Site Evolution Ltd

Proposed Housing Development,

Kirkland Road,

Ennerdale Bridge.

Drainage Strategy and Calculations

asher ASSOCIATES

Civil Engineers

Structural Engineers

Project Managers

Document No: AA6874/9/1/1B

Asher Associates Ltd

32 George Street

DUMFRIES

DG1 1EH

	Name	Signature	Date
Prepared by	William Milne	[redacted]	04/02/2021
Purpose of Issue	**Planning Application**		

04 February 2021

Surface Water Drainage Design

The proposed development lies the Northern edge of Ennerdale bridge. The site contains three positive outlets to which individual catchments for overland flows can be attributed totalling 4.03ha. Outlets are located on Back Lane at the south western boundary (western catchment), beneath prospect house on the southern boundary (central catchment) and via a culvert beneath Kirkland Road (eastern catchment).
The proposed development will bisect these catchments at the northern site boundary. Filter drains will intercept the overland flows and direct them around the site to outfall at greenfield run-off rates via two drainage networks.

Network 1 will cater for the central and eastern catchments will be discharged eastwards to the culvert beneath Kirkland Road These catchments are the most significant source of overland flows and will be intercepted by filter drains in branch 1 of the network and will be backed by a 'Kested' hedge. Branches 2 and 3 of this network will drain the main part of the site (plots 1,2. 5-9 and the access road). Flows from contributing areas to branches 2 and 3 will be treated by filter drains and attenuated by two Hydrobrakes and cellular storage. the first Hydrobrake, located in MH S16, is used to mobilise upstream storage, the second in MH S17 controls the discharge to QBar.
It is likely that an area of the Kirkland Road, from the lay-by at the crest of the hill above, may also drain to Croasdale Beck via the culvert (pipe 1.006 in the model) under the road and has been added to the contributing area for the culvert as 100% impermeable.

Network 2 accepts flows from the western catchment (0.253ha) and the remainder of the site (plots 3 and 4) will be directed to the outfall at Prospect house. The design follows similar design principals applied to network 1. Branch 1 will accommodate upstream overland flows. Branch 2 will cater for plots 3 and 4 with treatment and storage upstream of a flow control.

Greenfield runoff rates for the development site:

Greenfield runoff rates were calculated using HR Wallingford's Greenfield runoff rate estimation for sites and the following values were obtained for an area of 0.99ha. Peak surface water discharge from the site is to be discharged at QBar = 13.6l/s.

There are two proposed outfalls on the site and the discharge rate has been factored proportionally to the corresponding contributing areas. The main area plots 1,2. 5-9 and the access road are Network 1 to the culvert to the east at a rate of 9.5l/s. The remainder of the site will discharge via Network 2 to the culvert on the southern boundary at 4.1l/s.

Runoff rates for Overland flows from upstream catchments:

Runoff to be intercepted at the site boundary will be modelled at greenfield runoff rates for each corresponding return period to ensure that the proposed networks can accommodate the flows without risk off flooding downstream. These flows are added to the model as 'base flows' and will remain constant for each event.

Western Catchment (0.253ha) Rates :

1 Year	3.03
30 Years	5.92l/s
100years	7.25l/s
200years	8.3l/s

Combined Central and Eastern (2.1 and 0.687ha correspondingly) catchment Rates:

1 Year	38.38l/s
30 Years	65.22l/s
100years	79.8l/s
200years	90.92l/s

Calculations : All calculations are as prescribed by the Wallingford Procedure – 'Modified Rational Method' and use the parameters set out in Sewers for Adoption 8th edition as the design criteria. The CASDeF application within the Microdrainage suite was used to generate various rainfall events with return periods of 1, 30 & 100 years.

The design criteria for the network is as follows:

Design Storm, pipes full	1 year
Design Storm, no flooding	30 year
Flood Risk Assessment	100 year
Minimum velocity, pipe full	1m/sec
Ks roughness value	0.6mm
Time of Entry	5 mins
Contributing Area classification:	
Impervious areas	100%
Soft landscaping	25%

For all storm simulations the model was set to record a flood risk when manhole surcharge reached a level of 300mm below the cover level. A 40% uplift for climate change was added to the design storms. A further 10% was added to the impervious areas contributing to the proposed networks to allow for urban creep.

Contributing Area	Plot Area (m²)	Impermeable Areas Within Plots (m²)	Soft Landscaping (25%) for Remainder (m²)	Impermeable Area (110%) (m²)	Total Areas for Modelling (m²)
Plot 1	877.50	269.74	151.94	296.71	448.65
Plot 2	911.80	211.64	175.04	232.80	407.84
Plot 3	664.00	247.50	104.13	272.25	376.38
Plot 4	884.30	277.20	151.78	304.92	456.70
Plot 5	958.14	339.00	154.79	372.90	527.69
Plot 6	940.60	339.60	150.25	373.56	523.81
Plot 7	854.71	332.50	130.55	365.75	496.30
Plot 8	1333.60	328.50	251.28	361.35	612.63
Plot 9	1148.60	318.80	207.45	350.68	558.13
Access Road	1326.00				1326.00
Total	9899.25				5734.12

Where possible, a minimum cover of 1200mm has been applied to pipework under roads and 900mm in open ground. Where cover is less then 1200mm below the road, concrete protection will be applied to pipework.

Critical Storms:

The network was modelled in Microdrainage to ensure that no flooding is experienced for storms with a return period of up to 30 years and also to establish the critical storms with return periods of 1, 30 and 100 years for use in the network simulation. The critical storms for the network were established during this process and are presented in the MicroDrainage calculations.

Network Simulation

The network including all manholes, pipes, storage features and flow control was simulated for the critical storm events shown in the Microdrainage calculations.

During the 1 year return period critical storms all flows are contained within the system. No surcharging is experienced at any point in the system during the1 year return period critical storms.

During the 30 year return period critical storms all flows are contained within the system, some surcharging is evident in the manholes. No flooding is experienced at any point in the system during the 30 year return period critical storms.

No flooding is experienced in the system during the 100 year return period critical storms.

Microdrainage calculations – Network 1

1 Year

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for S NET -1.SWS

Pipe Sizes STORM 2 Manhole Sizes STORM 2

FSR Rainfall Model - England and Wales

Return Period (years)	100	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	0.000
M5-60 (mm)	17.400	Volumetric Runoff Coeff.	0.750	Min Design Depth for Optimisation (m)	1.200
Ratio R	0.243	PIMP (%)	100	Min Vel for Auto Design only (m/s)	0.75
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	40	Min Slope for Optimisation (1:X)	200
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.200		

