

DRAINAGE CALCULATIONS

Surface Water Drainage Design First Issue



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Project No: 3292

09/04/2021

 Stockrail House, Waggon Lane, Upton, Pontefract West Yorkshire, WF9 1FE Phone: 01977 654300 Fax: 01977 647823 E-mail: mail@peterwadeconsultancy.co.uk	Project				Job Ref	
	Proposed Residential Development Off Birk Avenue Kendray, Barnsley				3292	
					Sheet no/rev	
	Calcs by	Date	Checked by	Date	Approved by	Date
	RS	09/04/2021	PW	09/04/2021	PW	09/04/2021

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Revision History

Rev.	Summary	Date
	First Issue	09/04/2021

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1. INTRODUCTION

1.1. PROJECT DETAILS

Location: Land off Birk Avenue, Kendray, Barnsley, S70 3AH

Client: Kirsopp Building Contractors Ltd.

1.2. DESIGN TEAM DETAILS

Peter Wade Consultancy

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1.3. BUILDING REGULATION AUTHORITY

T.B.C.

1.4. COMPUTER SOFTWARE

We are licensed users of the following computer software, which is generally used to assist with design:

Tekla Structural Designer 2015, TEDDS 2015, MasterSeries 2015, Autodesk Building Suite, Fitzroy
Computers SCALE 2015, Microsoft Office 2013

1.5. REFERENCES

Drainage design, where appropriate, is in accordance with:

CIRIA publication C753 - The SUDS Manual

BRE365

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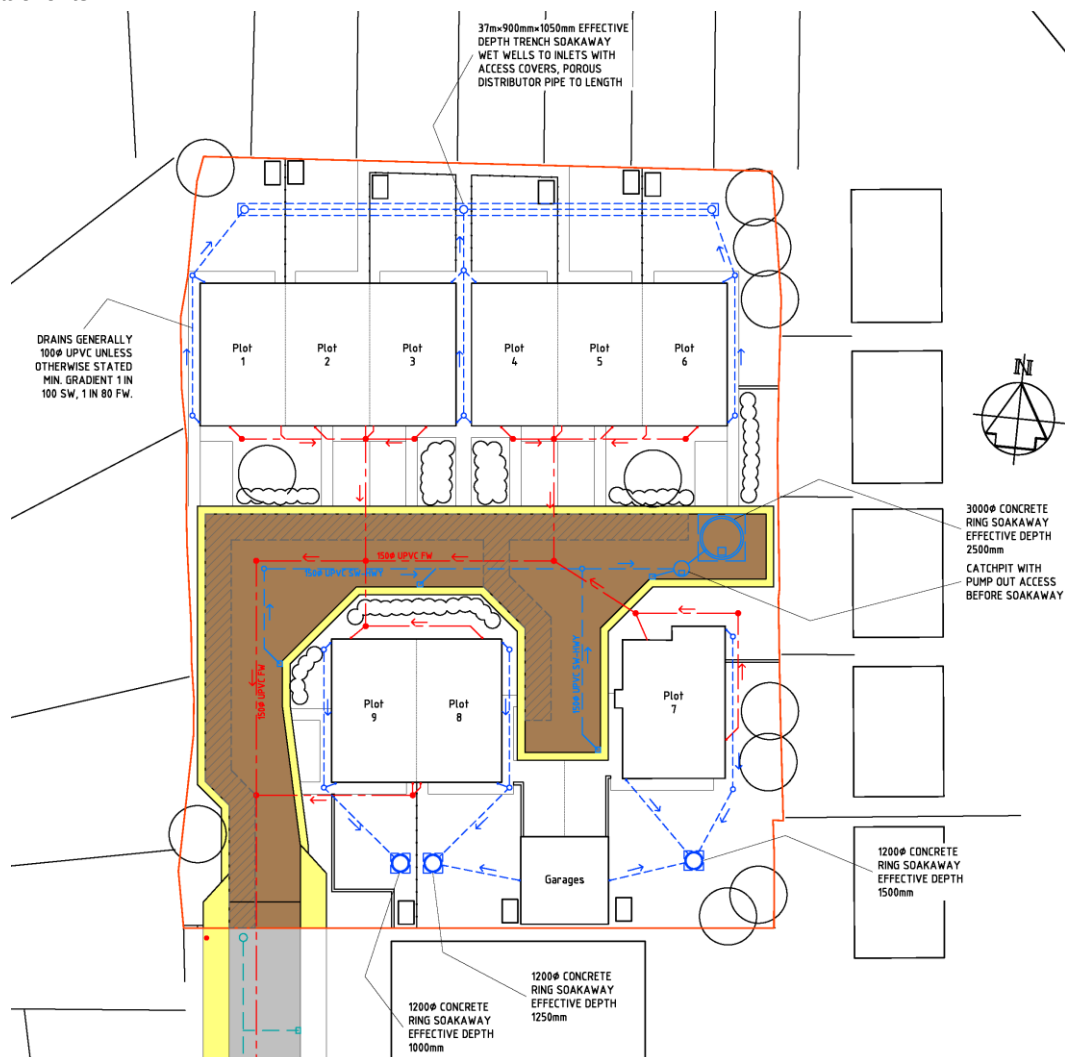
2. BASIS OF CALCULATIONS

