



Rigby & Partners LLP

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Job No.		
Sheet no. 0		
Date 28/09/18		
By	Checked	Reviewed

MasterDrain
SW

Project **Rowan Foods Freezer Ext & new road entrance**
Title **Peak flow storage calcs for WREXHAM**

Data:-

FSR Hydrology:-

Location = WREXHAM
M5-60 (mm) = 18
Soil index = 0.45
Return period = 100
UCWI = 84.0

Grid reference = SJ3349
r = 0.32
SAAR (mm/yr) = 800
WRAPx = 4

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

Runoff factor (RF) = 80.0, calculated from:-

$$\text{Runoff factor} = (0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$$

where

PIMP = Impervious Area*100/(Impervious Area+Pervious Area)

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 1200 m²
Total area (TA) = 1200 m²
Discharge to drain = 0.530 l/s
Additional flow = 0.00 l/s

Pervious area = 0 m²
Equiv area = 960 m² (TA x RF)
Areal reduction factor = 1.000
Climate change factor = 40

Calculated data:-

Time to max = 808.0 mins
Rainfall at max = 7.97 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 77.3 m³
Discharge rate per Ha = 4.42 l/s/Ha
Available MH storage = 0.0 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	Ovoid	Len	Box culvert	Len
100	9845.5	1125	77.8	400 x 600	429.5	500 x 500	309.2
150	4375.8	1200	68.4	600 x 900	187.0	500 x 750	206.2
225	1944.8	1275	60.6	800 x 1200	105.2	500 x 1000	154.6
300	1093.9	1350	54.0			750 x 1000	103.1
375	700.1	1425	48.5			750 x 1200	85.9
450	486.2	1500	43.8			750 x 1500	68.7
525	357.2	1575	39.7			1000 x 1000	77.3
600	273.5	1650	36.2			1000 x 1200	64.4
675	216.1	1725	33.1			1000 x 1500	51.5
750	175.0	1800	30.4			1000 x 1800	43.0
825	144.7	1875	28.0			1000 x 2000	38.7
900	121.5	1950	25.9			1500 x 1500	34.4
975	103.6	2025	24.0			1500 x 1800	28.6
1050	89.3	2100	22.3			1500 x 2000	25.8



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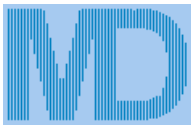
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Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
20	98.0	31.290	0.636	30.654
40	65.0	41.894	1.272	40.622
60	51.0	48.779	1.908	46.871
80	42.0	53.965	2.544	51.421
100	36.0	58.146	3.180	54.966
120	32.0	61.651	3.816	57.835
140	29.0	64.667	4.452	60.215
160	26.0	67.308	5.088	62.220
180	24.0	69.652	5.724	63.928
200	22.0	71.753	6.360	65.393
220	21.0	73.652	6.996	66.656
240	20.0	75.380	7.632	67.748
260	19.0	76.960	8.268	68.692
280	18.0	78.412	8.904	69.508
300	17.0	79.816	9.540	70.276
320	16.0	81.195	10.176	71.019
340	15.0	82.506	10.812	71.694
360	15.0	83.757	11.448	72.309
380	14.0	84.952	12.084	72.868
400	13.0	86.099	12.720	73.379
420	13.0	87.200	13.356	73.844
440	13.0	88.259	13.992	74.267
460	12.0	89.280	14.628	74.652
480	12.0	90.266	15.264	75.002
500	11.0	91.220	15.900	75.320
520	11.0	92.143	16.536	75.607
540	11.0	93.038	17.172	75.866
560	10.0	93.907	17.808	76.099
580	10.0	94.750	18.444	76.306
600	10.0	95.571	19.080	76.491
620	10.0	96.370	19.716	76.654
640	9.0	97.148	20.352	76.796
660	9.0	97.907	20.988	76.919
680	9.0	98.647	21.624	77.023
700	9.0	99.370	22.260	77.110
720	9.0	100.076	22.896	77.180
740	9.0	100.767	23.532	77.235
760	8.0	101.442	24.168	77.274
780	8.0	102.103	24.804	77.299
800	8.0	102.751	25.440	77.311
820	8.0	103.386	26.076	77.310
840	8.0	104.008	26.712	77.296
860	8.0	104.618	27.348	77.270
880	7.0	105.217	27.984	77.233
900	7.0	105.804	28.620	77.184
920	7.0	106.382	29.256	77.126
940	7.0	106.949	29.892	77.057
960	7.0	107.506	30.528	76.978
980	7.0	108.054	31.164	76.890
1000	7.0	108.593	31.800	76.793
1020	7.0	109.123	32.436	76.687
1040	7.0	109.645	33.072	76.573
1060	6.0	110.158	33.708	76.450
1080	6.0	110.664	34.344	76.320
1100	6.0	111.162	34.980	76.182
1120	6.0	111.653	35.616	76.037
1140	6.0	112.137	36.252	75.885
1160	6.0	112.614	36.888	75.726
1180	6.0	113.084	37.524	75.560
1200	6.0	113.547	38.160	75.387

