Site Evolution Ltd

Proposed Housing Development,

Kirkland Road,

Ennerdale Bridge.

Drainage Strategy and Calculations

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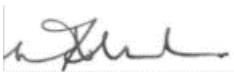
Prepared by	William Milne		18/05/21
Purpose of Issue	**Planning Application**		

18 May 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 4.01ha. Outlets are located on Back Lane at the south western boundary (western catchment), beneath prospect house on the southern boundary draining a portion of the site and via a culvert beneath Kirkland Road (eastern catchment). There is a ditch in the eastern catchment which enters the road boundary at the lay-by above the site before returning to the field. It is highly likely that this will overtop and run down Kirkland Road during storms. This potential loss off runoff from the upper eastern catchment has not been modelled and all overland flows have been retained within network 1.

The proposed development will bisect the east and west catchments at the northern site boundary. Filter drains will be installed to 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 eastern catchment discharging eastwards to the culvert beneath Kirkland Road. This catchment is the most significant source of overland flow 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 cellular storage with two Hydrobrakes and an orifice plate controlling flows. The first Hydrobrake is located in MH S14 and the orifice plate in MH S12 are used to mobilise upstream storage, the second Hydrobrake will be located in MH S17 controls the discharge to QBar.

It is likely that an area of the Kirkland Road (0.98ha) 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 (0.22ha) 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 value was obtained for the positively drained site area of 0.87ha. Peak surface water discharge from the site is to be discharged at QBar = 11.98l/s. There are two proposed outfalls on the site. The main area plots 1,2. 5-9 and the access road are drained via 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 2.4l/s.

Runoff rates for Overland flows from upstream catchments:

Runoff to be intercepted at the site boundary will be modelled at peak 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 (0.22ha) Peak Run-off Rates:

1 Year	2.63
30 Years	5.15l/s
100years	6.3l/s
200years	7.18l/s

Eastern Catchment (2.92ha) Peak Run-off Rates:

1 Year	34.97l/s
30 Years	68.33l/s
100years	83.6l/s
200years	95.26l/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	47%

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. A 47% run-off factor was applied to the remainder of the surfaces in the development that will be soft landscaping.

Contributing Area	Plot Area (m^2)	Impermeable Areas Within Plots (m^2)	Impermeable Area (110%) (m^2)	Soft Landscaping (47%) for Remainder (m^2)	Total Areas for Modelling (m^2)
Plot 1	877.50	269.74	296.71	272.97	569.68
Plot 2	437.00	211.64	232.80	95.97	328.78
Plot 3	406.50	247.50	272.25	63.10	335.35
Plot 4	628.00	277.20	304.92	151.85	456.77
Plot 5	958.14	339.00	372.90	275.06	647.96
Plot 6	968.00	339.60	373.56	279.39	652.95
Plot 7	897.00	332.50	365.75	249.69	615.44
Plot 8	1333.60	328.50	361.35	456.96	818.31
Plot 9	1127.60	318.80	350.68	365.15	715.83
Access Road	1066.00				1066.00
Total	8699.34				6207.06

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. Some minor surcharging was experienced at the lowest points in each system during the 1 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. Flooding (9.3m^3) occurred in network 1 at the flow control in MH S16 during the 200 year critical storm. This will follow the exceedance route to the proposed ditch at the south of the site.

Microdrainage calculations – Network 1

1 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	35.0	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	0.055	150.9	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	9.587	0.064	149.8	0.035	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.002	4.446	0.030	150.0	0.014	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.003	9.627	0.064	150.0	0.065	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.004	9.296	0.062	150.0	0.011	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.005	7.017	0.117	60.0	0.015	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	150.8	0.072	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.002	9.514	0.063	151.0	0.082	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.003	19.050	0.127	150.0	0.067	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.004	9.390	0.063	149.0	0.062	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.006	13.745	0.092	149.4	0.047	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.007	33.661	1.426	23.6	0.057	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	

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	35.0	0.0	14.0	1.23	86.8	49.0
S1.001	50.00	5.78	113.913	0.000	35.0	0.0	14.0	2.77	195.9	49.0
S1.002	50.00	5.86	112.065	0.000	35.0	0.0	14.0	1.12	79.0	49.0
S1.003	50.00	5.99	112.038	0.000	35.0	0.0	14.0	3.98	281.7	49.0
S1.004	50.00	6.13	110.122	0.000	35.0	0.0	14.0	3.80	268.3	49.0
S1.005	50.00	6.15	108.207	0.000	35.0	0.0	14.0	3.37	238.4	49.0
S2.000	50.00	5.17	110.100	0.030	0.0	0.0	1.6	0.82	14.4	5.7
S2.001	50.00	5.32	109.970	0.065	0.0	0.0	3.5	1.07	42.4	12.3
S2.002	50.00	5.39	109.906	0.079	0.0	0.0	4.3	1.07	42.4	15.0
S2.003	50.00	5.54	109.876	0.144	0.0	0.0	7.8	1.07	42.4	27.3
S2.004	50.00	5.66	109.737	0.155	0.0	0.0	8.4	1.28	90.6	29.4
S2.005	50.00	5.72	109.675	0.170	0.0	0.0	9.2	2.03	143.7	32.2
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	0.082	0.0	0.0	4.4	0.82	14.4«	15.5
S3.002	50.00	5.51	109.904	0.164	0.0	0.0	8.9	1.06	42.2	31.1
S3.003	50.00	5.81	109.840	0.231	0.0	0.0	12.5	1.07	42.4«	43.8
S3.004	50.00	5.93	109.638	0.293	0.0	0.0	15.9	1.29	90.9	55.5
S2.006	50.00	6.11	109.576	0.510	0.0	0.0	27.6	1.28	90.8«	96.7
S2.007	50.00	6.29	109.484	0.567	0.0	0.0	30.7	3.25	229.7	107.5
S2.008	50.00	6.34	108.078	0.567	0.0	0.0	30.7	1.12	78.9«	107.5

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -1.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
S1.006	8.144	0.054	150.8	0.098	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)
S1.006	50.00	6.45	108.058	0.665	35.0	0.0	50.0	1.28	90.3«	175.1

Simulation Criteria for S NET -1.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)	30
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 3 Number of Storage Structures 6 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)	17.400	Storm Duration (mins)	30
Ratio R	0.243		

Online Controls for S NET -1.SWS

Orifice Manhole: S11, DS/PN: S2.003, Volume (m³): 2.1

Diameter (m) 0.057 Discharge Coefficient 0.600 Invert Level (m) 109.876

Hydro-Brake® Optimum Manhole: S14, DS/PN: S2.006, Volume (m³): 3.3

Unit Reference	MD-SHE-0133-9500-1600-9500
Design Head (m)	1.600
Design Flow (l/s)	9.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	133
Invert Level (m)	109.576
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

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

Hydro-Brake® Optimum Manhole: S16, DS/PN: S2.008, Volume (m³): 4.0

Unit Reference	MD-SHE-0135-9500-1500-9500
Design Head (m)	1.500
Design Flow (l/s)	9.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	135
Invert Level (m)	108.078
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	9.5	Kick-Flo®	0.927	7.6
Flush-Flo™	0.436	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

Hydro-Brake® