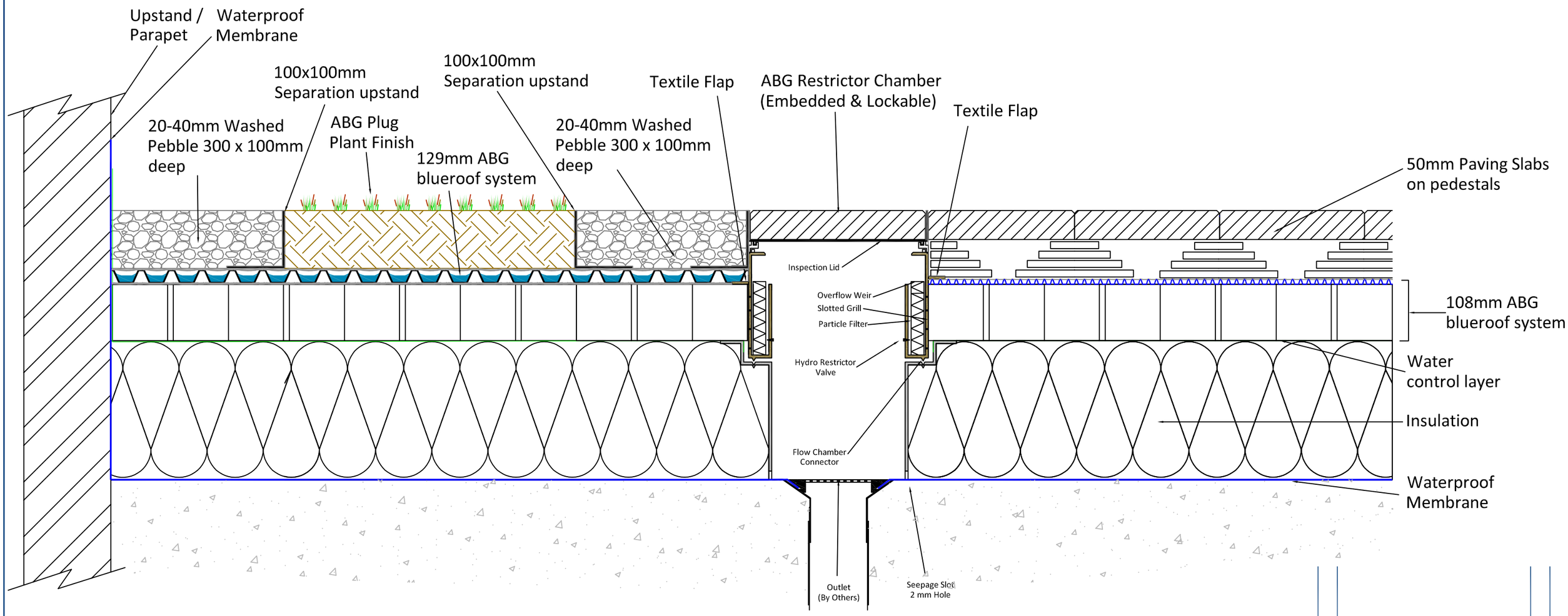

Rev:	Comments:	By:	Date:

Project: Blue Roof - Inverted

Title: Restrictor Chamber & Green Roof / Paved Details

Drawn by:	Date:	
JH	28/05/18	
Scale:	Drawing Ref:	Rev:
NTS	BR02	XX

abg creative geosynthetic engineering

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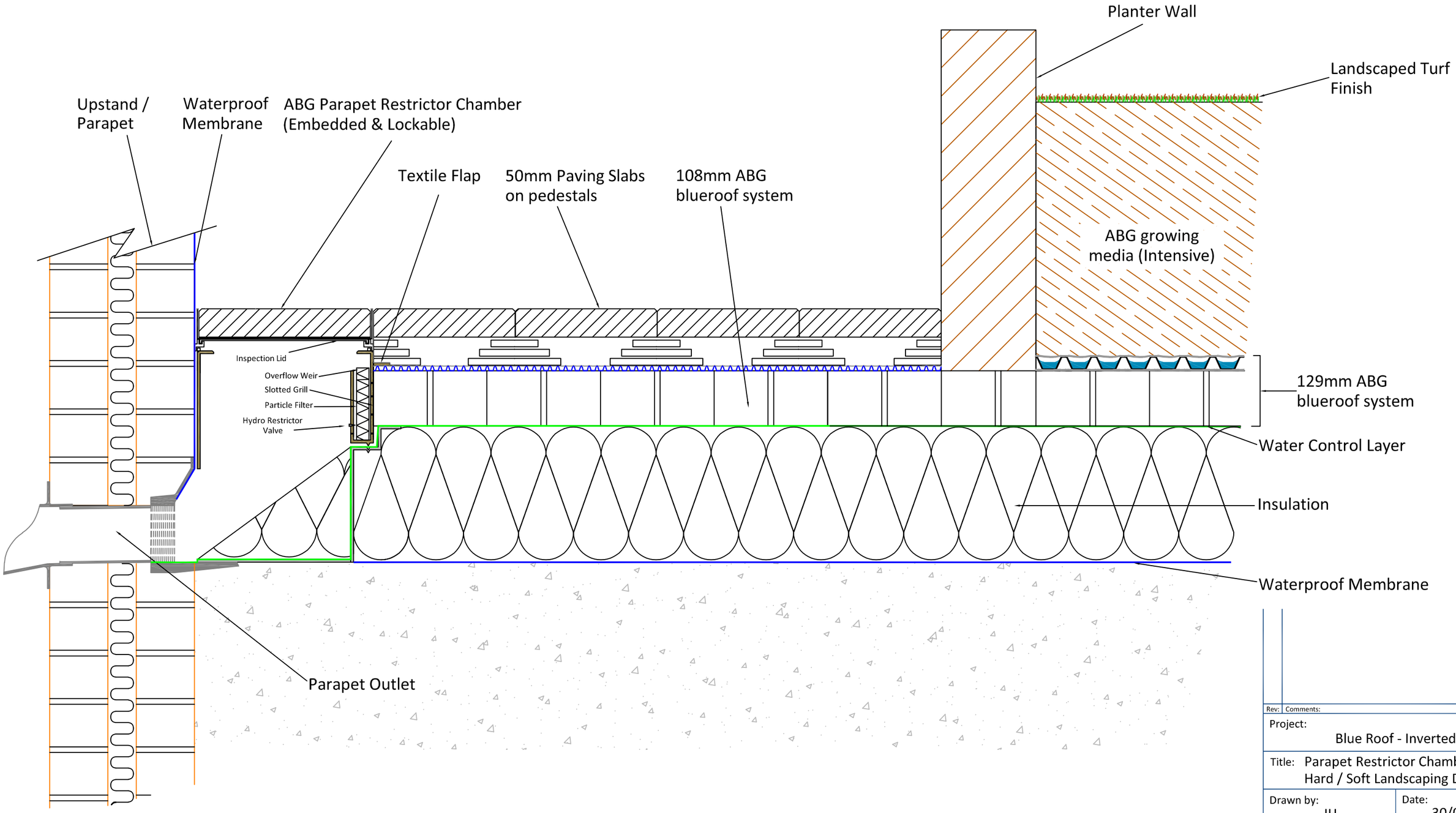
Retaining Walls | Erosion Control | Landfill
Tunnels | Green Roofs | Landscaping | Highways



Rev:	Comments:	By:	Date:

Project: Blue Roof - Inverted

Title: Parapet Restrictor Chamber & Hard / Soft Landscaping Detail

Drawn by:	Date:	
JH	30/05 /18	
Scale: NTS	Drawing Ref: BR09	Rev: XX

abg creative geosynthetic engineering

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Retaining Walls | Erosion Control | Landfill
Tunnels | Green Roofs | Landscaping | Highways

Appendix I

Foul Water Calculations

HEYNE TILLETT STEEL

FOUL WATER FLOW RATES CALCULATIONS BASED ON CONTRIBUTING BUILDING AREA (BASED ON THAMES WATER 'FOUL SEWER DESIGN FLOWS FOR IMPACT STUDIES')

Use	Attributable Floor Area (m2)	Design Flow (l/100sqm/day)* 150 - warehouse 750 - office flow	No. of Hours/Day	Average DWF (l/s)	Daily Volume (m3)
BUILDING A -WAREHOUSE	2536	150.00	10.00	0.11	4
BUILDING A -OFFICES	634	750.00	8.00	0.17	5
			24.00	0.00	0
			8.00	0.00	0
			24.00	0.00	0
			8.00	0.00	0

TOTAL	0.27	8.56
6 DWF INDUSTRIAL PEAK FLOW	1.62	

*__NOTE:__

The warehouse buildings are assumed be operational for 8 hours per day, as required by Thames Water design flow figures of 150 l/100 sqm/day.

The offices are assumed to be opened for 8 hours a day, as required by Thames Water design flow figures of 750 l/100 sqm/day.

Project:	9 Nestles Avenue	***Project No:***	2006
Address:	LB Hillingdon	***Date:***	29/11/18
	Proposed Foul Water Calculations	***Calcs by:***	AGH
		Page No:	1

Proposed Foul Water Peak Discharge Rate (DU method - BS 12056-2:2000)

Development Type:-

- (●) Dwelling, guesthouse, office (intermittent use)
- ( ) Hospital, School, Restaurant, Hotel (frequent use)
- ( ) Toilets and/or shower open to the public (congested use)
- ( ) Laboratory buildings (special use)

Appliance	No.	Discharge Units per Appliance	Total Units
Washbasin	120	0.6	72
Shower	120	0.6	72
Urinal	5	0.8	4
Bath	120	1.3	156
Kitchen Sink	82	1.3	106.6
Dishwasher	82	0.8	65.6
Household Washing Machine	81	0.8	64.8
Commercial Washing Machine	0	1.5	0
WCs	120	2.5	300
Floor Drains	0	2	0

Total Discharge Units for Site 841

Therefore, total flow from site = 14.50 l/s

Appendix J

Thames Water Pre-development correspondence

HEYNE TILLETT STEEL

Planning your wastewater

We've put together some information on sewerage to help you plan your new development.

How long does it take to get consent to connect to a sewer?

If you're applying for consent to connect to a sewer under Section 106 of the Water Industry Act 1991, you'll need to give us 21 days' notice.

I think I'll need to connect to a trunk sewer – is that possible?

Connecting directly to trunk sewers can be complex and dangerous, and we won't permit this at all in London. If you're considering a trunk sewer as a point of connection, please contact us as soon as possible to discuss.

How do I handle trade effluent and groundwater discharges?

You mustn't discharge non-domestic waste to our sewers without a valid trade effluent consent - doing this is an offence under Section 109(1) of the Water Industry Act 1991. You can call our trade effluent team on 0203 577 9200 to get help with trade effluent consents and ground water discharge permits.

Where can I discharge surface water?

The Lead Local Flood Authority, or if you are in a London Borough, 'The London Plan', advises that your development should utilise sustainable drainage systems (SuDS) unless there are practical reasons for not doing so. You should aim to achieve greenfield run-off rates and ensure you manage surface water run-off as close to its source as possible in line with the following drainage hierarchy:

1. Store rainwater for later use.
2. Use infiltration techniques, such as porous surfaces in non-clay areas.
3. Attenuate rainwater in ponds or open water features for gradual release.
4. Attenuate rainwater by storing in tanks or sealed water features for gradual release.
5. Discharge rainwater direct to a watercourse.
6. Discharge rainwater to a surface water sewer or drain.
7. Discharge rainwater to a combined sewer.

Please note that if you're discharging surface water anywhere other than to a public sewer – such as to a watercourse – you'll need approval from the relevant authority, for example the Environment Agency, the local authority or the Canals and Rivers Trust.

If you don't follow the surface water hierarchy you may not be granted planning permission, and Thames Water may seek to put conditions on the planning application.

There's no right of discharge of highway drainage into the public sewerage system, and we'd need to agree this with the relevant highway authority under Section 115 of the Water Industry Act 1991. You can contact us to discuss this further.

What can I do about redundant sewers and rising mains on my site?

On brownfield sites where existing sewers or rising mains need to be made redundant or diverted, the developer will need to fund the work, as set out in Section 185 of the Water Industry Act. If there's no practical way of making a diversion, we'll apply the standoff distances in Sewers for Adoption 7th edition to assess the width of easement required.

Mr K Gyba
KTS
4 Pear Tree Court
London
EC1R 0DS

Our ref: DS6052475

0800 009 3921
Monday to Friday, 8am to 5pm

10TH Sept 2018

Pre-planning enquiry: Wastewater Capacity check

Dear Ms Gyba

Thank you for providing details of your development with the Pre-Planning application dated 23rd Aug 18' for development @ 9 Nestle Avenue Hayes UB3 4SA

{ Brownfield site with 3178m2 of office area , developed to 82 Flats+1 House+ 480 m2 office area}.

Foul

If your proposals progress in line with the details you've provided as above, we're pleased to confirm that there will be sufficient sewerage capacity to serve your foul discharges from your development.

Surface Water

In considering your surface water needs, we support the use of sustainable drainage on development sites.

The surface water drainage strategy should follow policy 5.13 of the London Plan. Typically greenfield run off rates of 5l/s/ha should be aimed for using the drainage hierarchy. The hierarchy lists the preference for surface water disposal as follows; Store Rainwater for later use > Use infiltration techniques, such as porous surfaces in non-clay areas > Attenuate rainwater in ponds or open water features for gradual release > Discharge rainwater direct to a watercourse > Discharge by storing and attenuating rainwater direct to a surface water sewer/drain > Discharge by storing and attenuating rainwater to the combined sewer.

The proposed discharge rate given on your application form (27.5 l/s) is not acceptable. You have to aim for a discharge rate between 2 - 3.8 l/s, by storing and attenuating.

Please refer to the attached document titled ''Planning your wastewater'' attached to this letter, specifically to notes relating to surface water. Also I would advise you to liaise with the LA and discuss their criteria regarding surface water discharges in that area and

adhere to their stipulation. If you agree & adhere to a LA stipulation then TW will be able to accommodate that agreed discharge.

This confirmation is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of three years.

Please note that you must keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient sewerage capacity.

What happens next?

Please make sure you submit your connection application, when you are ready, giving us at least 21 days' notice of the date you wish to make your new connection/s.

If you've any further questions, please contact me.

Yours sincerely

Siva Sivarajan

Developer Services- Wastewater Adoptions Engineer
Office:0203 577 7752 Mobile: 07747842608
siva.sivarajan@thameswater.co.uk

Thames Water Utilities Ltd, Clearwater Court, Vastern Road, Reading, Berkshire, RG1 8DB
Find us online at developers.thameswater.co.uk

TW internal ref: DTS 59072

Appendix K

SuDS Flows and Volumes – Hillingdon LLFA
Technical Assessment Proformance

HEYNE TILLETT STEEL

SuDS Flows and Volumes – Hillingdon LLFA Technical Assessment Proforma

This form identifies the information required by the LLFA to enable technical assessment of flows and volumes determined as part of drainage / SuDS calculations. *Note : * means delete as appropriate; Numbers in brackets refer to accompanying notes.*

SITE BACKGROUND INFORMATION

1.0 SITE DETAILS AND RELEVANT CLASSIFICIATIONS

1.1 Planning application reference 51175/PRC/2018/151

1.2 Site name 9 Nestles Avenue, Hayes, UB3 4SA

1.3 Total application site area (1) 2550 m² 0.255 ha

1.4 Is the site in an area at SW flood risk, a CDA or LFRZ (see L.B. Hillingdon website SWMP) Y / N

1.5 Is the site located in a SPZ (refer to Environment Agency website Groundwater) Y / N

2.0 VOLUME AND FLOW DESIGN INPUTS

2.1 Site area which is positively drained by SuDS (2) 1780 m²

2.2 Impermeable area drained pre development (3) 2550 m²

2.3 Impermeable area drained post development (3) 1780 m²

2.4 Additional impermeable area (2.3 minus 2.2) 770 m²

2.5 Predevelopment use (4) Greenfield / Brownfield / Mixed*

2.6 Coefficient of runoff (Cv) (6) 0.95

The LLFA would typically anticipate a Cv of 0.95 from roofed areas and a Cv of 0.9 from other hard standing areas.
These values should be applied for both summer and winter scenarios if using hydraulic design software

2.7 Justification for Cv used if less than this ……

2.8 FEH rainfall data used (for Hillingdon typical value 4l/s/ha (Note that FSR not to be used)) Y / N

3.0 DISCHARGE(5)

3.1 Infiltration
Rate (evidence to be supplied to BRE365 as minimum) N/A m/s
Influencing factors on infiltration N/A
Depth to highest known ground water table N/A mAOD
Appropriate site investigations should be undertaken at the likely highest ground water level time in the year, as this fluctuates.

3.2 Waterbody
Invert level at outlet (invert level of final flow control) N/A mAOD
1in 100 year plus CC Waterbody Flood Level N/A mAOD
Surcharged outfall Y / N

3.3 Adopted surface water storm sewer (Note no combined sewer in LBH)
Provide confirmation of invert levels at discharge point Y / N

SuDS Flows and Volumes – Hillingdon LLFA Technical Assessment Proforma

3.4 Private Sewer
Provide condition and levels of private system and any remediation works Y / N
Provide legal easement agreement, where not within same ownership Y / N

CALCULATION OUTPUTS REQUIRED

FEH does not provide results for the 1 in 1 year event - 1 in 2 year figures have been shown here instead

Note: Sections 3 and 4 refer to site where storage is provided by attenuation and / or partial infiltration. Where all flows are infiltrated to ground omit Sections 3 -5 and complete Section 6.

4.0 Defining rate of runoff from the site and betterment. These values must be calculated for each return period and should vary.

	Max Discharge	Greenfield		Existing		Proposed		Reduction
		l/s/ha	l/s for the site	l/s/ha	l/s for the site	l/s/ha	l/s for the site	%
4.1	1 in 1 year rainfall	N/A	N/A	103.5	26.4	21.3	3.8	86
4.2	Q_{med} rainfall	3.5	0.9	N/A	N/A	N/A	N/A	N/A
4.3	1 in 30 year rainfall	N/A	N/A	301.6	76.9	21.3	3.8	95
4.4	1 in 100 year rainfall	N/A	N/A	392.2	100.0	21.3	3.8	96
4.5	1 in 100 year plus 40%CC	N/A	N/A	N/A	N/A	21.3	3.8	N/A

5.0 Attenuation storage to manage peak runoff rates from the site. These values must be calculated for each

		m³	m³/m² (of developed impermeable area)
5.1	Storage - 1 in 1 year	60	60/1780
5.2	Storage - 1in 30 year (7)	69	69/1780
5.3	Storage - 1in 100 year (8)	89	89/1780
5.4	Storage - 1 in 100 year plus 40%CC (10)	146	146/1780

6.0 Controlling volume of runoff from the site

6.1 Pre development runoff volume 264 m³ for the site

6.2 Post development runoff volume (unmitigated) 183 m³ for the site

6.3 Volume to be controlled/ does not leave site (5.2 - 5.1) 81 m³ for the site

Results genertated for 1 in 100 year event

6.4 Volume control provided by:
1. Interception losses(12) 0 m³
2. Rain harvesting(13) tbc - following detailed design m³
3. Infiltration (even at very low rates) 0 m³
4. Separate area designated as long term storage(14) 0 m³

6.5 Total volume control (sum of inputs for 5.4 (1-4) tbc - following detailed design m³ (15)

7.0 Site storage volumes (full infiltration only)

7.1 Storage - 1in 30 year (7) ……m³ ……m³/m² (of developed impermeable area)
7.2 Storage - 1 in 100 year plus CC (8) ……m³ ……m³/m²

SuDS Flows and Volumes –
Hillingdon LLFA Technical Assessment Proforma

Notes

1. All area with the proposed application site boundary to be included.
2. The site area which is positively drained, includes all green areas which drain to the SuDS system and area of surface SuDS features. It excludes large open green spaces which do not drain to the SuDS system. http://www.uksuds.com/
3. Impermeable area should be measured pre and post development. Impermeable surfaces includes, roofs, pavements, driveways and paths where runoff is conveyed to the drainage system.
4. Predevelopment use may impact on the allowable discharge rate. The LLFA will seek for reduction in flow rates to GF status in all instances. The design statement and drawings explain / demonstrate how flows will be managed from the site.
5. Runoff may be discharge via one or a number of means.
6. Sewers for Adoption 6th Edition recommends a Cv of 100% when designing drainage for impermeable area (assumes no loss of runoff from impermeable surfaces) and 0% for permeable areas. Where lower Cv's are used the application should justify the selection of Cv.
7. Storage for the 1 in 30 year must be fully contained within the SuDS components. Note that standing water within SuDS components such as ponds, basins and swales is not classified as flooding. Storage should be calculated for the critical duration rainfall event.
8. Runoff generated from rainfall events up to the 1 in 100 year (plus Climate Change) will not be allowed to leave the site in an uncontrolled way.
9. Temporary flooding of specified areas to shallow depths (150-300mm) may be permitted in agreement with the LLFA.
10. Climate change is specified as 40% increase to rainfall intensity, unless otherwise agreed with the LLFA / EA.
11. To be determined using the 100 year return period 6 hour duration rainfall event.
12. Where Source Control is provided Interception losses will occur. An allowance of 5mm rainfall depth can be subtracted from the net inflow to the storage calculation where interception losses are demonstrated. The Applicant should demonstrate use of subcatchments and source control techniques.
13. Please refer to Rainwater harvesting systems BS 8515:2009+A1:2013 for guidance on available storage.
14. Flow diverted to Long term storage areas should be infiltrated to the ground, or where this is not possible, discharged to the receiving water at slow flow rates (maximum 2 l/s/ha). LT storage would not be allowed to empty directly back into attenuation storage and would be expected to drain away over 5-10 days. Typically LT storage may be provided on multi-functional open space or sacrificial car parking areas.
15. Careful consideration should be used for calculations where flow control / storage is likely to be influenced by surcharged sewer or peak levels within a watercourse. Storm sewers are designed for pipe full capacity for 1 in 1 - 1 in 5year return period. Beyond this, the pipe network will usually be in conditions of surcharge. Where information cannot be gathered from Thames Water, engineering judgement should be used to evaluate potential impact (using sensitivity analysis for example).
16. In controlling the volume of runoff the total volume from mitigation measures should be greater than or equal to the additional volume generated.