These calculations relate to the surface water drainage of a residential development Off Birk Avenue, Kendray, Barnsley. It is intended to dispose of surface water with soakaways.

Percolation testing of the soils in accordance with BRE365 has been carried out. An infiltration rate of $1.67 \times 10^{-6} \text{m/s}$ was found to the south east of the site, but a rate of $46.3 \times 10^{-6} \text{m/s}$ was found to the west side. Ground investigation found clayey deposits to the north west. The higher rate has been used for design of soakaways close to the trial holes that had the higher infiltration rate, and the lower rate has been used for elsewhere on the site. These calculations should be read in conjunction with the associated report on infiltration testing.

Surface water from plots 1-6 is to be drained to a trench soakaway at the rear of the properties. Plots 7, 8 and 9 are to have individual ring soakaways in the rear gardens. The roads are to be drained by a single larger ring soakaway.

The soakaways are designed to have the capacity for 1 in 30 year storm events +30% for climate change. The volume of the soakaway must balance the inflow from the storm with the outflow due to infiltration during the storm period. The soakaway must also empty half of its volume in under 24 hrs to allow sufficient capacity in case of repeat events.



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3. SUMMARY

3.1. DRAINAGE DESIGN

Soakaway Plots 1-6	37m long 900x1050 effective depth trench soakaway. 30% void fill.
Soakaway Plot 7	1200 internal diameter ring soakaway, effective depth 1500mm.
Soakaway Plot 8	1200 internal diameter ring soakaway, effective depth 1250mm.
Soakaway Plot 9	1200 internal diameter ring soakaway, effective depth 1000mm.
Soakaway to Road	3000 internal diameter ring soakaway, effective depth 2500mm.

Notes:

All existing drains to be confirmed on site before works commence.

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4. Plot 1-6 Trench Soakaway

In accordance with BRE Digest 365 - Soakaway design

Tedds calculation version 2.0.04

Design rainfall intensity

Location of catchment area; Sheffield
Impermeable area drained to the system; A = **433.4 m²**
Return period; Period = **30 yr**
Ratio 60 min to 2 day rainfall of 5 yr return period; r = **0.360**
5-year return period rainfall of 60 minutes duration; M5_60min = **18.9 mm**
Increase of rainfall intensity due to global warming; p_{climate} = **30 %**

Soakaway / infiltration trench details

Soakaway type; Rectangular
Minimum depth of pit (below incoming invert); d = **1050 mm**
Width of pit; w = **900 mm**
Length of pit; l = **37000 mm**
Percentage free volume; V_{free} = **30 %**
Soil infiltration rate; f = **46.3*10⁻⁶ m/s**
Wetted area of pit 50% full; a_{s50} = l * d + w * d = **39795000 mm²**

Table equations

Inflow (cl.3.3.1); I = M30 * A
Outflow (cl.3.3.2); O = a_{s50} * f * D
Storage (cl.3.3.3); S = I - O

