Clegg Associates
CIVIL AND STRUCTURAL CONSULTING ENGINEERS

St George's Works, Trowbridge

Drainage calculations

For

Gaiger Brother Ltd

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Project Information

Notes:

Architectural drawings and setting out information provided by others.

The dimensions used within these calculations are for design purposes only. Detailed measurements are to be taken from site by the building contractor. Should any inconsistencies occur inform the Engineer immediately.

The contractor is to act as the temporary works coordinator and should be competent and experienced enough to carry out the design and installation of temporary works to BS 5975 in order to maintain stability of the building and excavations.

Reference Drawings:

Proposed drainage strategy — Dwg No. 2017-364-GA-601-P2

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Foul water

The foul water drainage system was designed in accordance with the Building Regulations Approved document H.

The development comprises 30 dwellings, for which a flow rate of 5.8l/s is given in Table 5 below.

The pipes were sized using the flows from table 5 along with recommended falls and pipe diameter from Diagram 9 below.

Diagram 9 Discharge capacities of foul drains running 0.75 proportional depth

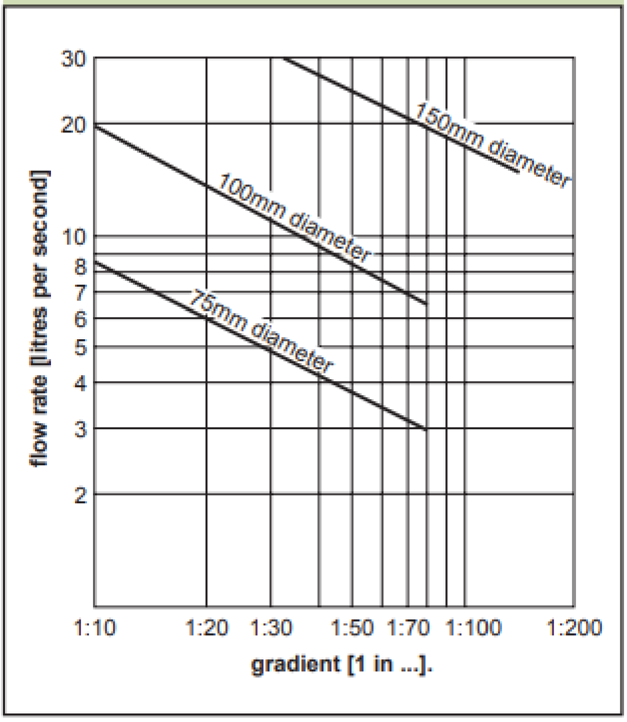

Table 5 Flow rates from dwellings

Number of dwellings	Flow rate (litres/sec)
1	2.5
5	3.5
10	4.1
15	4.6
20	5.1
25	5.4
30	5.8

Surface water

The surface water is to be attenuated and the discharge flow into the existing public sewer limited to 5l/s.

The attenuation system was designed using Tedds, in accordance with Ciria publication C753, as below.

ATTENUATION DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 1.0.03

EA_Defra method

Site characteristics

Location; Bristol

Hydrological region; 8

Soil type (Wallingford Procedure W.R.A.P map); 4

Standard percentage runoff; SPR = **0.47**

Average annual rainfall; SAAR = **850** mm

5 year return period rainfall of 60 minute duration; M5_60min = **20.0** mm

Ratio 60-minute to 2 day rainfalls of 5 year return; r = **0.35**

Rainfall intensity increase due to global warming; $p_{climate}$ = **30**%

Impervious area req. attenuation storage; □ = **100.0** %

Catchment details

Subcatchment	Name	Area (ha)	PIMP (%);	Impermeable. area (ha)
1;	1;	0.26;	90.0;	0.23;
	Total	0.26;	90.0;	0.23;

Greenfield runoff rates

Catchment area; AREA = **50.00** hectare

Greenfield runoff rate (50 hectare site); $\square Q_{rural} = 0.00108 m^3/s \ \square\ (AREA/1km^2)^{0.89}\ \square\ (SAAR/1mm)^{1.17}\ \square\ SPR^{2.17}$ = **303.0** l / s

Greenfield runoff rate; $\square Q = \square Q_{rural}$ / AREA □ A = **1.6** l / s

Greenfield runoff rate per unit area; $\square Q_A = \square Q$ / A = **6.1** l / s / hectare

Estimated site discharges

FSR growth rate (1 year); FSR_{1yr} = **0.78**

Discharge (1 year); $Q_{1yr} = \square Q\ \square\ FSR_{1yr}$ = **1.2** l/s

FSR growth rate (30 year); FSR_{30yr} = **1.95**

Discharge (30 year); $Q_{30yr} = \square Q\ \square\ FSR_{30yr}$ = **3.1** l/s

FSR growth rate (100 year); FSR_{100yr} = **2.43**

Discharge (100 year); $Q_{100yr} = \square Q\ \square\ FSR_{100yr}$ = **3.8** l/s

Estimated attenuation volume - 1 year

Attenuation storage vol (fig A7.1 - A7.8); $Uvol_{1yr}$ = **130.5** m^3 / hectare

Basic storage volume ; $BSV_{1yr} = Uvol_{1yr}\ \square\ \square\ \square$ A = **33.93** m^3

FEH rainfall factor (figs A11.1, A6.1.1 - A6.3.4); FF_{1yr} = **1.05**

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Storage volume ratio (fig A8.1 - A8.8); SVR_{1yr} = **1.35**

Adjusted storage volume; ASV_{1yr} = SVR_{1yr} □ BSV_{1yr} = **45.77** m^3

Hydrological regional volume ratio (fig A9.1); HR_{1yr} = **1.03**

Final estimated attenuation storage; Vol_{1yr} = HR_{1yr} □ ASV_{1yr} = **47.02** m^3

Library item: Estimated attenuation output

Estimated attenuation volume - 30 year

Attenuation storage vol (fig A7.1 - A7.8); $Uvol_{30yr}$ = **290.0** m^3 / hectare

Basic storage volume ; BSV_{30yr} = $Uvol_{30yr}$ □ □ □ A = **75.40** m^3

FEH rainfall factor (figs A11.1, A6.1.1 - A6.3.4); FF_{30yr} = **1.00**

Storage volume ratio (fig A8.1 - A8.8); SVR_{30yr} = **1.46**

Adjusted storage volume; ASV_{30yr} = SVR_{30yr} □ BSV_{30yr} = **109.98** m^3

Hydrological regional volume ratio (fig A9.1); HR_{30yr} = **1.05**

Final estimated attenuation storage; Vol_{30yr} = HR_{30yr} □ ASV_{30yr} = **115.81** m^3

Library item: Estimated attenuation output

Estimated attenuation volume - 100 year

Attenuation storage vol (fig A7.1 - A7.8); $Uvol_{100yr}$ = **362.0** m^3 / hectare

Basic storage volume ; BSV_{100yr} = $Uvol_{100yr}$ □ □ □ A = **94.12** m^3

FEH rainfall factor (figs A11.1, A6.1.1 - A6.3.4); FF_{100yr} = **1.00**

Storage volume ratio (fig A8.1 - A8.8); SVR_{100yr} = **1.46**

Adjusted storage volume; ASV_{100yr} = SVR_{100yr} □ BSV_{100yr} = **137.29** m^3

Hydrological regional volume ratio (fig A9.1); HR_{100yr} = **1.09**

Final estimated attenuation storage; Vol_{100yr} = HR_{100yr} □ ASV_{100yr} = **150.11** m^3

Library item: Estimated attenuation output

Attenuation storage required

Vol. increase due to head-discharge relationship; p_{hydro} = **1.25**

Maximum attenuation storage required; V_{req_max} = Vol_{30yr} □ p_{hydro} = **144.8** m^3

Interception storage

Interception rainfall depth; d_{int} = **5** mm

Volume of interception storage required; V_{int_req} = 0.8 □ A_{imp} □ d_{int} = **9.36** m^3