Designed with Level Soffits

Network Design Table for S NET -1.SWS

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	30.687	0.188	163.2	0.000	5.00	33.4	0.600	o	300	Pipe/Conduit	
S1.001	60.683	1.873	32.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	5.316	0.027	196.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	30.125	1.916	15.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	33.195	1.916	17.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	3.266	0.149	21.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	8.298	0.047	176.6	0.053	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	9.587	0.169	56.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	4.446	0.087	50.8	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.003	9.627	0.267	36.0	0.053	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.004	9.296	0.395	23.5	0.011	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.005	7.017	0.230	30.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	10.921	0.106	103.0	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
S3.001	8.895	0.059	150.0	0.056	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.002	9.514	0.063	150.0	0.061	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.003	19.050	0.127	150.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.004	9.390	0.063	150.0	0.094	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.006	13.745	0.092	150.0	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.007	33.661	1.426	23.6	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.008	3.947	0.020	197.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	8.144	0.054	150.8	0.089	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.42	114.101	0.000	33.4	0.0	13.4	1.23	86.8	46.8
S1.001	50.00	5.78	113.913	0.000	33.4	0.0	13.4	2.77	195.9	46.8
S1.002	50.00	5.86	112.065	0.000	33.4	0.0	13.4	1.12	79.0	46.8
S1.003	50.00	5.99	112.038	0.000	33.4	0.0	13.4	3.98	281.6	46.8
S1.004	50.00	6.13	110.123	0.000	33.4	0.0	13.4	3.79	268.2	46.8
S1.005	50.00	6.15	108.207	0.000	33.4	0.0	13.4	3.37	238.4	46.8
S2.000	50.00	5.18	110.942	0.053	0.0	0.0	2.9	0.75	13.3	10.0
S2.001	50.00	5.30	110.895	0.053	0.0	0.0	2.9	1.34	23.6	10.0
S2.002	50.00	5.36	110.726	0.060	0.0	0.0	3.2	1.41	25.0	11.3
S2.003	50.00	5.45	110.639	0.113	0.0	0.0	6.1	1.68	29.7	21.3
S2.004	50.00	5.53	110.371	0.123	0.0	0.0	6.7	2.09	36.9	23.4
S2.005	50.00	5.57	109.826	0.123	0.0	0.0	6.7	2.86	201.9	23.4
S3.000	50.00	5.18	110.144	0.010	0.0	0.0	0.5	0.99	17.5	1.9
S3.001	50.00	5.37	110.038	0.066	0.0	0.0	3.6	0.82	14.5	12.5
S3.002	50.00	5.51	109.904	0.127	0.0	0.0	6.9	1.07	42.4	24.1
S3.003	50.00	5.81	109.840	0.143	0.0	0.0	7.7	1.07	42.4	27.1
S3.004	50.00	5.93	109.638	0.237	0.0	0.0	12.8	1.28	90.6	44.9
S2.006	50.00	6.11	109.576	0.374	0.0	0.0	20.3	1.28	90.6	70.9
S2.007	50.00	6.29	109.484	0.415	0.0	0.0	22.5	3.25	229.7	78.7
S2.008	50.00	6.34	108.078	0.415	0.0	0.0	22.5	1.12	78.9	78.7
S1.006	50.00	6.45	108.058	0.504	33.4	0.0	40.7	1.28	90.3«	142.3

Free Flowing Outfall Details for S NET -1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.006	S8(HW)	109.000	108.004	18.000	0	0

Online Controls for S NET -1.SWS

Hydro-Brake® Optimum Manhole: S16, DS/PN: S2.007, Volume (m³): 2.9

Unit Reference	MD-SHE-0143-1100-1600-1100	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	143
Design Flow (l/s)	11.0	Invert Level (m)	109.484
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	225
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1500
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	10.9	Kick-Flo®	0.995	8.8
Flush-Flo™	0.473	11.0	Mean Flow over Head Range	-	9.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	0.600	10.8	1.600	10.9	2.600	13.8	5.000	18.8	7.500	22.9
0.200	9.7	0.800	10.3	1.800	11.6	3.000	14.7	5.500	19.7	8.000	23.6
0.300	10.6	1.000	8.8	2.000	12.2	3.500	15.9	6.000	20.5	8.500	24.3
0.400	10.9	1.200	9.6	2.200	12.7	4.000	16.9	6.500	21.3	9.000	25.0
0.500	10.9	1.400	10.3	2.400	13.3	4.500	17.9	7.000	22.1	9.500	25.6

Hydro-Brake® Optimum Manhole: S17, DS/PN: S2.008, Volume (m³): 4.0

Unit Reference	MD-SHE-0133-9500-1600-9500	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	133
Design Flow (l/s)	9.5	Invert Level (m)	108.078
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	9.5	Kick-Flo®	0.980	7.5
Flush-Flo™	0.466	9.5	Mean Flow over Head Range	-	8.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	0.600	9.4	1.600	9.5	2.600	11.9	5.000	16.3	7.500	19.8
0.200	8.4	0.800	8.8	1.800	10.0	3.000	12.8	5.500	17.1	8.000	20.4
0.300	9.2	1.000	7.6	2.000	10.5	3.500	13.7	6.000	17.8	8.500	21.0
0.400	9.4	1.200	8.3	2.200	11.0	4.000	14.7	6.500	18.5	9.000	21.6
0.500	9.5	1.400	8.9	2.400	11.5	4.500	15.5	7.000	19.1	9.500	22.2

Storage Structures for S NET -1.SWS

Cellular Storage Manhole: S11, DS/PN: S2.002

Invert Level (m) 110.823 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S13, DS/PN: S2.004

Invert Level (m) 110.468 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S20, DS/PN: S3.002

Invert Level (m) 109.912 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S21, DS/PN: S3.003

Invert Level (m) 109.864 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S15, DS/PN: S2.006

Invert Level (m) 109.652 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	80.0	0.0	0.800	80.0	0.0

Cellular Storage Manhole: S17, DS/PN: S2.008

Invert Level (m) 108.078 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Summary of Critical Results by Maximum Level (Rank 1) for S NET -1.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.400 Cv (Summer) 0.750
Region England and Wales Ratio R 0.246 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	S1	15 Summer	1	+0%					114.237	-0.164	0.000	0.42			33.4
S1.001	S2	15 Summer	1	+0%					113.998	-0.215	0.000	0.18			33.4
S1.002	S4	15 Summer	1	+0%					112.238	-0.127	0.000	0.63			33.5
S1.003	S5	15 Summer	1	+0%					112.112	-0.226	0.000	0.13			33.8
S1.004	S5	15 Summer	1	+0%					110.200	-0.223	0.000	0.14			33.8
S1.005	S6	15 Summer	1	+0%					108.337	-0.170	0.000	0.35			33.4
S2.000	S9	15 Winter	1	+0%					111.015	-0.077	0.000	0.47			5.4
S2.001	S10	15 Winter	1	+0%					110.947	-0.098	0.000	0.26			5.4
S2.002	S11	15 Winter	1	+0%					110.785	-0.091	0.000	0.33		7	6.0
S2.003	S12	15 Winter	1	+0%					110.705	-0.084	0.000	0.40			10.6
S2.004	S13	15 Winter	1	+0%					110.433	-0.088	0.000	0.35		8	11.5
S2.005	S14	15 Winter	1	+0%					109.888	-0.238	0.000	0.10			11.5
S3.000	S18	15 Winter	1	+0%					110.169	-0.125	0.000	0.06			1.0
S3.001	S19	15 Winter	1	+0%					110.110	-0.078	0.000	0.46			5.9
S3.002	S20	30 Winter	1	+0%					109.982	-0.147	0.000	0.26		12	9.1
S3.003	S21	30 Winter	1	+0%					109.915	-0.150	0.000	0.24		12	9.3
S3.004	S22	60 Winter	1	+0%					109.789	-0.149	0.000	0.20			12.5
S2.006	S15	60 Winter	1	+0%					109.785	-0.091	0.000	0.13		21	9.7
S2.007	S16	60 Winter	1	+0%					109.776	-0.008	0.000	0.05			10.4
S2.008	S17	120 Winter	1	+0%	1/15 Summer				108.546	0.168	0.000	0.19		25	9.2
S1.006	S7	120 Winter	1	+0%					108.250	-0.108	0.000	0.74			45.3

PN	US/MH Name	Status	Level Exceeded
S1.000	S1	OK	
S1.001	S2	OK	
S1.002	S4	OK	
S1.003	S5	OK	
S1.004	S5	OK	
S1.005	S6	OK	
S2.000	S9	OK	
S2.001	S10	OK	
S2.002	S11	OK	
S2.003	S12	OK	
S2.004	S13	OK	
S2.005	S14	OK	
S3.000	S18	OK	
S3.001	S19	OK	
S3.002	S20	OK	
S3.003	S21	OK	
S3.004	S22	OK	
S2.006	S15	OK	
S2.007	S16	OK	
S2.008	S17	SURCHARGED	
S1.006	S7	OK	

30 Year

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -1.SWS

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	30.687	0.188	163.2	0.000	5.00	65.0	0.600	o	300	Pipe/Conduit	
S1.001	60.683	1.873	32.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	5.316	0.027	196.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	30.125	1.916	15.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	33.195	1.916	17.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	3.266	0.149	21.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	8.298	0.047	176.6	0.053	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	9.587	0.169	56.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	4.446	0.087	50.8	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.003	9.627	0.267	36.0	0.053	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.004	9.296	0.395	23.5	0.011	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.005	7.017	0.230	30.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	10.921	0.106	103.0	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
S3.001	8.895	0.059	150.0	0.056	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.002	9.514	0.063	150.0	0.061	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.003	19.050	0.127	150.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.004	9.390	0.063	150.0	0.094	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.006	13.745	0.092	150.0	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.007	33.661	1.426	23.6	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.008	3.947	0.020	197.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	8.144	0.054	150.8	0.089	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.42	114.101	0.000	65.0	0.0	26.0	1.23	86.8«	91.0
S1.001	50.00	5.78	113.913	0.000	65.0	0.0	26.0	2.77	195.9	91.0
S1.002	50.00	5.86	112.065	0.000	65.0	0.0	26.0	1.12	79.0«	91.0
S1.003	50.00	5.99	112.038	0.000	65.0	0.0	26.0	3.98	281.6	91.0
S1.004	50.00	6.13	110.123	0.000	65.0	0.0	26.0	3.79	268.2	91.0
S1.005	50.00	6.15	108.207	0.000	65.0	0.0	26.0	3.37	238.4	91.0
S2.000	50.00	5.18	110.942	0.053	0.0	0.0	2.9	0.75	13.3	10.0
S2.001	50.00	5.30	110.895	0.053	0.0	0.0	2.9	1.34	23.6	10.0
S2.002	50.00	5.36	110.726	0.060	0.0	0.0	3.2	1.41	25.0	11.3
S2.003	50.00	5.45	110.639	0.113	0.0	0.0	6.1	1.68	29.7	21.3
S2.004	50.00	5.53	110.371	0.123	0.0	0.0	6.7	2.09	36.9	23.4
S2.005	50.00	5.57	109.826	0.123	0.0	0.0	6.7	2.86	201.9	23.4
S3.000	50.00	5.18	110.144	0.010	0.0	0.0	0.5	0.99	17.5	1.9
S3.001	50.00	5.37	110.038	0.066	0.0	0.0	3.6	0.82	14.5	12.5
S3.002	50.00	5.51	109.904	0.127	0.0	0.0	6.9	1.07	42.4	24.1
S3.003	50.00	5.81	109.840	0.143	0.0	0.0	7.7	1.07	42.4	27.1
S3.004	50.00	5.93	109.638	0.237	0.0	0.0	12.8	1.28	90.6	44.9
S2.006	50.00	6.11	109.576	0.374	0.0	0.0	20.3	1.28	90.6	70.9
S2.007	50.00	6.29	109.484	0.415	0.0	0.0	22.5	3.25	229.7	78.7
S2.008	50.00	6.34	108.078	0.415	0.0	0.0	22.5	1.12	78.9	78.7
S1.006	50.00	6.45	108.058	0.504	65.0	0.0	53.3	1.28	90.3«	186.6

Online Controls for S NET -1.SWS

Hydro-Brake® Optimum Manhole: S16, DS/PN: S2.007, Volume (m³): 2.9

Unit Reference	MD-SHE-0143-1100-1600-1100	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	143
Design Flow (l/s)	11.0	Invert Level (m)	109.484
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	225
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1500
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	10.9	Kick-Flo®	0.995	8.8
Flush-Flo™	0.473	11.0	Mean Flow over Head Range	-	9.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	0.600	10.8	1.600	10.9	2.600	13.8	5.000	18.8	7.500	22.9
0.200	9.7	0.800	10.3	1.800	11.6	3.000	14.7	5.500	19.7	8.000	23.6
0.300	10.6	1.000	8.8	2.000	12.2	3.500	15.9	6.000	20.5	8.500	24.3
0.400	10.9	1.200	9.6	2.200	12.7	4.000	16.9	6.500	21.3	9.000	25.0
0.500	10.9	1.400	10.3	2.400	13.3	4.500	17.9	7.000	22.1	9.500	25.6

Hydro-Brake® Optimum Manhole: S17, DS/PN: S2.008, Volume (m³): 4.0

Unit Reference	MD-SHE-0133-9500-1600-9500	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	133
Design Flow (l/s)	9.5	Invert Level (m)	108.078
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	9.5	Kick-Flo®	0.980	7.5
Flush-Flo™	0.466	9.5	Mean Flow over Head Range	-	8.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	0.600	9.4	1.600	9.5	2.600	11.9	5.000	16.3	7.500	19.8
0.200	8.4	0.800	8.8	1.800	10.0	3.000	12.8	5.500	17.1	8.000	20.4
0.300	9.2	1.000	7.6	2.000	10.5	3.500	13.7	6.000	17.8	8.500	21.0
0.400	9.4	1.200	8.3	2.200	11.0	4.000	14.7	6.500	18.5	9.000	21.6
0.500	9.5	1.400	8.9	2.400	11.5	4.500	15.5	7.000	19.1	9.500	22.2

Storage Structures for S NET -1.SWS

Cellular Storage Manhole: S11, DS/PN: S2.002

Invert Level (m) 110.823 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S13, DS/PN: S2.004

Invert Level (m) 110.468 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S20, DS/PN: S3.002

Invert Level (m) 109.912 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S21, DS/PN: S3.003

Invert Level (m) 109.864 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S15, DS/PN: S2.006

Invert Level (m) 109.652 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	80.0	0.0	0.800	80.0	0.0

Cellular Storage Manhole: S17, DS/PN: S2.008

Invert Level (m) 108.078 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Summary of Critical Results by Maximum Level (Rank 1) for S NET -1.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.400 Cv (Summer) 0.750
Region England and Wales Ratio R 0.246 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	30
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	S1	10080 Summer	30	+40%					114.309	-0.092	0.000	0.82			65.0
S1.001	S2	15 Summer	30	+40%					114.035	-0.178	0.000	0.35			65.0
S1.002	S4	15 Summer	30	+40%	30/15 Summer				112.398	0.033	0.000	1.23			65.6
S1.003	S5	15 Summer	30	+40%					112.144	-0.194	0.000	0.26			65.7
S1.004	S5	15 Summer	30	+40%					110.230	-0.193	0.000	0.26			65.0
S1.005	S6	30 Summer	30	+40%	30/15 Summer				108.570	0.063	0.000	0.68			65.6
S2.000	S9	15 Winter	30	+40%	30/15 Summer				111.161	0.069	0.000	1.58			18.3
S2.001	S10	15 Winter	30	+40%					111.005	-0.040	0.000	0.88			18.5
S2.002	S11	15 Winter	30	+40%	30/15 Summer				110.888	0.011	0.000	1.01		4	18.8
S2.003	S12	15 Winter	30	+40%	30/15 Summer				110.842	0.053	0.000	1.09			28.8
S2.004	S13	15 Winter	30	+40%					110.489	-0.032	0.000	0.97		5	31.6
S2.005	S14	180 Winter	30	+40%	30/15 Winter				110.478	0.352	0.000	0.11			13.6
S3.000	S18	180 Winter	30	+40%	30/15 Summer				110.495	0.201	0.000	0.07			1.1
S3.001	S19	180 Winter	30	+40%	30/15 Summer				110.494	0.306	0.000	0.57			7.3
S3.002	S20	180 Winter	30	+40%	30/15 Winter				110.489	0.361	0.000	0.32		102	11.3
S3.003	S21	180 Winter	30	+40%	30/15 Summer				110.486	0.421	0.000	0.27		109	10.3
S3.004	S22	180 Winter	30	+40%	30/15 Summer				110.480	0.542	0.000	0.26			16.3
S2.006	S15	180 Winter	30	+40%	30/15 Summer				110.477	0.601	0.000	0.15		132	11.1
S2.007	S16	180 Winter	30	+40%	30/15 Summer				110.483	0.699	0.000	0.05			10.8
S2.008	S17	600 Winter	30	+40%	30/15 Summer				109.113	0.735	0.000	0.19		34	9.4
S1.006	S7	30 Summer	30	+40%	30/15 Summer				108.438	0.080	0.000	1.56			95.8

PN	US/MH Name	Status	Level Exceeded
S1.000	S1	OK	
S1.001	S2	OK	
S1.002	S4	SURCHARGED	
S1.003	S5	OK	
S1.004	S5	OK	
S1.005	S6	SURCHARGED	
S2.000	S9	SURCHARGED	
S2.001	S10	OK	
S2.002	S11	SURCHARGED	
S2.003	S12	SURCHARGED	
S2.004	S13	OK	
S2.005	S14	SURCHARGED	
S3.000	S18	SURCHARGED	
S3.001	S19	SURCHARGED	
S3.002	S20	SURCHARGED	
S3.003	S21	SURCHARGED	
S3.004	S22	SURCHARGED	
S2.006	S15	SURCHARGED	
S2.007	S16	SURCHARGED	
S2.008	S17	SURCHARGED	
S1.006	S7	SURCHARGED	

100 Year

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -1.SWS

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	30.687	0.188	163.2	0.000	5.00	79.8	0.600	o	300	Pipe/Conduit	
S1.001	60.683	1.873	32.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	5.316	0.027	196.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	30.125	1.916	15.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	33.195	1.916	17.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	3.266	0.149	21.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	8.298	0.047	176.6	0.053	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	9.587	0.169	56.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	4.446	0.087	50.8	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.003	9.627	0.267	36.0	0.053	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.004	9.296	0.395	23.5	0.011	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.005	7.017	0.230	30.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	10.921	0.106	103.0	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
S3.001	8.895	0.059	150.0	0.056	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.002	9.514	0.063	150.0	0.061	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.003	19.050	0.127	150.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.004	9.390	0.063	150.0	0.094	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.006	13.745	0.092	150.0	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.007	33.661	1.426	23.6	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.008	3.947	0.020	197.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	8.144	0.054	150.8	0.089	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.42	114.101	0.000	79.8	0.0	31.9	1.23	86.8«	111.7
S1.001	50.00	5.78	113.913	0.000	79.8	0.0	31.9	2.77	195.9	111.7
S1.002	50.00	5.86	112.065	0.000	79.8	0.0	31.9	1.12	79.0«	111.7
S1.003	50.00	5.99	112.038	0.000	79.8	0.0	31.9	3.98	281.6	111.7
S1.004	50.00	6.13	110.123	0.000	79.8	0.0	31.9	3.79	268.2	111.7
S1.005	50.00	6.15	108.207	0.000	79.8	0.0	31.9	3.37	238.4	111.7
S2.000	50.00	5.18	110.942	0.053	0.0	0.0	2.9	0.75	13.3	10.0
S2.001	50.00	5.30	110.895	0.053	0.0	0.0	2.9	1.34	23.6	10.0
S2.002	50.00	5.36	110.726	0.060	0.0	0.0	3.2	1.41	25.0	11.3
S2.003	50.00	5.45	110.639	0.113	0.0	0.0	6.1	1.68	29.7	21.3
S2.004	50.00	5.53	110.371	0.123	0.0	0.0	6.7	2.09	36.9	23.4
S2.005	50.00	5.57	109.826	0.123	0.0	0.0	6.7	2.86	201.9	23.4
S3.000	50.00	5.18	110.144	0.010	0.0	0.0	0.5	0.99	17.5	1.9
S3.001	50.00	5.37	110.038	0.066	0.0	0.0	3.6	0.82	14.5	12.5
S3.002	50.00	5.51	109.904	0.127	0.0	0.0	6.9	1.07	42.4	24.1
S3.003	50.00	5.81	109.840	0.143	0.0	0.0	7.7	1.07	42.4	27.1
S3.004	50.00	5.93	109.638	0.237	0.0	0.0	12.8	1.28	90.6	44.9
S2.006	50.00	6.11	109.576	0.374	0.0	0.0	20.3	1.28	90.6	70.9
S2.007	50.00	6.29	109.484	0.415	0.0	0.0	22.5	3.25	229.7	78.7
S2.008	50.00	6.34	108.078	0.415	0.0	0.0	22.5	1.12	78.9	78.7
S1.006	50.00	6.45	108.058	0.504	79.8	0.0	59.2	1.28	90.3«	207.3

Free Flowing Outfall Details for S NET -1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.006	S8(HW)	109.000	108.004	18.000	0	0

Online Controls for S NET -1.SWS

Hydro-Brake® Optimum Manhole: S16, DS/PN: S2.007, Volume (m³): 2.9

Unit Reference	MD-SHE-0143-1100-1600-1100	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	143
Design Flow (l/s)	11.0	Invert Level (m)	109.484
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	225
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1500
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	10.9	Kick-Flo®	0.995	8.8
Flush-Flo™	0.473	11.0	Mean Flow over Head Range	-	9.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	0.600	10.8	1.600	10.9	2.600	13.8	5.000	18.8	7.500	22.9
0.200	9.7	0.800	10.3	1.800	11.6	3.000	14.7	5.500	19.7	8.000	23.6
0.300	10.6	1.000	8.8	2.000	12.2	3.500	15.9	6.000	20.5	8.500	24.3
0.400	10.9	1.200	9.6	2.200	12.7	4.000	16.9	6.500	21.3	9.000	25.0
0.500	10.9	1.400	10.3	2.400	13.3	4.500	17.9	7.000	22.1	9.500	25.6

Hydro-Brake® Optimum Manhole: S17, DS/PN: S2.008, Volume (m³): 4.0

Unit Reference	MD-SHE-0133-9500-1600-9500	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	133
Design Flow (l/s)	9.5	Invert Level (m)	108.078
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	9.5	Kick-Flo®	0.980	7.5
Flush-Flo™	0.466	9.5	Mean Flow over Head Range	-	8.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	0.600	9.4	1.600	9.5	2.600	11.9	5.000	16.3	7.500	19.8
0.200	8.4	0.800	8.8	1.800	10.0	3.000	12.8	5.500	17.1	8.000	20.4
0.300	9.2	1.000	7.6	2.000	10.5	3.500	13.7	6.000	17.8	8.500	21.0
0.400	9.4	1.200	8.3	2.200	11.0	4.000	14.7	6.500	18.5	9.000	21.6
0.500	9.5	1.400	8.9	2.400	11.5	4.500	15.5	7.000	19.1	9.500	22.2

Storage Structures for S NET -1.SWS

Cellular Storage Manhole: S11, DS/PN: S2.002

Invert Level (m) 110.823 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S13, DS/PN: S2.004

Invert Level (m) 110.468 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S20, DS/PN: S3.002

Invert Level (m) 109.912 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S21, DS/PN: S3.003

Invert Level (m) 109.864 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S15, DS/PN: S2.006

Invert Level (m) 109.652 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	80.0	0.0	0.800	80.0	0.0

Cellular Storage Manhole: S17, DS/PN: S2.008

Invert Level (m) 108.078 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Summary of Critical Results by Maximum Level (Rank 1) for S NET -1.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.400 Cv (Summer) 0.750
Region England and Wales Ratio R 0.246 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 100
Climate Change (%) 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	S1	1440 Summer	100	+40%					114.401	0.000	0.000	1.01			79.9
S1.001	S2	1440 Summer	100	+40%					114.050	-0.163	0.000	0.43			80.0
S1.002	S4	15 Summer	100	+40%	100/15 Summer				112.433	0.068	0.000	1.51			80.5
S1.003	S5	15 Summer	100	+40%					112.158	-0.180	0.000	0.32			80.9
S1.004	S5	15 Summer	100	+40%					110.245	-0.177	0.000	0.33			80.4
S1.005	S6	30 Summer	100	+40%	100/15 Summer				108.647	0.140	0.000	0.83			80.7
S2.000	S9	15 Winter	100	+40%	100/15 Summer				111.282	0.190	0.000	1.92			22.3
S2.001	S10	15 Winter	100	+40%	100/15 Summer				111.116	0.071	0.000	1.03			21.5
S2.002	S11	15 Winter	100	+40%	100/15 Summer				110.958	0.081	0.000	1.18		5	22.0
S2.003	S12	15 Winter	100	+40%	100/15 Summer				110.907	0.118	0.000	1.18			31.2
S2.004	S13	180 Winter	100	+40%	100/30 Summer				110.800	0.279	0.000	0.56		62	18.1
S2.005	S14	180 Winter	100	+40%	100/15 Summer				110.790	0.664	0.000	0.15			17.6
S3.000	S18	180 Winter	100	+40%	100/15 Summer				110.809	0.515	0.000	0.08			1.3
S3.001	S19	180 Winter	100	+40%	100/15 Summer				110.808	0.620	0.000	0.67			8.5
S3.002	S20	180 Winter	100	+40%	100/15 Summer				110.803	0.674	0.000	0.33		146	11.6
S3.003	S21	180 Winter	100	+40%	100/15 Summer				110.799	0.734	0.000	0.26		151	10.0
S3.004	S22	180 Winter	100	+40%	100/15 Summer				110.792	0.854	0.000	0.27			16.7
S2.006	S15	180 Winter	100	+40%	100/15 Summer				110.789	0.913	0.000	0.14		175	10.9
S2.007	S16	180 Winter	100	+40%	100/15 Summer				110.784	1.000	0.000	0.05			10.7
S2.008	S17	960 Winter	100	+40%	100/15 Summer				109.238	0.860	0.000	0.19		39	9.4
S1.006	S7	30 Summer	100	+40%	100/15 Summer				108.516	0.158	0.000	1.93			118.2

PN	US/MH Name	Status	Level Exceeded
S1.000	S1	OK	
S1.001	S2	OK	
S1.002	S4	SURCHARGED	
S1.003	S5	OK	
S1.004	S5	OK	
S1.005	S6	SURCHARGED	
S2.000	S9	SURCHARGED	
S2.001	S10	SURCHARGED	
S2.002	S11	SURCHARGED	
S2.003	S12	SURCHARGED	
S2.004	S13	SURCHARGED	
S2.005	S14	SURCHARGED	
S3.000	S18	SURCHARGED	
S3.001	S19	SURCHARGED	
S3.002	S20	SURCHARGED	
S3.003	S21	SURCHARGED	
S3.004	S22	SURCHARGED	
S2.006	S15	SURCHARGED	
S2.007	S16	SURCHARGED	
S2.008	S17	SURCHARGED	
S1.006	S7	SURCHARGED	

200 Year

1000 Year

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -1.SWS

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	30.687	0.188	163.2	0.000	5.00	33.4	0.600	o	300	Pipe/Conduit	
S1.001	60.683	1.873	32.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	5.316	0.027	196.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	30.125	1.916	15.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	33.195	1.916	17.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	3.266	0.149	21.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	8.298	0.047	176.6	0.053	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	9.587	0.169	56.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	4.446	0.087	50.8	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.003	9.627	0.267	36.0	0.053	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.004	9.296	0.395	23.5	0.011	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.005	7.017	0.230	30.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	10.921	0.106	103.0	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
S3.001	8.895	0.059	150.0	0.056	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.002	9.514	0.063	150.0	0.061	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.003	19.050	0.127	150.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.004	9.390	0.063	150.0	0.094	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.006	13.745	0.092	150.0	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.007	33.661	1.426	23.6	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.008	3.947	0.020	197.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	8.144	0.054	150.8	0.089	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.42	114.101	0.000	33.4	0.0	13.4	1.23	86.8	46.8
S1.001	50.00	5.78	113.913	0.000	33.4	0.0	13.4	2.77	195.9	46.8
S1.002	50.00	5.86	112.065	0.000	33.4	0.0	13.4	1.12	79.0	46.8
S1.003	50.00	5.99	112.038	0.000	33.4	0.0	13.4	3.98	281.6	46.8
S1.004	50.00	6.13	110.123	0.000	33.4	0.0	13.4	3.79	268.2	46.8
S1.005	50.00	6.15	108.207	0.000	33.4	0.0	13.4	3.37	238.4	46.8
S2.000	50.00	5.18	110.942	0.053	0.0	0.0	2.9	0.75	13.3	10.0
S2.001	50.00	5.30	110.895	0.053	0.0	0.0	2.9	1.34	23.6	10.0
S2.002	50.00	5.36	110.726	0.060	0.0	0.0	3.2	1.41	25.0	11.3
S2.003	50.00	5.45	110.639	0.113	0.0	0.0	6.1	1.68	29.7	21.3
S2.004	50.00	5.53	110.371	0.123	0.0	0.0	6.7	2.09	36.9	23.4
S2.005	50.00	5.57	109.826	0.123	0.0	0.0	6.7	2.86	201.9	23.4
S3.000	50.00	5.18	110.144	0.010	0.0	0.0	0.5	0.99	17.5	1.9
S3.001	50.00	5.37	110.038	0.066	0.0	0.0	3.6	0.82	14.5	12.5
S3.002	50.00	5.51	109.904	0.127	0.0	0.0	6.9	1.07	42.4	24.1
S3.003	50.00	5.81	109.840	0.143	0.0	0.0	7.7	1.07	42.4	27.1
S3.004	50.00	5.93	109.638	0.237	0.0	0.0	12.8	1.28	90.6	44.9
S2.006	50.00	6.11	109.576	0.374	0.0	0.0	20.3	1.28	90.6	70.9
S2.007	50.00	6.29	109.484	0.415	0.0	0.0	22.5	3.25	229.7	78.7
S2.008	50.00	6.34	108.078	0.415	0.0	0.0	22.5	1.12	78.9	78.7
S1.006	50.00	6.45	108.058	0.504	33.4	0.0	40.7	1.28	90.3«	142.3

Free Flowing Outfall Details for S NET -1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.006	S8(HW)	109.000	108.004	18.000	0	0

Online Controls for S NET -1.SWS

Hydro-Brake® Optimum Manhole: S16, DS/PN: S2.007, Volume (m³): 2.9

Unit Reference	MD-SHE-0143-1100-1600-1100	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	143
Design Flow (l/s)	11.0	Invert Level (m)	109.484
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	225
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1500
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	10.9	Kick-Flo®	0.995	8.8
Flush-Flo™	0.473	11.0	Mean Flow over Head Range	-	9.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	0.600	10.8	1.600	10.9	2.600	13.8	5.000	18.8	7.500	22.9
0.200	9.7	0.800	10.3	1.800	11.6	3.000	14.7	5.500	19.7	8.000	23.6
0.300	10.6	1.000	8.8	2.000	12.2	3.500	15.9	6.000	20.5	8.500	24.3
0.400	10.9	1.200	9.6	2.200	12.7	4.000	16.9	6.500	21.3	9.000	25.0
0.500	10.9	1.400	10.3	2.400	13.3	4.500	17.9	7.000	22.1	9.500	25.6

Hydro-Brake® Optimum Manhole: S17, DS/PN: S2.008, Volume (m³): 4.0

Unit Reference	MD-SHE-0133-9500-1600-9500	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	133
Design Flow (l/s)	9.5	Invert Level (m)	108.078
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	9.5	Kick-Flo®	0.980	7.5
Flush-Flo™	0.466	9.5	Mean Flow over Head Range	-	8.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	0.600	9.4	1.600	9.5	2.600	11.9	5.000	16.3	7.500	19.8
0.200	8.4	0.800	8.8	1.800	10.0	3.000	12.8	5.500	17.1	8.000	20.4
0.300	9.2	1.000	7.6	2.000	10.5	3.500	13.7	6.000	17.8	8.500	21.0
0.400	9.4	1.200	8.3	2.200	11.0	4.000	14.7	6.500	18.5	9.000	21.6
0.500	9.5	1.400	8.9	2.400	11.5	4.500	15.5	7.000	19.1	9.500	22.2

Storage Structures for S NET -1.SWS

Cellular Storage Manhole: S11, DS/PN: S2.002

Invert Level (m) 110.823 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S13, DS/PN: S2.004

Invert Level (m) 110.468 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S20, DS/PN: S3.002

Invert Level (m) 109.912 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S21, DS/PN: S3.003

Invert Level (m) 109.864 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S15, DS/PN: S2.006

Invert Level (m) 109.652 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	80.0	0.0	0.800	80.0	0.0

Cellular Storage Manhole: S17, DS/PN: S2.008

Invert Level (m) 108.078 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.800	30.0	0.0

Summary of Critical Results by Maximum Level (Rank 1) for S NET -1.SWS

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.400 Cv (Summer) 0.750
Region England and Wales Ratio R 0.246 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1000
Climate Change (%) 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)
S1.000	S1	10080 Summer	1000	+40%					114.237	-0.164	0.000	0.42		
S1.001	S2	15 Summer	1000	+40%					113.998	-0.215	0.000	0.18		
S1.002	S4	15 Summer	1000	+40%					112.238	-0.127	0.000	0.63		
S1.003	S5	15 Summer	1000	+40%					112.112	-0.226	0.000	0.13		
S1.004	S5	15 Summer	1000	+40%					110.200	-0.223	0.000	0.14		
S1.005	S6	30 Summer	1000	+40%	1000/15 Summer				108.559	0.052	0.000	0.38		
S2.000	S9	15 Winter	1000	+40%	1000/15 Summer				111.897	0.805	0.000	2.85		
S2.001	S10	15 Winter	1000	+40%	1000/15 Summer				111.525	0.480	0.000	1.52		
S2.002	S11	180 Winter	1000	+40%	1000/15 Summer				111.445	0.569	0.000	0.68		182
S2.003	S12	180 Winter	1000	+40%	1000/15 Summer				111.438	0.650	0.000	0.89		
S2.004	S13	180 Winter	1000	+40%	1000/15 Summer				111.415	0.894	0.000	0.66		
S2.005	S14	180 Winter	1000	+40%	1000/15 Summer				111.391	1.265	0.000	0.17		
S3.000	S18	180 Winter	1000	+40%	1000/15 Summer				111.463	1.169	0.000	0.11		
S3.001	S19	180 Winter	1000	+40%	1000/15 Summer	1000/180 Winter			111.459	1.271	0.369	1.13		
S3.002	S20	180 Winter	1000	+40%	1000/15 Summer				111.443	1.315	0.000	0.41		
S3.003	S21	180 Winter	1000	+40%	1000/15 Summer				111.430	1.364	0.000	0.35		
S3.004	S22	180 Winter	1000	+40%	1000/15 Summer				111.410	1.472	0.000	0.41		
S2.006	S15	180 Winter	1000	+40%	1000/15 Summer				111.387	1.511	0.000	0.34		
S2.007	S16	240 Winter	1000	+40%	1000/15 Summer	1000/120 Winter			111.334	1.550	46.750	0.06		
S2.008	S17	720 Winter	1000	+40%	1000/15 Summer	1000/180 Summer			109.619	1.241	41.253	0.19		110
S1.006	S7	30 Summer	1000	+40%	1000/15 Summer				108.446	0.088	0.000	1.58		

PN	US/MH Name	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	33.4	OK	
S1.001	S2	33.4	OK	
S1.002	S4	33.5	OK	
S1.003	S5	33.8	OK	
S1.004	S5	33.8	OK	
S1.005	S6	36.4	SURCHARGED	
S2.000	S9	33.1	SURCHARGED	
S2.001	S10	31.9	SURCHARGED	
S2.002	S11	12.6	SURCHARGED	
S2.003	S12	23.4	SURCHARGED	
S2.004	S13	21.3	SURCHARGED	
S2.005	S14	20.7	FLOOD RISK	
S3.000	S18	1.8	FLOOD RISK	
S3.001	S19	14.4	FLOOD	1
S3.002	S20	14.4	FLOOD RISK	
S3.003	S21	13.4	SURCHARGED	
S3.004	S22	25.5	FLOOD RISK	
S2.006	S15	25.2	SURCHARGED	
S2.007	S16	11.7	FLOOD	10
S2.008	S17	9.4	FLOOD	17
S1.006	S7	97.2	SURCHARGED	

Microdrainage calculations – Network 2

1 Year

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -2.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	45.730	1.526	30.0	0.000	5.00	7.2	0.600	o	100	Pipe/Conduit	
S1.001	25.910	1.479	17.5	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	8.050	0.265	30.3	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.003	33.733	2.717	12.4	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.004	31.579	1.101	28.7	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S2.000	17.655	0.171	103.2	0.046	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	10.254	0.350	29.3	0.037	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	7.354	1.212	6.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	8.122	0.041	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.54	114.253	0.000	7.2	0.0	2.9	1.41	11.1	10.1
S1.001	50.00	5.77	112.727	0.000	7.2	0.0	2.9	1.85	14.6	10.1
S1.002	50.00	5.87	111.248	0.000	7.2	0.0	2.9	1.41	11.0	10.1
S1.003	50.00	6.12	110.983	0.000	7.2	0.0	2.9	2.20	17.3	10.1
S1.004	50.00	6.49	108.267	0.000	7.2	0.0	2.9	1.45	11.4	10.1
S2.000	50.00	5.30	108.849	0.046	0.0	0.0	2.5	0.99	17.5	8.7
S2.001	50.00	5.39	108.678	0.083	0.0	0.0	4.5	1.87	33.0	15.7
S2.002	50.00	5.42	108.328	0.083	0.0	0.0	4.5	4.12	72.8	15.7
S1.005	50.00	6.63	107.041	0.083	7.2	0.0	7.4	0.92	36.6	25.8

Simulation Criteria for S NET -2.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.200	Storm Duration (mins)	30
Ratio R	0.248		

Online Controls for S NET -2.SWS

Orifice Manhole: S31, DS/PN: S2.002, Volume (m³): 1.7

Diameter (m) 0.042 Discharge Coefficient 0.600 Invert Level (m) 108.328

Storage Structures for S NET -2.SWS

Cellular Storage Manhole: S30, DS/PN: S2.001

Invert Level (m) 108.678 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	20.0	0.800	20.0	163.1

Cellular Storage Manhole: S31, DS/PN: S2.002

Invert Level (m) 108.328 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	0.0	0.800	20.0	0.0

30 Year

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -2.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	45.730	1.526	30.0	0.000	5.00	7.2	0.600	o	100	Pipe/Conduit	
S1.001	25.910	1.479	17.5	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	8.050	0.265	30.3	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.003	33.733	2.717	12.4	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.004	31.579	1.101	28.7	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S2.000	17.655	0.171	103.2	0.046	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	10.254	0.350	29.3	0.037	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	7.354	1.212	6.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	8.122	0.041	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.54	114.253	0.000	7.2	0.0	2.9	1.41	11.1	10.1
S1.001	50.00	5.77	112.727	0.000	7.2	0.0	2.9	1.85	14.6	10.1
S1.002	50.00	5.87	111.248	0.000	7.2	0.0	2.9	1.41	11.0	10.1
S1.003	50.00	6.12	110.983	0.000	7.2	0.0	2.9	2.20	17.3	10.1
S1.004	50.00	6.49	108.267	0.000	7.2	0.0	2.9	1.45	11.4	10.1
S2.000	50.00	5.30	108.849	0.046	0.0	0.0	2.5	0.99	17.5	8.7
S2.001	50.00	5.39	108.678	0.083	0.0	0.0	4.5	1.87	33.0	15.7
S2.002	50.00	5.42	108.328	0.083	0.0	0.0	4.5	4.12	72.8	15.7
S1.005	50.00	6.63	107.041	0.083	7.2	0.0	7.4	0.92	36.6	25.8

Simulation Criteria for S NET -2.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.200	Storm Duration (mins)	30
Ratio R	0.248		

Online Controls for S NET -2.SWS

Orifice Manhole: S31, DS/PN: S2.002, Volume (m³): 1.7

Diameter (m) 0.042 Discharge Coefficient 0.600 Invert Level (m) 108.328

Storage Structures for S NET -2.SWS

Cellular Storage Manhole: S30, DS/PN: S2.001

Invert Level (m) 108.678 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	20.0	0.800	20.0	163.1

Cellular Storage Manhole: S31, DS/PN: S2.002

Invert Level (m) 108.328 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	0.0	0.800	20.0	0.0

Summary of Critical Results by Maximum Level (Rank 1) for S NET -2.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	17.200
Region	England and Wales	Ratio R	0.248
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	30
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S22	120 Summer	30	+40%					114.312	-0.041
S1.001	S23	15 Summer	30	+40%					112.783	-0.044
S1.002	S24	60 Winter	30	+40%					111.311	-0.037
S1.003	S25	60 Winter	30	+40%					111.032	-0.051
S1.004	S26	15 Summer	30	+40%					108.326	-0.041
S2.000	S29	180 Winter	30	+40%	30/120 Winter				109.031	0.032
S2.001	S30	180 Winter	30	+40%	30/30 Summer				109.023	0.195
S2.002	S31	180 Winter	30	+40%	30/15 Summer				109.012	0.534
S1.005	S27	180 Winter	30	+40%					107.132	-0.134

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S22	0.000	0.66			7.2	OK	
S1.001	S23	0.000	0.51			7.2	OK	
S1.002	S24	0.000	0.71			7.2	OK	
S1.003	S25	0.000	0.43			7.3	OK	
S1.004	S26	0.000	0.65			7.2	OK	
S2.000	S29	0.000	0.31			5.1	SURCHARGED	
S2.001	S30	0.000	0.24		78	7.0	SURCHARGED	
S2.002	S31	0.000	0.05		126	3.0	SURCHARGED	
S1.005	S27	0.000	0.35			10.2	OK	

100 Year

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -2.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	45.730	1.526	30.0	0.000	5.00	7.2	0.600	o	100	Pipe/Conduit	
S1.001	25.910	1.479	17.5	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	8.050	0.265	30.3	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.003	33.733	2.717	12.4	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.004	31.579	1.101	28.7	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S2.000	17.655	0.171	103.2	0.046	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	10.254	0.350	29.3	0.037	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	7.354	1.212	6.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	8.122	0.041	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.54	114.253	0.000	7.2	0.0	2.9	1.41	11.1	10.1
S1.001	50.00	5.77	112.727	0.000	7.2	0.0	2.9	1.85	14.6	10.1
S1.002	50.00	5.87	111.248	0.000	7.2	0.0	2.9	1.41	11.0	10.1
S1.003	50.00	6.12	110.983	0.000	7.2	0.0	2.9	2.20	17.3	10.1
S1.004	50.00	6.49	108.267	0.000	7.2	0.0	2.9	1.45	11.4	10.1
S2.000	50.00	5.30	108.849	0.046	0.0	0.0	2.5	0.99	17.5	8.7
S2.001	50.00	5.39	108.678	0.083	0.0	0.0	4.5	1.87	33.0	15.7
S2.002	50.00	5.42	108.328	0.083	0.0	0.0	4.5	4.12	72.8	15.7
S1.005	50.00	6.63	107.041	0.083	7.2	0.0	7.4	0.92	36.6	25.8

Simulation Criteria for S NET -2.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.200	Storm Duration (mins)	30
Ratio R	0.248		

Online Controls for S NET -2.SWS

Orifice Manhole: S31, DS/PN: S2.002, Volume (m³): 1.7

Diameter (m) 0.042 Discharge Coefficient 0.600 Invert Level (m) 108.328

Storage Structures for S NET -2.SWS

Cellular Storage Manhole: S30, DS/PN: S2.001

Invert Level (m) 108.678 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	20.0	0.800	20.0	163.1

Cellular Storage Manhole: S31, DS/PN: S2.002

Invert Level (m) 108.328 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	0.0	0.800	20.0	0.0

Summary of Critical Results by Maximum Level (Rank 1) for S NET -2.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 17.200	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.248	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S22	120 Summer	100	+40%					114.312	-0.041
S1.001	S23	15 Summer	100	+40%					112.783	-0.044
S1.002	S24	60 Summer	100	+40%					111.311	-0.037
S1.003	S25	60 Winter	100	+40%					111.032	-0.051
S1.004	S26	15 Summer	100	+40%					108.326	-0.041
S2.000	S29	180 Winter	100	+40%	100/15 Summer				109.237	0.238
S2.001	S30	180 Winter	100	+40%	100/15 Summer				109.228	0.400
S2.002	S31	180 Winter	100	+40%	100/15 Summer				109.216	0.737
S1.005	S27	180 Winter	100	+40%					107.134	-0.132

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S22	0.000	0.66			7.2	OK	
S1.001	S23	0.000	0.51			7.2	OK	
S1.002	S24	0.000	0.71			7.2	OK	
S1.003	S25	0.000	0.43			7.3	OK	
S1.004	S26	0.000	0.65			7.2	OK	
S2.000	S29	0.000	0.38			6.2	SURCHARGED	
S2.001	S30	0.000	0.25		99	7.3	SURCHARGED	
S2.002	S31	0.000	0.05		144	3.4	SURCHARGED	
S1.005	S27	0.000	0.36			10.6	OK	

200 Year

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -2.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	45.730	1.526	30.0	0.000	5.00	8.3	0.600	o	150	Pipe/Conduit	
S1.001	25.910	1.479	17.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	8.050	0.265	30.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.003	33.733	2.717	12.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.004	31.579	1.101	28.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	17.655	0.171	103.2	0.046	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	10.254	0.350	29.3	0.037	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	7.354	1.162	6.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	8.122	0.041	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.41	114.253	0.000	8.3	0.0	3.3	1.85	32.6	11.6
S1.001	50.00	5.59	112.727	0.000	8.3	0.0	3.3	2.42	42.7	11.6
S1.002	50.00	5.66	111.248	0.000	8.3	0.0	3.3	1.83	32.4	11.6
S1.003	50.00	5.86	110.983	0.000	8.3	0.0	3.3	2.87	50.8	11.6
S1.004	50.00	6.14	108.267	0.000	8.3	0.0	3.3	1.89	33.3	11.6
S2.000	50.00	5.30	108.849	0.046	0.0	0.0	2.5	0.99	17.5	8.7
S2.001	50.00	5.39	108.678	0.083	0.0	0.0	4.5	1.87	33.0	15.7
S2.002	50.00	5.42	108.328	0.083	0.0	0.0	4.5	4.03	71.3	15.7
S1.005	50.00	6.29	107.091	0.083	8.3	0.0	7.8	0.92	36.6	27.4

Simulation Criteria for S NET -2.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.200	Storm Duration (mins)	30
Ratio R	0.248		

Online Controls for S NET -2.SWS

Orifice Manhole: S31, DS/PN: S2.002, Volume (m³): 1.7

Diameter (m) 0.042 Discharge Coefficient 0.600 Invert Level (m) 108.328

Storage Structures for S NET -2.SWS

Cellular Storage Manhole: S30, DS/PN: S2.001

Invert Level (m) 108.678 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	20.0	0.800	20.0	163.1

Cellular Storage Manhole: S31, DS/PN: S2.002

Invert Level (m) 108.328 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	0.0	0.800	20.0	0.0

Summary of Critical Results by Maximum Level (Rank 1) for S NET -2.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 17.200	Cv (Summer) 0.750
Region England and Wales		Ratio R 0.248	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	200
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S22	15 Summer	200	+40%					114.305	-0.098
S1.001	S23	15 Summer	200	+40%					112.776	-0.101
S1.002	S24	60 Summer	200	+40%					111.304	-0.095
S1.003	S25	180 Summer	200	+40%					111.024	-0.109
S1.004	S26	60 Winter	200	+40%					108.322	-0.094
S2.000	S29	180 Winter	200	+40%	200/15 Summer				109.388	0.389
S2.001	S30	180 Winter	200	+40%	200/15 Summer				109.378	0.550
S2.002	S31	180 Winter	200	+40%	200/15 Summer				109.365	0.886
S1.005	S27	180 Winter	200	+40%					107.191	-0.125

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S22	0.000	0.26			8.3	OK	
S1.001	S23	0.000	0.20			8.3	OK	
S1.002	S24	0.000	0.29			8.3	OK	
S1.003	S25	0.000	0.17			8.3	OK	
S1.004	S26	0.000	0.26			8.4	OK	
S2.000	S29	0.000	0.45			7.3	SURCHARGED	
S2.001	S30	0.000	0.28		108	8.2	SURCHARGED	
S2.002	S31	0.000	0.06		150	3.7	SURCHARGED	
S1.005	S27	0.000	0.41			12.0	OK	

1000 Year

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -2.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	45.730	1.526	30.0	0.000	5.00	8.3	0.600	o	150	Pipe/Conduit	
S1.001	25.910	1.479	17.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	8.050	0.265	30.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.003	33.733	2.717	12.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.004	31.579	1.101	28.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	17.655	0.171	103.2	0.046	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	10.254	0.350	29.3	0.037	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	7.354	1.162	6.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	8.122	0.041	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.41	114.253	0.000	8.3	0.0	3.3	1.85	32.6	11.6
S1.001	50.00	5.59	112.727	0.000	8.3	0.0	3.3	2.42	42.7	11.6
S1.002	50.00	5.66	111.248	0.000	8.3	0.0	3.3	1.83	32.4	11.6
S1.003	50.00	5.86	110.983	0.000	8.3	0.0	3.3	2.87	50.8	11.6
S1.004	50.00	6.14	108.267	0.000	8.3	0.0	3.3	1.89	33.3	11.6
S2.000	50.00	5.30	108.849	0.046	0.0	0.0	2.5	0.99	17.5	8.7
S2.001	50.00	5.39	108.678	0.083	0.0	0.0	4.5	1.87	33.0	15.7
S2.002	50.00	5.42	108.328	0.083	0.0	0.0	4.5	4.03	71.3	15.7
S1.005	50.00	6.29	107.091	0.083	8.3	0.0	7.8	0.92	36.6	27.4

Simulation Criteria for S NET -2.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.200	Storm Duration (mins)	30
Ratio R	0.248		

Online Controls for S NET -2.SWS

Orifice Manhole: S31, DS/PN: S2.002, Volume (m^3): 1.7

Diameter (m) 0.042 Discharge Coefficient 0.600 Invert Level (m) 108.328

Storage Structures for S NET -2.SWS

Cellular Storage Manhole: S30, DS/PN: S2.001

Invert Level (m) 108.678 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	20.0	0.800	20.0	163.1

Cellular Storage Manhole: S31, DS/PN: S2.002

Invert Level (m) 108.328 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	0.0	0.800	20.0	0.0

Summary of Critical Results by Maximum Level (Rank 1) for S NET -2.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 17.200	Cv (Summer) 0.750
Region England and Wales		Ratio R 0.248	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1000
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S22	15 Summer	1000	+40%					114.305
S1.001	S23	15 Summer	1000	+40%					112.776
S1.002	S24	60 Summer	1000	+40%					111.304
S1.003	S25	180 Winter	1000	+40%					111.024
S1.004	S26	60 Winter	1000	+40%					108.322
S2.000	S29	180 Winter	1000	+40%	1000/15 Summer				109.761
S2.001	S30	180 Winter	1000	+40%	1000/15 Summer				109.731
S2.002	S31	180 Winter	1000	+40%	1000/15 Summer	1000/120 Winter			109.685
S1.005	S27	180 Winter	1000	+40%					107.193

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S22	-0.098	0.000	0.26			8.3	OK	
S1.001	S23	-0.101	0.000	0.20			8.3	OK	
S1.002	S24	-0.095	0.000	0.29			8.3	OK	
S1.003	S25	-0.109	0.000	0.17			8.3	OK	
S1.004	S26	-0.094	0.000	0.26			8.4	OK	
S2.000	S29	0.762	0.000	0.64			10.4	SURCHARGED	
S2.001	S30	0.903	0.000	0.38		177	11.3	FLOOD RISK	
S2.002	S31	1.207	6.648	0.07		156	4.3	FLOOD	4
S1.005	S27	-0.123	0.000	0.43			12.6	OK	

Greenfield Calculations

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	William Milne
Site name:	Ennerdale bridge
Site location:	West catchment

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:	54.53234° N
Longitude:	3.43787° W
Reference:	410216953
Date:	Jan 21 2021 16:46

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): .253

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	1714	1714
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

(1) Is Q_{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 SPR/SPRHOST ≤ 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):	3.48	3.48
1 in 1 year (l/s):	3.03	3.03
1 in 30 years (l/s):	5.92	5.92
1 in 100 year (l/s):	7.24	7.24
1 in 200 years (l/s):	8.25	8.25

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by: William Milne

Site name: ennerdale

Site location: Central And East

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: 54.53316° N

Longitude: 3.43801° W

Reference: 2253055830

Date: Jan 20 2021 06:49

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 2.787

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	1714	1714
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

(1) Is Q_{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 SPR/SPRHOST ≤ 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):	38.36	38.36
1 in 1 year (l/s):	33.38	33.38
1 in 30 years (l/s):	65.22	65.22
1 in 100 year (l/s):	79.8	79.8
1 in 200 years (l/s):	90.92	90.92

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	William Milne
Site name:	Ennerdale bridge
Site location:	Ennerdale Site Runoff

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:	54.53207° N
Longitude:	3.43791° W
Reference:	119470346
Date:	Aug 27 2020 17:19

Runoff estimation approach IH124

Site characteristics

Total site area (ha): .99

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	1714	1714
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

(1) Is Q_{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 SPR/SPRHOST ≤ 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):	13.63	13.63
1 in 1 year (l/s):	11.86	11.86
1 in 30 years (l/s):	23.17	23.17
1 in 100 year (l/s):	28.35	28.35
1 in 200 years (l/s):	32.3	32.3