Storage volume (m³) = 77.3 m³



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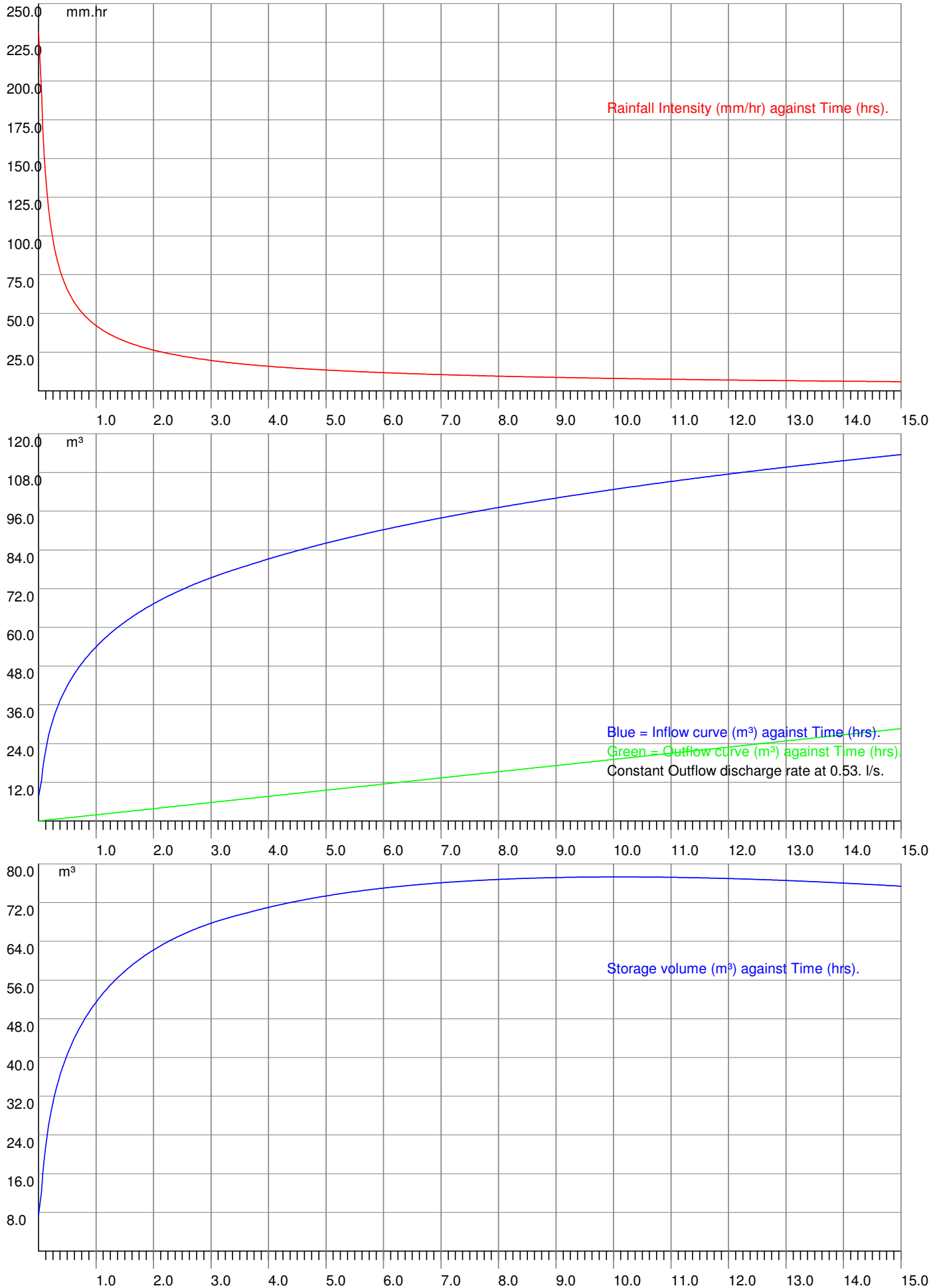
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Title **Peak flow storage calcs for WREXHAM**

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?