Long term storage

Proportion of paved area draining in to network; □ = **1.0**

Proportion of pervious area draining in to network; □ = **0.5**

Rainfall depth for 100years, 6 hour event; RD = M100_360 = **81.7** mm

Extra runoff vol of dev.runoff over greenfield runoff; Vol_{xs} = max(RD □ A □ (PIMP □ □ □ 0.8 + ((1 - PIMP) □ □ □ SPR) - SPR), 0m^3) = **58.07** m^3

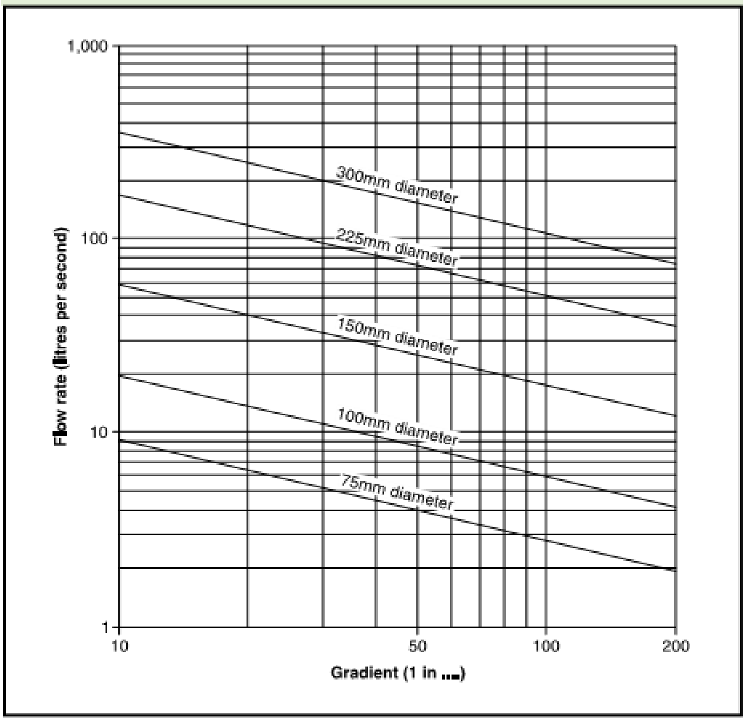
Treatment volume

Treatment volume (assume 80% runoff); T_{vol} = 0.8 □ A □ 15mm □ PIMP = **28.08** m^3

All pipework was designed in accordance with Approved document H and calculated design rainfall intensities.

It was established that for small impermeable areas, a storm event of 5 minutes duration gives the maximum surface runoff rate. All pipes have a minimum diameter of 150mm at a fall of 1 in 80, which gives a capacity of 20l/s according to diagram 3 below.

Diagram 3 Discharge capacities of rainwater drains running full



The impermeable area which would give a flow of 20l/s is equal to 520m2, as per the Tedds calculation below, which is far less than the maximum area drained by one pipe.

Therefore system is adequate.

<u>DESIGN RAINFALL</u>

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area; Bristol

Storm duration; D = **5** min

Return period; Period = **10** yr

Ratio 60 min to 2 day rainfall of 5 yr return period; r = **0.350**

5-year return period rainfall of 60 minutes duration; M5_60min = **20.0** mm

Increase of rainfall intensity due to global warming; $p_{climate}$ = **30** %

Factor Z1 (Wallingford procedure); Z1 = **0.36**

Rainfall for 5min storm with 5 year return period; $M5\_5min_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **9.3** mm

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Factor Z2 (Wallingford procedure); Z2 = **1.22**

Rainfall for 5min storm with 10 year return period; M10_5min = Z2 $\times$ M5_5min$_i$ = **11.3** mm

Design rainfall intensity; I_{max} = M10_5min / D = **135.3** mm/hr

Maximum surface water runoff

Catchment area; A_{catch} = **520** m^2

Percentage of area that is impermeable; p = **100** %

Maximum surface water runoff; $Q_{max} = A_{catch} \times p \times I_{max}$ = **19.5** l/s