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	30 year rainfall, M30 (mm)	Inflow (m ³)	Outflow (m ³)	Storage required (m ³)
5;	0.36;	8.8;	1.48;	13.0;	5.66;	0.55;	5.10
10;	0.51;	12.5;	1.51;	18.9;	8.19;	1.11;	7.09
15;	0.62;	15.2;	1.53;	23.3;	10.08;	1.66;	8.43
30;	0.79;	19.4;	1.54;	29.9;	12.97;	3.32;	9.65
60;	1.00;	24.6;	1.53;	37.7;	16.34;	6.63;	9.70
120;	1.22;	30.0;	1.51;	45.4;	19.66;	13.27;	6.40
240;	1.48;	36.4;	1.48;	54.0;	23.38;	26.53;	0.00
360;	1.67;	41.0;	1.46;	60.0;	26.00;	39.80;	0.00
600;	1.90;	46.7;	1.44;	67.0;	29.04;	66.33;	0.00
1440;	2.42;	59.5;	1.39;	82.7;	35.85;	159.19;	0.00

Required storage volume; S_{req} = **9.70 m³**
Soakaway storage volume; S_{act} = l * d * w * V_{free} = **10.49 m³**

PASS - Soakaway storage volume

Time for emptying soakaway to half volume; t_{s50} = S_{req} * 0.5 / (a_{s50} * f); = 43min 53s

PASS - Soakaway discharge time less than or equal to 24 hours

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5. Plot 7 PCC Ring Soakaway

Tedd's calculation version 2.0.04

Design rainfall intensity

Location of catchment area;	Sheffield
Impermeable area drained to the system;	A = 113.0 m²
Return period;	Period = 30 yr
Ratio 60 min to 2 day rainfall of 5 yr return period;	r = 0.360
5-year return period rainfall of 60 minutes duration;	M5_60min = 18.9 mm
Increase of rainfall intensity due to global warming;	p _{climate} = 30 %

Soakaway details

Soakaway type;	Concentric ring
Depth of pit (below incoming invert);	d = 1500 mm
Width of pit (square excavation assumed);	w = 1500 mm
Internal diameter of concrete ring;	D _{ring} = 1200 mm
Thickness of concrete ring walls;	T _{ring} = 90 mm
Percentage free volume;	V _{free} = 30 %
Soil infiltration rate;	f = 167.*10⁻⁶ m/s
Wetted area of pit 50% full;	a _{s50} = 2 * w * d = 4500000 mm²

Table equations

Inflow (cl.3.3.1);	I = M30 * A
Outflow (cl.3.3.2);	O = a _{s50} * f * D
Storage (cl.3.3.3);	S = I - O

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	30 year rainfall, M30 (mm)	Inflow (m ³)	Outflow (m ³)	Storage required (m ³)
5;	0.36;	8.8;	1.48;	13.0;	1.47;	0.23;	1.25
10;	0.51;	12.5;	1.51;	18.9;	2.14;	0.45;	1.69
15;	0.62;	15.2;	1.53;	23.3;	2.63;	0.68;	1.95
30;	0.79;	19.4;	1.54;	29.9;	3.38;	1.35;	2.03
60;	1.00;	24.6;	1.53;	37.7;	4.26;	2.71;	1.55
120;	1.22;	30.0;	1.51;	45.4;	5.13;	5.41;	0.00
240;	1.48;	36.4;	1.48;	54.0;	6.10;	10.82;	0.00
360;	1.67;	41.0;	1.46;	60.0;	6.78;	16.23;	0.00
600;	1.90;	46.7;	1.44;	67.0;	7.57;	27.05;	0.00
1440;	2.42;	59.5;	1.39;	82.7;	9.35;	64.93;	0.00

Required storage volume;

$$S_{req} = \mathbf{2.03 \text{ m}^3}$$

Soakaway storage volume;

$$S_{act} = \pi * (D_{ring}^2 / 4) * d + (d * w^2 - (\pi * ((D_{ring} + 2 * T_{ring})^2 / 4) * d)) * V_{free} = \mathbf{2.04 \text{ m}^3}$$

PASS - Soakaway storage volume

Time for emptying soakaway to half volume;

$$t_{s50} = S_{req} * 0.5 / (a_{s50} * f); = \mathbf{22 \text{ min } 31 \text{ s}}$$

PASS - Soakaway discharge time less than or equal to 24 hours

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6. Plot 8 PCC Ring Soakaway

Tedds calculation version 2.0.04

Design rainfall intensity

Location of catchment area; Sheffield
Impermeable area drained to the system; A = **113.0 m²**
Return period; Period = **30 yr**
Ratio 60 min to 2 day rainfall of 5 yr return period; r = **0.360**
5-year return period rainfall of 60 minutes duration; M5_60min = **18.9 mm**
Increase of rainfall intensity due to global warming; p_{climate} = **30 %**

