MasterDrain SW

MASTERDRAIN
The alternative drainage design software
http://www.mstdrain.co.uk.

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Job No.	Sheet no.	Date	By	Checked	Approved
1234/2010	1	24/09/10	IJ		

Project

Title: Peak flow storage calcs for BECKENHAM

Data:-

FSR Hydrology:-

Location = BECKENHAM
M5-60 (mm) = 20
Soil index = 0.15
Return period = 100
UCWI = 67.7

Grid reference = TQ3769
r = 0.41
SAAR (mm/yr) = 660
WRAP = 1

i) Well drained permeable sandy or loam soils and shallower analogues over highly permeable limestone, chalk, sandstone or related drifts;
ii) Earthy peat soils drained by dykes and pumps;
iii) Less permeable loamy over clayey soils on plateaux adjacent to very permeable soils in valleys.

User Runoff factor factors =

Factor for Impervious areas = 95%
Factor for Pervious areas = 33%

Design data:-

Imperv. area = 15175 m²
Total area (TA) = 15175 m²
Discharge to drain = 5.00 l/s
Additional flow = 0.00 l/s

Pervious area = 0 m²
Equiv area = 10774 m² (TA x RF).
Areal reduction factor = 0.974

Calculated data:-

Time to max = 630.0 mins
Rainfall at max = 6.47 mm/hr

Storage volume = 790.7 m³
Discharge rate per Ha = 3.29 l/s/Ha

Adjustments to result for climate change:-

Volume + 10% for normal discharge (W5-074) - Storage volume = 869.8 m³
Volume + 20% for discharge into river flows (DEFRA)- Storage volume = 948.8 m³
Volume + 30% for EA residential requirements - Storage volume = 1027.9 m³
Volume + 50% for other residential requirements - Storage volume = 1186.0 m³

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len
100	100693.6	1125	795.6
150	44752.7	1200	699.3
225	19890.1	1275	619.4
300	11188.2	1350	552.5
375	7160.4	1425	495.9
450	4972.5	1500	447.5
525	3653.3	1575	405.9
600	2797.0	1650	369.9
675	2210.0	1725	338.4
750	1790.1	1800	310.8
825	1479.4	1875	286.4
900	1243.1	1950	264.8
975	1059.2	2025	245.6
1050	913.3	2100	228.3

Ovoid	Len
400 x 600	4392.8
600 x 900	1912.7
800 x 1200	1075.7

Box culvert	Len
500 x 500	3162.8
500 x 750	2108.5
500 x 1000	1581.4
750 x 1000	1054.3
750 x 1200	878.6
750 x 1500	702.8
1000 x 1000	790.7
1000 x 1200	658.9
1000 x 1500	527.1
1000 x 1800	439.3
1000 x 2000	395.3
1500 x 1500	351.4
1500 x 1800	292.9
1500 x 2000	263.6

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Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
20	84.0	401.425	6.000	395.425
40	53.0	512.272	12.000	500.272
60	40.0	578.771	18.000	560.771
80	33.0	626.546	24.000	602.546
100	28.0	663.838	30.000	633.838
120	24.0	694.376	36.000	658.376
140	21.0	720.173	42.000	678.173
160	19.0	742.447	48.000	694.447
180	18.0	761.996	54.000	707.996
200	16.0	779.368	60.000	719.368
220	15.0	794.959	66.000	728.959
240	14.0	809.065	72.000	737.065
260	13.0	821.915	78.000	743.915
280	12.0	833.684	84.000	749.684
300	12.0	845.465	90.000	755.465
320	11.0	856.671	96.000	760.671
340	11.0	867.277	102.000	765.277
360	10.0	877.347	108.000	769.347
380	10.0	886.937	114.000	772.937
400	9.0	896.092	120.000	776.092
420	9.0	904.853	126.000	778.853
440	9.0	913.255	132.000	781.255
460	8.0	921.328	138.000	783.328
480	8.0	929.098	144.000	785.098
500	8.0	936.588	150.000	786.588
520	8.0	943.819	156.000	787.819
540	7.0	950.810	162.000	788.810
560	7.0	957.577	168.000	789.577
580	7.0	964.134	174.000	790.134
600	7.0	970.496	180.000	790.496
620	7.0	976.673	186.000	790.673
640	6.0	982.678	192.000	790.678
660	6.0	988.519	198.000	790.519
680	6.0	994.207	204.000	790.207
700	6.0	999.749	210.000	789.749
720	6.0	1005.153	216.000	789.153
740	6.0	1010.427	222.000	788.427
760	6.0	1015.576	228.000	787.576
780	5.0	1020.608	234.000	786.608
800	5.0	1025.526	240.000	785.526
820	5.0	1030.338	246.000	784.338
840	5.0	1035.047	252.000	783.047
860	5.0	1039.657	258.000	781.657
880	5.0	1044.174	264.000	780.174
900	5.0	1048.602	270.000	778.602
920	5.0	1052.943	276.000	776.943
940	5.0	1057.201	282.000	775.201
960	5.0	1061.380	288.000	773.380
980	5.0	1065.483	294.000	771.483
1000	4.0	1069.512	300.000	769.512
1020	4.0	1073.471	306.000	767.471
1040	4.0	1077.361	312.000	765.361
1060	4.0	1081.186	318.000	763.186
1080	4.0	1084.947	324.000	760.947
1100	4.0	1088.647	330.000	758.647
1120	4.0	1092.288	336.000	756.288
1140	4.0	1095.871	342.000	753.871
1160	4.0	1099.399	348.000	751.399
1180	4.0	1102.873	354.000	748.873
1200	4.0	1106.296	360.000	746.296

Storage volume (m^3) = 790.7 m^3

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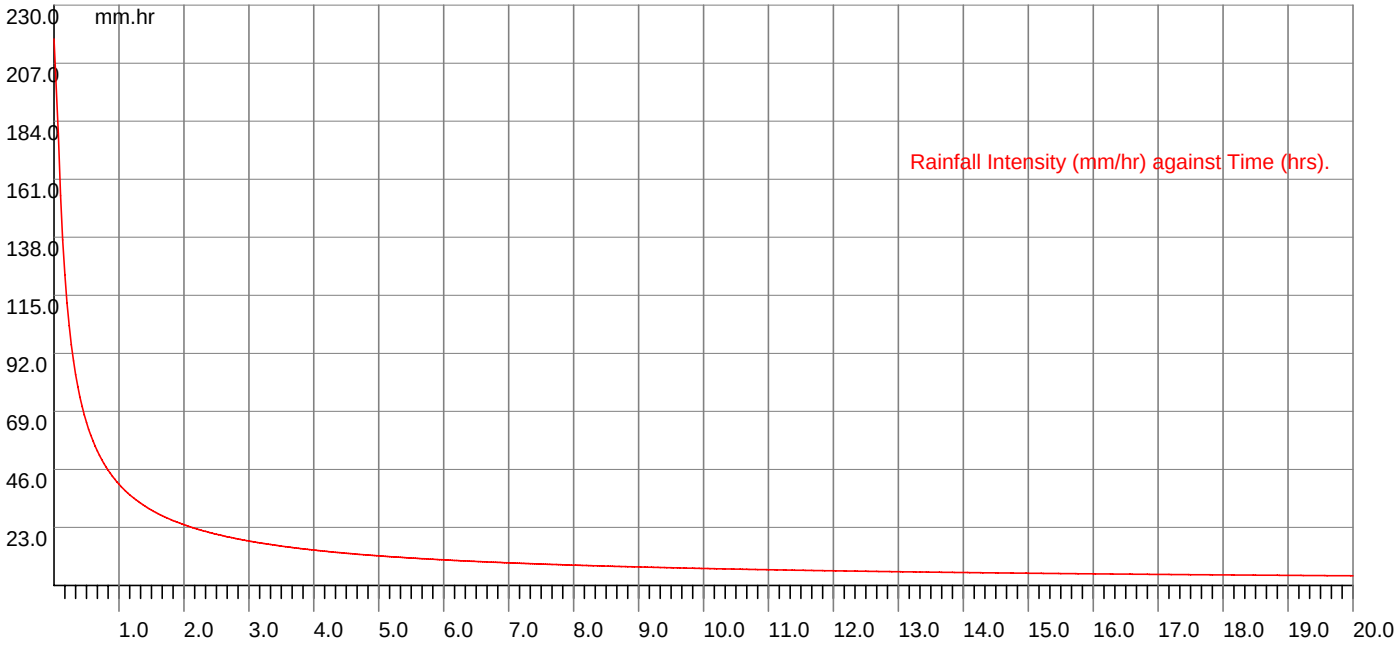
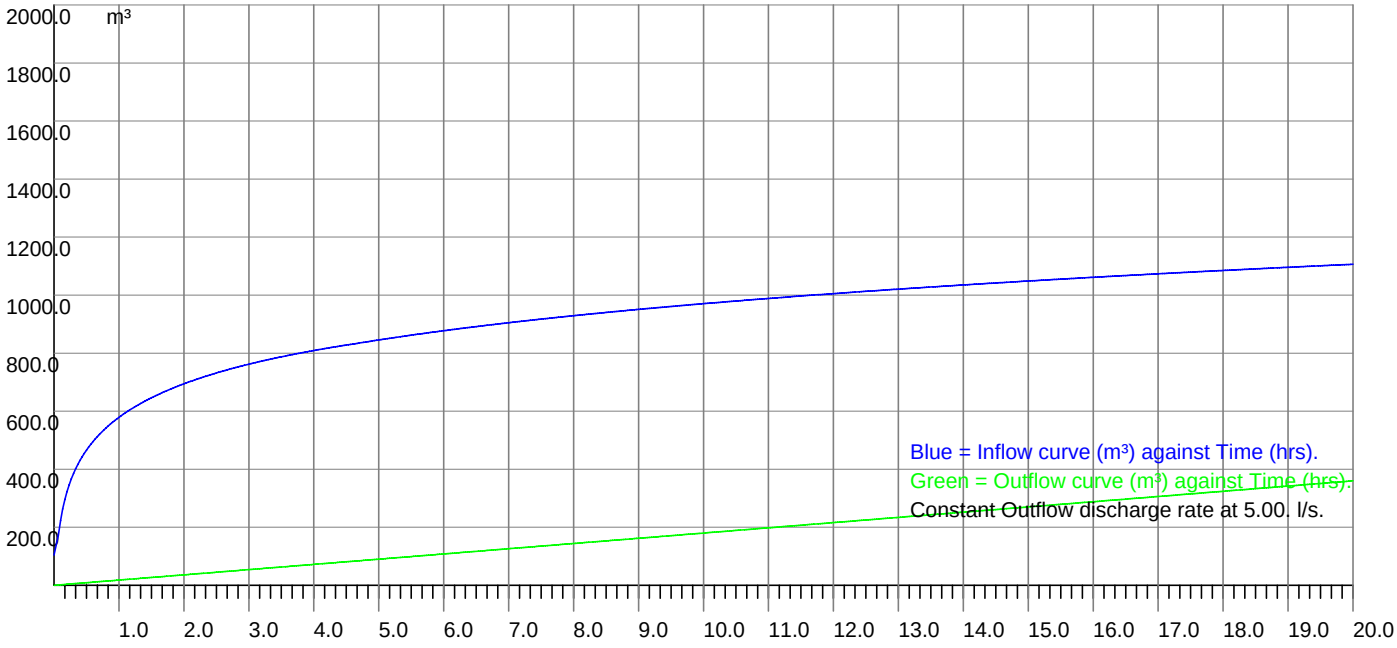
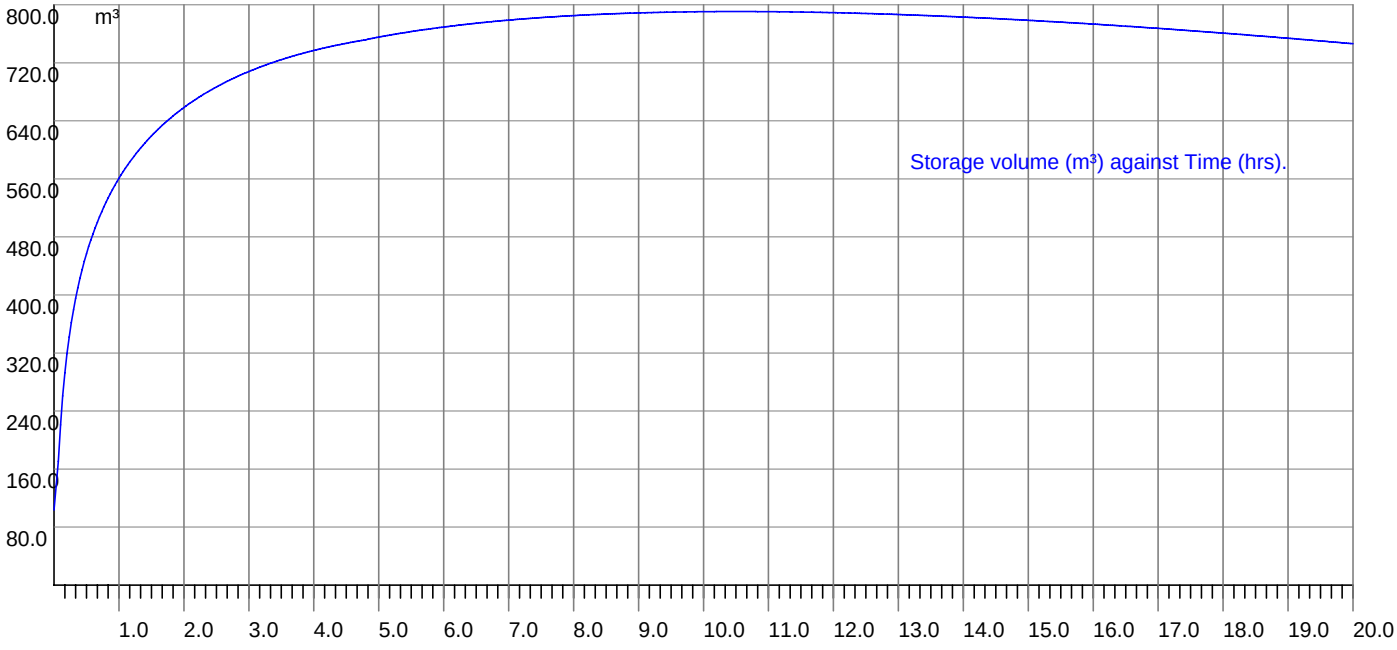
Project

Title **Peak flow storage calcs for BECKENHAM**







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Title: **Peak flow storage calcs for BECKENHAM**

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 outflow is regarded as constant for the duration of the storm; i.e. no allowance is made for the changing head behind the flow restrictor.*
3) The balance is calculated from the inflow minus the outflow.
4) The storage volume is the maximum value of the balance curve.
5) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
6) References to 'storm duration' relate only to the hydrograph method (qv).
7) 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 outflow is regarded as constant for the duration of the storm; i.e. no allowance is made for the changing head behind the flow restrictor.*
5) The balance is calculated from the inflow minus the outflow.
6) The storage volume is the sum of the balance values for each step.
7) 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.