



MasterDrain
SW

Muir Associates (UK) Limited

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Job No. 18-1022		
Sheet no. 1		
Date 31/07/18		
By	Checked	Reviewed

Project **Bridge Road North Wrexham**

Title **Preliminary Attenuation Calculations 1 in 100 + 30% Climate Change**

Data:-

Location = WREXHAM Grid reference = SJ3349
M5-60 (mm) = 18 r = 0.32
Soil index = 0.45 SAAR (mm/yr) = 800
Return period = 100 WRAP = 4
UCWI = 0.0 Climate change = 30%

Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.

Pipeline storage = 0.0 m³ Available MH storage = 0.0 m³
Offline storage = 0.0 m³

Percentage runoff = 95.0% (manual setting)

Imperv. area = 7250 m² Pervious area = 0 m²
Total area = 7250 m² Equiv area = 6888 m² (Tot. area x % runoff).
Total runoff = 666.7 m³ Discharge rate = 5.000 l/s
Storage (m³) = 479.7 m³ (Sum of all balance quantities)
Total rainfall depth = 96.8 mm

Calculations :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
0.120	20.0	1.6	1.333	2.160	0.000	0.000
0.240	20.0	1.6	1.333	2.160	0.000	0.000
0.360	21.0	1.7	1.400	2.160	0.000	0.000
0.480	21.0	1.7	1.400	2.160	0.000	0.000
0.600	22.0	1.8	1.467	2.160	0.000	0.000
0.720	23.0	1.9	1.533	2.160	0.000	0.000
0.840	24.0	1.9	1.600	2.160	0.000	0.000
0.960	26.0	2.1	1.733	2.160	0.000	0.000
1.080	27.0	2.2	1.800	2.160	0.000	0.000
1.200	29.0	2.3	1.933	2.160	0.000	0.000
1.320	31.0	2.5	2.067	2.160	0.000	0.000
1.440	32.0	2.6	2.133	2.160	0.000	0.000
1.560	33.0	2.7	2.200	2.160	0.040	0.040
1.680	34.0	2.7	2.267	2.160	0.107	0.147
1.800	36.0	2.9	2.400	2.160	0.240	0.387
1.920	38.0	3.1	2.533	2.160	0.373	0.761
2.040	39.0	3.1	2.600	2.160	0.440	1.201
2.160	40.0	3.2	2.667	2.160	0.507	1.708
2.280	42.0	3.4	2.800	2.160	0.640	2.348
2.400	45.0	3.6	3.000	2.160	0.840	3.188
2.520	49.0	4.0	3.267	2.160	1.107	4.295
2.640	53.0	4.3	3.534	2.160	1.374	5.668
2.760	57.0	4.6	3.800	2.160	1.640	7.309
2.880	62.0	5.0	4.134	2.160	1.974	9.282
3.000	66.0	5.3	4.400	2.160	2.240	11.522
3.120	71.0	5.7	4.734	2.160	2.574	14.096
3.240	77.0	6.2	5.134	2.160	2.974	17.070
3.360	84.0	6.8	5.600	2.160	3.440	20.510
3.480	91.0	7.3	6.067	2.160	3.907	24.417
3.600	98.0	7.9	6.534	2.160	4.374	28.791
3.720	105.0	8.5	7.000	2.160	4.840	33.631
3.840	114.0	9.2	7.600	2.160	5.440	39.072
3.960	125.0	10.1	8.334	2.160	6.174	45.246
4.080	135.0	10.9	9.001	2.160	6.841	52.086
4.200	143.0	11.5	9.534	2.160	7.374	59.460
4.320	154.0	12.4	10.267	2.160	8.107	67.567
4.440	164.0	13.2	10.934	2.160	8.774	76.341
4.560	173.0	14.0	11.534	2.160	9.374	85.715
4.680	183.0	14.8	12.201	2.160	10.041	95.756
4.800	194.0	15.6	12.934	2.160	10.774	106.530



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Calculations (cont.) :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
4.920	204.0	16.5	13.601	2.160	11.441	117.971
5.040	212.0	17.1	14.134	2.160	11.974	129.945
5.160	219.0	17.7	14.601	2.160	12.441	142.386
5.280	226.0	18.2	15.068	2.160	12.908	155.294
5.400	233.0	18.8	15.534	2.160	13.374	168.668
5.520	239.0	19.3	15.934	2.160	13.774	182.442
5.640	244.0	19.7	16.268	2.160	14.108	196.550
5.760	248.0	20.0	16.534	2.160	14.374	210.925
5.880	249.0	20.1	16.601	2.160	14.441	225.366
6.000	250.0	20.2	16.668	2.160	14.508	239.873
6.120	250.0	20.2	16.668	2.160	14.508	254.381
6.240	249.0	20.1	16.601	2.160	14.441	268.822
6.360	248.0	20.0	16.534	2.160	14.374	283.196
6.480	244.0	19.7	16.268	2.160	14.108	297.304
6.600	239.0	19.3	15.934	2.160	13.774	311.078
6.720	233.0	18.8	15.534	2.160	13.374	324.453
6.840	226.0	18.2	15.068	2.160	12.908	337.360
6.960	219.0	17.7	14.601	2.160	12.441	349.801
7.080	212.0	17.1	14.134	2.160	11.974	361.775
7.200	204.0	16.5	13.601	2.160	11.441	373.216
7.320	194.0	15.6	12.934	2.160	10.774	383.990
7.440	183.0	14.8	12.201	2.160	10.041	394.031
7.560	173.0	14.0	11.534	2.160	9.374	403.405
7.680	164.0	13.2	10.934	2.160	8.774	412.179
7.800	154.0	12.4	10.267	2.160	8.107	420.286
7.920	143.0	11.5	9.534	2.160	7.374	427.660
8.040	135.0	10.9	9.001	2.160	6.841	434.501
8.160	125.0	10.1	8.334	2.160	6.174	440.675
8.280	114.0	9.2	7.600	2.160	5.440	446.115
8.400	105.0	8.5	7.000	2.160	4.840	450.956
8.520	98.0	7.9	6.534	2.160	4.374	455.329
8.640	91.0	7.3	6.067	2.160	3.907	459.236
8.760	84.0	6.8	5.600	2.160	3.440	462.677
8.880	77.0	6.2	5.134	2.160	2.974	465.650
9.000	71.0	5.7	4.734	2.160	2.574	468.224
9.120	66.0	5.3	4.400	2.160	2.240	470.464
9.240	62.0	5.0	4.134	2.160	1.974	472.438
9.360	57.0	4.6	3.800	2.160	1.640	474.078
9.480	53.0	4.3	3.534	2.160	1.374	475.452
9.600	49.0	4.0	3.267	2.160	1.107	476.559
9.720	45.0	3.6	3.000	2.160	0.840	477.399
9.840	42.0	3.4	2.800	2.160	0.640	478.039
9.960	40.0	3.2	2.667	2.160	0.507	478.546
10.080	39.0	3.1	2.600	2.160	0.440	478.986
10.200	38.0	3.1	2.533	2.160	0.373	479.359
10.320	36.0	2.9	2.400	2.160	0.240	479.600
10.440	34.0	2.7	2.267	2.160	0.107	479.706
10.560	33.0	2.7	2.200	2.160	0.040	479.746
10.680	32.0	2.6	2.133	2.160	0.000	479.720
10.800	31.0	2.5	2.067	2.160	0.000	479.627
10.920	29.0	2.3	1.933	2.160	0.000	479.400
11.040	27.0	2.2	1.800	2.160	0.000	479.040
11.160	26.0	2.1	1.733	2.160	0.000	478.614
11.280	24.0	1.9	1.600	2.160	0.000	478.054
11.400	23.0	1.9	1.533	2.160	0.000	477.427
11.520	22.0	1.8	1.467	2.160	0.000	476.734
11.640	21.0	1.7	1.400	2.160	0.000	475.974
11.760	21.0	1.7	1.400	2.160	0.000	475.214
11.880	20.0	1.6	1.333	2.160	0.000	474.388
12.000	20.0	1.6	1.333	2.160	0.000	473.561

Storage volume (m³) = 479.7 m³ (Sum of all balance quantities)



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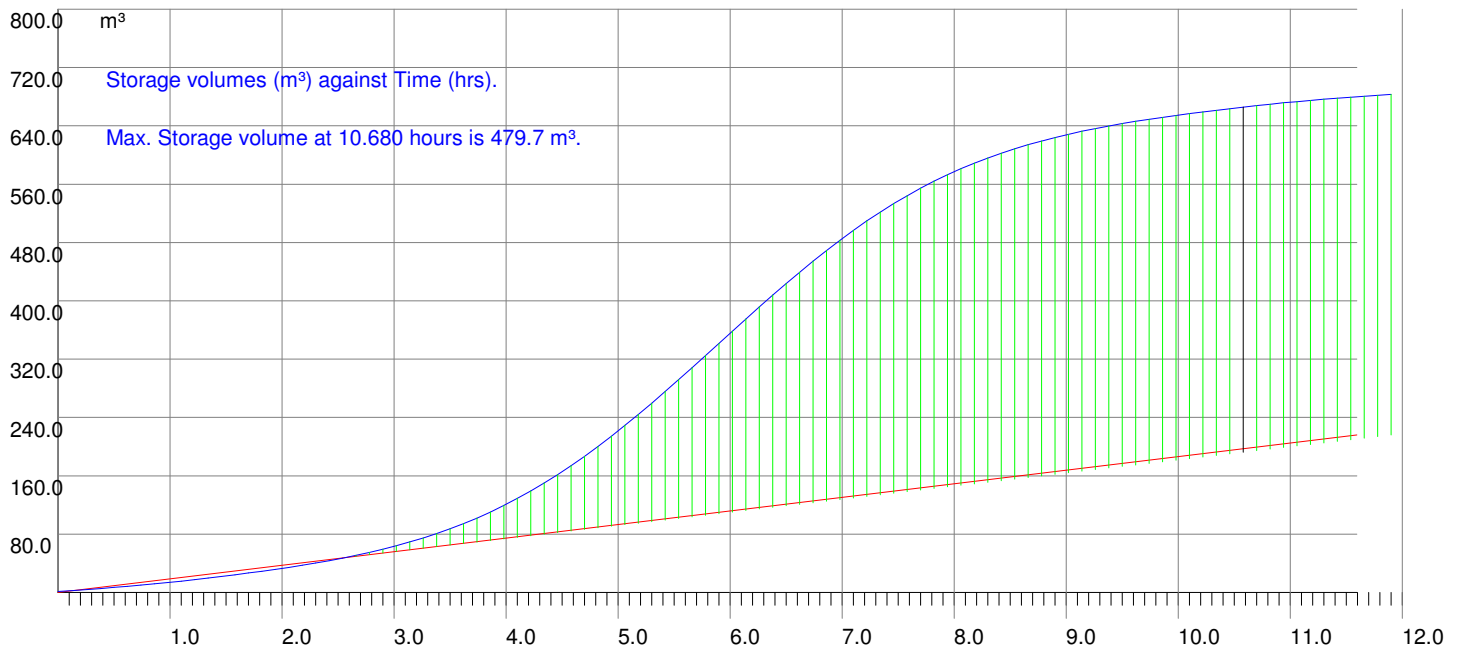
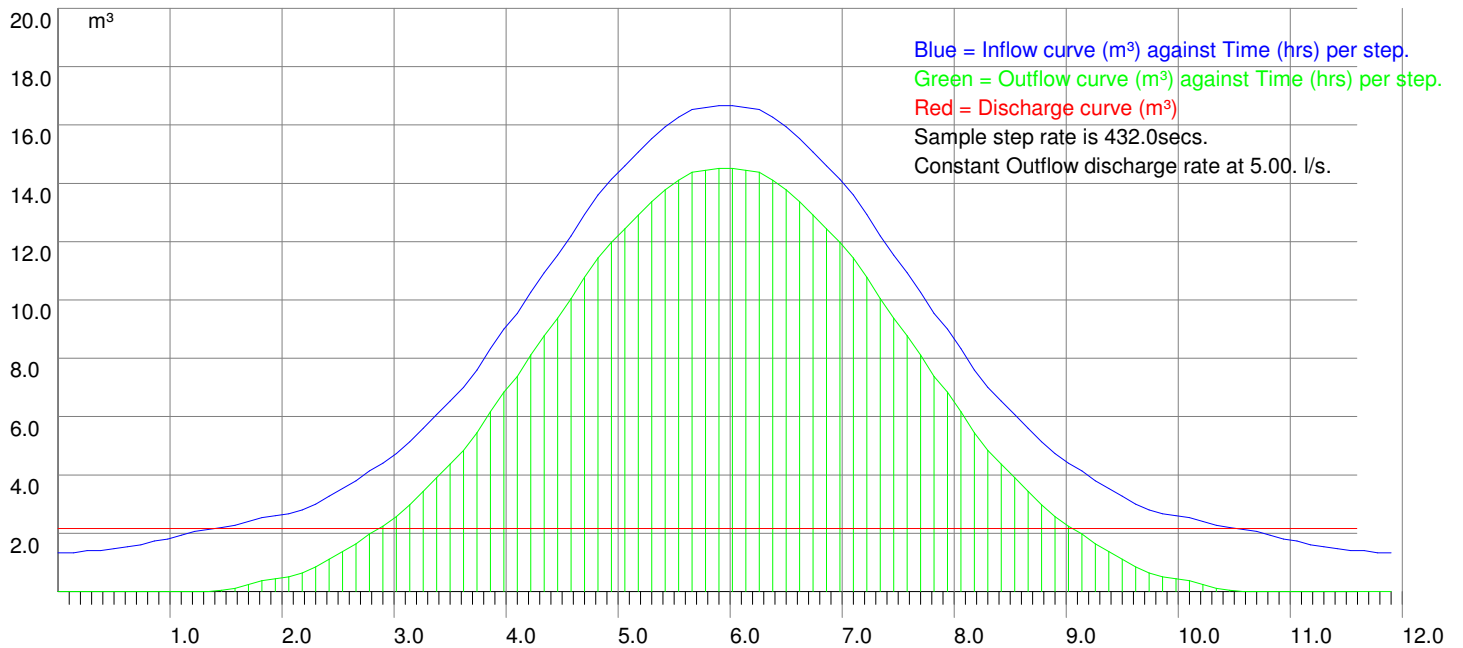
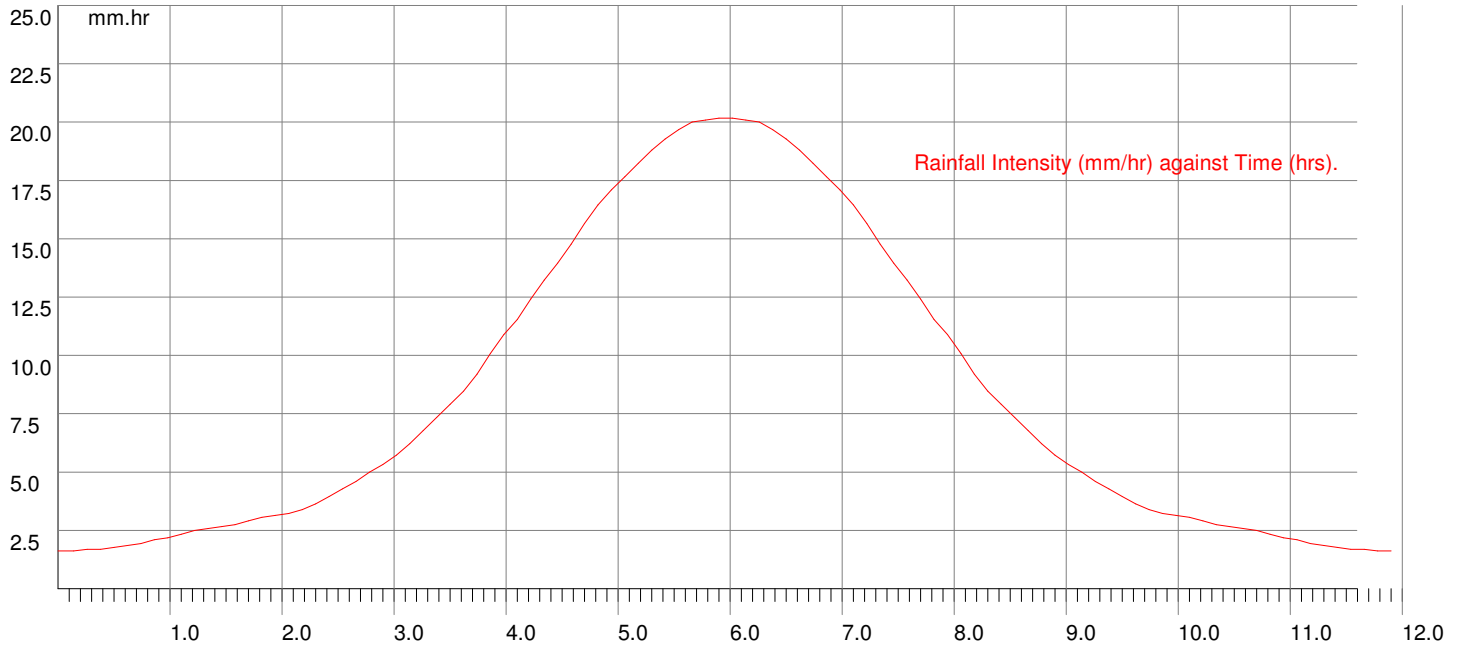
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Maximum storage volumes for varying duration storms.

Storm length (hrs)	Max. Vol (m ³)	Max. Vol time	Mean intens (mm/hr)	Step time. (mins)	Peak found
0.25	182.03	0.25	105.69	0.2	
0.5	245.81	0.50	72.19	0.3	
1	315.09	1.00	47.18	0.6	
2	384.99	2.00	29.82	1.2	
3	421.62	3.00	22.46	1.8	
4	442.74	4.00	18.23	2.4	
5	455.03	5.00	15.44	3.0	
6	463.94	6.00	13.50	3.6	
7	470.00	7.00	12.05	4.2	
8	474.40	8.00	10.91	4.8	
9	477.29	9.00	10.00	5.4	
10	479.04	10.00	9.24	6.0	
12	479.75	12.00	8.07	7.2	Peak found
15	477.29	---	6.82	9.0	
18	472.52	---	5.95	10.8	
20	468.14	---	5.49	12.0	
24	456.94	---	4.78	14.4	
30	436.47	---	4.04	18.0	
36	413.88	---	3.51	21.6	
42	389.79	---	3.12	25.2	
48	365.20	---	2.81	28.8	
54	340.46	---	2.57	32.4	
60	315.98	---	2.37	36.0	
66	291.70	---	2.20	39.6	
72	267.43	---	2.06	43.2	
84	220.49	---	1.83	50.4	
96	176.91	---	1.64	57.6	
120	100.67	---	1.38	72.0	
150	28.38	---	1.16	90.0	
175	0.00	---	1.03	105.0	
200	0.00	---	0.93	120.0	
250	0.00	---	0.79	150.0	
300	0.00	---	0.68	180.0	
375	0.00	---	0.58	225.0	
500	0.00	---	0.46	300.0	
750	0.00	---	0.34	450.0	
1000	0.00	---	0.28	600.0	
1250	0.00	---	0.24	750.0	
1500	0.00	---	0.21	900.0	
1570	0.00	---	0.20	942.0	
2000	0.00	---	0.17	1200.0	
2500	0.00	---	0.14	1500.0	
3000	0.00	---	0.12	1800.0	
3500	0.00	---	0.11	2100.0	
4000	0.00	---	0.10	2400.0	



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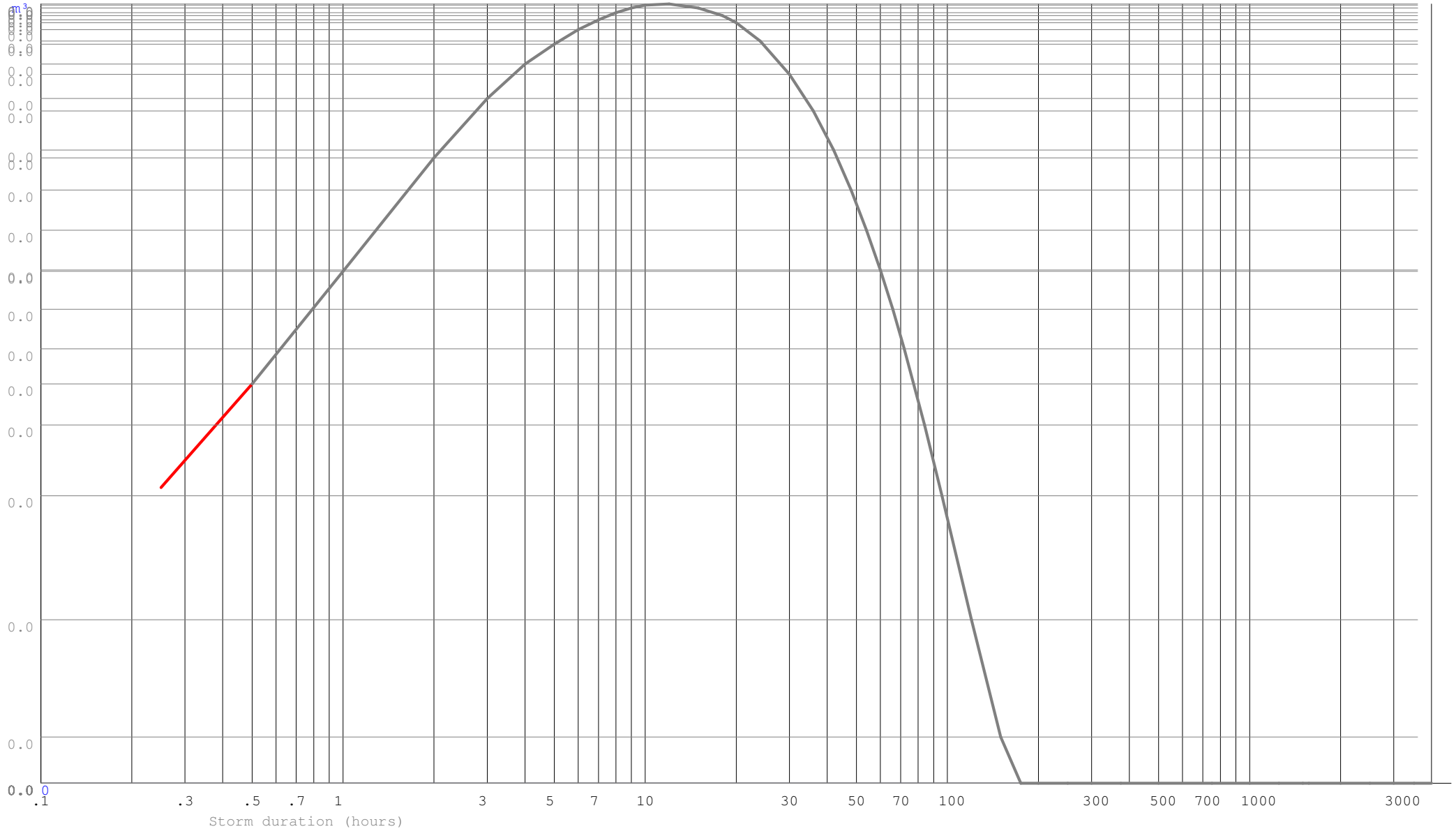
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Explanatory notes for Peak Flow Storage

- 1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
- 2) The balance is calculated from the inflow minus the outflow.
- 3) The storage volume is the maximum value of the balance curve.
- 4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
- 5) References to 'storm duration' relate only to the hydrograph method (qv).
- 6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

- 1) The user has the choice of Summer or Winter curves
- 2) The mean intensity varies with the duration of the storm curve
- 3) There are always 120 steps in the calculation process, irrespective of storm duration.
- 4) The balance is calculated from the inflow minus the outflow.
- 5) The storage volume is the sum of the balance values for each step.
- 6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function.
Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.