Soakaway details

Soakaway type; Concentric ring
Depth of pit (below incoming invert); d = **1500 mm**
Width of pit (square excavation assumed); w = **1500 mm**
Internal diameter of concrete ring; D_{ring} = **1200 mm**
Thickness of concrete ring walls; T_{ring} = **90 mm**
Percentage free volume; V_{free} = **30 %**
Soil infiltration rate; f = **167.*10⁻⁶ m/s**
Wetted area of pit 50% full; a_{s50} = 2 * w * d = **4500000 mm²**

Table equations

Inflow (cl.3.3.1); I = M30 * A
Outflow (cl.3.3.2); O = a_{s50} * f * D
Storage (cl.3.3.3); S = I - O

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	30 year rainfall, M30 (mm)	Inflow (m ³)	Outflow (m ³)	Storage required (m ³)
5;	0.36;	8.8;	1.48;	13.0;	1.47;	0.23;	1.25
10;	0.51;	12.5;	1.51;	18.9;	2.14;	0.45;	1.69
15;	0.62;	15.2;	1.53;	23.3;	2.63;	0.68;	1.95
30;	0.79;	19.4;	1.54;	29.9;	3.38;	1.35;	2.03
60;	1.00;	24.6;	1.53;	37.7;	4.26;	2.71;	1.55
120;	1.22;	30.0;	1.51;	45.4;	5.13;	5.41;	0.00
240;	1.48;	36.4;	1.48;	54.0;	6.10;	10.82;	0.00
360;	1.67;	41.0;	1.46;	60.0;	6.78;	16.23;	0.00
600;	1.90;	46.7;	1.44;	67.0;	7.57;	27.05;	0.00
1440;	2.42;	59.5;	1.39;	82.7;	9.35;	64.93;	0.00

Required storage volume;

$$S_{\text{req}} = 2.03 \text{ m}^3$$

Soakaway storage volume;

$$S_{\text{act}} = \pi * (D_{\text{ring}}^2 / 4) * d + (d * w^2 - (\pi * ((D_{\text{ring}} + 2 * T_{\text{ring}})^2 / 4) * d)) * V_{\text{free}} = 2.04 \text{ m}^3$$

PASS - Soakaway storage volume

Time for emptying soakaway to half volume;

$$t_{s50} = S_{\text{req}} * 0.5 / (a_{s50} * f); = 22\text{min } 31\text{s}$$

PASS - Soakaway discharge time less than or equal to 24 hours

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7. Plot 9 PCC Ring Soakaway

Tedd's calculation version 2.0.04

Design rainfall intensity

Location of catchment area; Sheffield
 Impermeable area drained to the system; A = **72.0 m²**
 Return period; Period = **30 yr**
 Ratio 60 min to 2 day rainfall of 5 yr return period; r = **0.360**
 5-year return period rainfall of 60 minutes duration; M5_60min = **18.9 mm**
 Increase of rainfall intensity due to global warming; p_{climate} = **30 %**

Soakaway details

Soakaway type; Concentric ring
 Depth of pit (below incoming invert); d = **1000 mm**
 Width of pit (square excavation assumed); w = **1500 mm**
 Internal diameter of concrete ring; D_{ring} = **1200 mm**
 Thickness of concrete ring walls; T_{ring} = **90 mm**
 Percentage free volume; V_{free} = **30 %**
 Soil infiltration rate; f = **167. * 10⁻⁶ m/s**
 Wetted area of pit 50% full; a_{s50} = 2 * w * d = **3000000 mm²**

Table equations

Inflow (cl.3.3.1); I = M30 * A
 Outflow (cl.3.3.2); O = a_{s50} * f * D
 Storage (cl.3.3.3); S = I - O

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	30 year rainfall, M30 (mm)	Inflow (m ³)	Outflow (m ³)	Storage required (m ³)
5;	0.36;	8.8;	1.48;	13.0;	0.94;	0.15;	0.79
10;	0.51;	12.5;	1.51;	18.9;	1.36;	0.30;	1.06
15;	0.62;	15.2;	1.53;	23.3;	1.68;	0.45;	1.22
30;	0.79;	19.4;	1.54;	29.9;	2.15;	0.90;	1.25
60;	1.00;	24.6;	1.53;	37.7;	2.71;	1.80;	0.91
120;	1.22;	30.0;	1.51;	45.4;	3.27;	3.61;	0.00
240;	1.48;	36.4;	1.48;	54.0;	3.88;	7.21;	0.00
360;	1.67;	41.0;	1.46;	60.0;	4.32;	10.82;	0.00
600;	1.90;	46.7;	1.44;	67.0;	4.82;	18.04;	0.00
1440;	2.42;	59.5;	1.39;	82.7;	5.95;	43.29;	0.00

Required storage volume;

$$S_{\text{req}} = 1.25 \text{ m}^3$$

Soakaway storage volume;

$$S_{\text{act}} = \pi * (D_{\text{ring}}^2 / 4) * d + (d * w^2 - (\pi * ((D_{\text{ring}} + 2 * T_{\text{ring}})^2 / 4) * d)) * V_{\text{free}} = 1.36 \text{ m}^3$$

PASS - Soakaway storage volume

Time for emptying soakaway to half volume;

$$t_{s50} = S_{\text{req}} * 0.5 / (a_{s50} * f); = 20 \text{ min } 48 \text{ s}$$

PASS - Soakaway discharge time less than or equal to 24 hours

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8. Road PCC Ring Soakaway

Teds calculation version 2.0.04

Design rainfall intensity

Location of catchment area;	Sheffield
Impermeable area drained to the system;	A = 589.0 m²
Return period;	Period = 30 yr
Ratio 60 min to 2 day rainfall of 5 yr return period;	r = 0.360
5-year return period rainfall of 60 minutes duration;	M5_60min = 18.9 mm
Increase of rainfall intensity due to global warming;	p _{climate} = 30 %

Soakaway details

Soakaway type;	Concentric ring
Depth of pit (below incoming invert);	d = 2500 mm
Width of pit (square excavation assumed);	w = 3600 mm
Internal diameter of concrete ring;	D _{ring} = 3000 mm
Thickness of concrete ring walls;	T _{ring} = 165 mm
Percentage free volume;	V _{free} = 30 %
Soil infiltration rate;	f = 46.3*10⁻⁶ m/s
Wetted area of pit 50% full;	a _{s50} = 2 * w * d = 18000000 mm²

Table equations

Inflow (cl.3.3.1);	I = M30 * A
Outflow (cl.3.3.2);	O = a _{s50} * f * D
Storage (cl.3.3.3);	S = I - O

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	30 year rainfall, M30 (mm)	Inflow (m ³)	Outflow (m ³)	Storage required (m ³)
5;	0.36;	8.8;	1.48;	13.0;	7.69;	0.25;	7.44
10;	0.51;	12.5;	1.51;	18.9;	11.13;	0.50;	10.63
15;	0.62;	15.2;	1.53;	23.3;	13.70;	0.75;	12.95
30;	0.79;	19.4;	1.54;	29.9;	17.62;	1.50;	16.12
60;	1.00;	24.6;	1.53;	37.7;	22.20;	3.00;	19.20
120;	1.22;	30.0;	1.51;	45.4;	26.72;	6.00;	20.72
240;	1.48;	36.4;	1.48;	54.0;	31.78;	12.00;	19.78
360;	1.67;	41.0;	1.46;	60.0;	35.33;	18.00;	17.33
600;	1.90;	46.7;	1.44;	67.0;	39.47;	30.00;	9.47
1440;	2.42;	59.5;	1.39;	82.7;	48.71;	72.01;	0.00

Required storage volume;

$$S_{\text{req}} = \mathbf{20.72 \text{ m}^3}$$

Soakaway storage volume;

$$S_{\text{act}} = \pi * (D_{\text{ring}}^2 / 4) * d + (d * w^2 - (\pi * ((D_{\text{ring}} + 2 * T_{\text{ring}})^2 / 4) * d)) * V_{\text{free}} = \mathbf{20.86 \text{ m}^3}$$

PASS - Soakaway storage volume

Time for emptying soakaway to half volume;

$$t_{s50} = S_{\text{req}} * 0.5 / (a_{s50} * f); = \mathbf{3 \text{ hr } 27 \text{ min } 12 \text{ s}}$$

PASS - Soakaway discharge time less than or equal to 24 hours