

SURFACE WATER DRAINAGE CALCULATIONS
UPON
LAND OFF
CROSSGATE LANE, PINCHBECK
LINCOLNSHIRE
PROJECT No: SW 21-181
DOCUMENT REF: SW 21-181-CAL-01



EXECUTORS OF P.J.BORST (DECEASED)

Structural Calculations	Project: Crossgate Lane, Pinchbeck	Date: Sep 21	Designer: APW
Project No: SW21-181	Subject: Surface Water Calculations	Sheet No: 2	Rev:

INTRODUCTION

The following set of calculations cover the design of the surface water drainage system for the proposed 16 plot development on the site of a current agricultural purpose field standing off Church Street and Crossgate Lane, Pinchbeck.

The system follows the principles of the SUDs hierarchy.

Infiltration has been considered, however our local knowledge of the site would suggest that ground water will be encountered approx. 1 – 1.4m Below ground level during the winter months and as such any infiltration system is highly unlikely to be suitable.

The majority of the surface water will collect via the permeable surfaces provided to the driveways and private road. This will provide a suitable treatment train.

The drainage system outfalls to a proposed culverted riparian drain located along the Northern boundary of the site, which runs Westwards and outfalls to the Welland and Deeping IDB system.

The proposed outfall is via a flow restriction device limiting flow to a practical minimum, with attenuation volume being provided within the permeable crates and voided hardcore within the private road build up.

Contained in the following document are hydraulic modelling calculations and the greenfield run-off estimate.

Calculated by:	Garry Dunnett
Site name:	Crossgate Lane
Site location:	Pinchbeck

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	52.82022° N
Longitude:	0.15764° W
Reference:	1270016424
Date:	Sep 08 2021 14:03

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	1.478
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Methodology

Q _{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	560	560
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Growth curve factor 200 years:	4.21	4.21

Notes

(1) Is $Q_{\text{BAR}} < 2.0$ l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is $\text{SPR/SPRHOST} \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q _{BAR} (l/s):	2.07	2.07
1 in 1 year (l/s):	1.8	1.8
1 in 30 years (l/s):	5.08	5.08
1 in 100 year (l/s):	7.39	7.39
1 in 200 years (l/s):	8.73	8.73

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.000
CV	0.750	Preferred Cover Depth (m)	0.900
Time of Entry (mins)	15.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	250.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
1	0.082	15.00	4.055	2700	2.068
S1	0.026	15.00	4.100	2700	2.225
2	0.083	15.00	4.055	2700	2.063
S2	0.006	15.00	4.100	2700	2.220
S3	0.105	15.00	4.150	2700	2.300
S3A	0.029	15.00	3.700	2700	1.940
S4	0.017	15.00	3.410	2700	1.700
S5	0.000		3.770	2700	2.090

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	S1	43.026	0.600	1.987	1.875	0.112	384.2	450	15.70	30.6
1.001	S1	S3	8.345	0.600	1.875	1.850	0.025	333.8	450	15.82	30.5
2.000	2	S2	43.026	0.600	1.992	1.880	0.112	384.2	450	15.70	30.6
2.001	S2	S3	10.487	0.600	1.880	1.850	0.030	349.6	450	15.86	30.4
1.002	S3	S3A	33.703	0.600	1.850	1.760	0.090	374.5	450	16.40	29.8
1.003	S3A	S4	18.438	0.600	1.760	1.710	0.050	368.8	450	16.69	29.5
1.004	S4	S5	10.238	0.600	1.710	1.680	0.030	341.3	450	16.84	29.3

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.031	164.0	6.8	1.618	1.775	0.082	0.0	62	0.517
1.001	1.107	176.0	8.9	1.775	1.850	0.108	0.0	68	0.588
2.000	1.031	164.0	6.9	1.613	1.770	0.083	0.0	62	0.517
2.001	1.081	172.0	7.3	1.770	1.850	0.089	0.0	63	0.547
1.002	1.044	166.1	24.4	1.850	1.490	0.302	0.0	116	0.754
1.003	1.053	167.4	26.5	1.490	1.250	0.331	0.0	120	0.775
1.004	1.095	174.1	27.7	1.250	1.640	0.348	0.0	121	0.810

29/09/2021

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	43.026	384.2	450	Circular	4.055	1.987	1.618	4.100	1.875	1.775
1.001	8.345	333.8	450	Circular	4.100	1.875	1.775	4.150	1.850	1.850
2.000	43.026	384.2	450	Circular	4.055	1.992	1.613	4.100	1.880	1.770
2.001	10.487	349.6	450	Circular	4.100	1.880	1.770	4.150	1.850	1.850
1.002	33.703	374.5	450	Circular	4.150	1.850	1.850	3.700	1.760	1.490
1.003	18.438	368.8	450	Circular	3.700	1.760	1.490	3.410	1.710	1.250
1.004	10.238	341.3	450	Circular	3.410	1.710	1.250	3.770	1.680	1.640

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	2700	Manhole	Adoptable	S1	2700	Manhole	Adoptable
1.001	S1	2700	Manhole	Adoptable	S3	2700	Manhole	Adoptable
2.000	2	2700	Manhole	Adoptable	S2	2700	Manhole	Adoptable
2.001	S2	2700	Manhole	Adoptable	S3	2700	Manhole	Adoptable
1.002	S3	2700	Manhole	Adoptable	S3A	2700	Manhole	Adoptable
1.003	S3A	2700	Manhole	Adoptable	S4	2700	Manhole	Adoptable
1.004	S4	2700	Manhole	Adoptable	S5	2700	Manhole	Adoptable

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
1	4.055	2.068	2700					
				0	1.000	1.987	450	
S1	4.100	2.225	2700		1	1.000	1.875	450
				0	1.001	1.875	450	
2	4.055	2.063	2700					
				0	2.000	1.992	450	
S2	4.100	2.220	2700		1	2.000	1.880	450
				0	2.001	1.880	450	
S3	4.150	2.300	2700		1	2.001	1.850	450
				2	1.001	1.850	450	
				0	1.002	1.850	450	
S3A	3.700	1.940	2700		1	1.002	1.760	450
				0	1.003	1.760	450	
S4	3.410	1.700	2700		1	1.003	1.710	450
				0	1.004	1.710	450	

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S5	3.770	2.090	2700	1	1.004	1.680	450

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
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Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	40	0	0

Node S1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	1.875	Product Number	CTL-SHE-0164-1300-1000-1300
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	13.0	Min Node Diameter (mm)	1200

Node S2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	1.880	Product Number	CTL-SHE-0164-1300-1000-1300
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	13.0	Min Node Diameter (mm)	1200

Node S4 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	1.710	Product Number	CTL-SHE-0062-2000-1400-2000
Design Depth (m)	1.400	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	2.680	Slope (1:X)	1000.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	1.145
Safety Factor	2.0	Width (m)	4.100	Inf Depth (m)	1.145
Porosity	0.30	Length (m)	43.026		

Node 2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	2.680	Slope (1:X)	1000.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	1.145
Safety Factor	2.0	Width (m)	4.100	Inf Depth (m)	1.145
Porosity	0.30	Length (m)	43.026		

Node 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.880
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	258.0	0.0	0.400	258.0	0.0	0.800	258.0	0.0

Node 2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.880
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	258.0	0.0	0.400	258.0	0.0	0.800	258.0	0.0

29/09/2021

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	1	328	2.054	0.067	2.6	16.7965	0.0000	OK
360 minute winter	S1	328	2.054	0.179	1.4	1.0679	0.0000	OK
240 minute winter	2	236	2.051	0.059	3.5	14.8018	0.0000	OK
240 minute winter	S2	236	2.051	0.171	1.3	0.9900	0.0000	OK
180 minute winter	S3	124	2.067	0.217	4.2	1.4419	0.0000	OK
180 minute winter	S3A	128	2.067	0.307	4.0	1.8509	0.0000	OK
180 minute winter	S4	128	2.067	0.357	2.6	2.1170	0.0000	OK
60 minute winter	S5	44	1.706	0.026	1.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute winter	1	1.000	S1	0.8	0.069	0.005	1.5831	
360 minute winter	S1	1.001	S3	0.8	0.146	0.004	0.5619	
240 minute winter	2	2.000	S2	1.1	0.121	0.007	1.4551	
240 minute winter	S2	2.001	S3	0.7	0.060	0.004	0.7228	
180 minute winter	S3	1.002	S3A	3.3	0.257	0.020	3.2188	
180 minute winter	S3A	1.003	S4	2.2	0.241	0.013	2.3071	
180 minute winter	S4	1.004	S5	1.6	0.389	0.009	0.0431	36.5

29/09/2021

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	1	472	2.233	0.246	6.9	61.8944	0.0000	OK
480 minute winter	S1	472	2.233	0.358	3.3	2.1359	0.0000	OK
480 minute winter	2	480	2.224	0.232	6.4	58.3407	0.0000	OK
480 minute winter	S2	480	2.224	0.344	2.8	1.9902	0.0000	OK
30 minute winter	S3	29	2.244	0.394	27.2	2.6162	0.0000	OK
30 minute winter	S3A	29	2.242	0.482	16.6	2.9061	0.0000	SURCHARGED
30 minute winter	S4	30	2.245	0.535	9.9	3.1733	0.0000	SURCHARGED
60 minute summer	S5	32	1.706	0.026	1.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute winter	1	1.000	S1	-2.9	0.073	-0.018	4.8240	
480 minute winter	S1	1.001	S3	-2.1	0.145	-0.012	1.1532	
480 minute winter	2	2.000	S2	-2.4	0.102	-0.015	4.5754	
480 minute winter	S2	2.001	S3	-2.6	0.104	-0.015	1.4395	
30 minute winter	S3	1.002	S3A	12.1	0.468	0.073	5.1500	
30 minute winter	S3A	1.003	S4	7.3	0.359	0.043	2.9214	
30 minute winter	S4	1.004	S5	1.6	0.389	0.009	0.0431	25.0

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Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute winter	1	720	2.595	0.608	10.6	152.8617	0.0000	SURCHARGED
720 minute winter	S1	720	2.595	0.720	5.4	4.2912	0.0000	SURCHARGED
720 minute winter	2	720	2.583	0.591	10.2	148.5771	0.0000	SURCHARGED
720 minute winter	S2	720	2.583	0.703	5.2	4.0634	0.0000	SURCHARGED
30 minute winter	S3	32	3.146	1.296	45.4	8.6012	0.0000	SURCHARGED
30 minute winter	S3A	32	3.151	1.391	23.7	8.3834	0.0000	SURCHARGED
30 minute winter	S4	32	3.154	1.444	15.3	8.5553	0.0000	FLOOD RISK
30 minute winter	S5	32	1.709	0.029	2.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
720 minute winter	1	1.000	S1	-4.9	0.061	-0.030	6.8172	
720 minute winter	S1	1.001	S3	-4.6	0.127	-0.026	1.3222	
720 minute winter	2	2.000	S2	-4.5	0.083	-0.028	6.8172	
720 minute winter	S2	2.001	S3	-4.9	0.076	-0.028	1.6616	
30 minute winter	S3	1.002	S3A	15.2	0.483	0.092	5.3400	
30 minute winter	S3A	1.003	S4	9.3	0.377	0.055	2.9214	
30 minute winter	S4	1.004	S5	2.0	0.413	0.012	0.0500	24.4