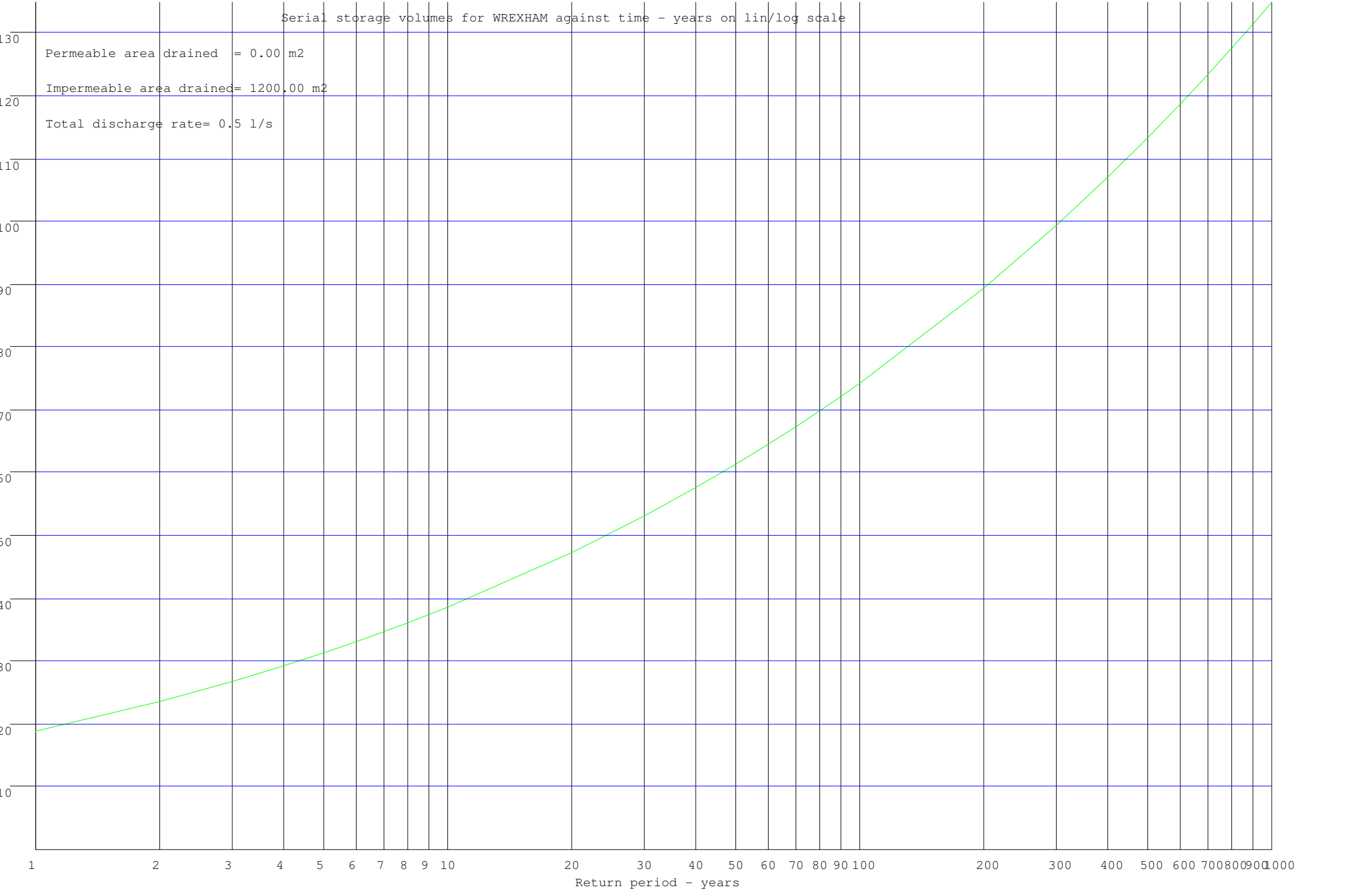
The rainfall characteristics for each method are very different.

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.

m3 storage



Storage volumes for WREXHAM against varying discharge rates

m3 storage Design discharge rate= 0.5

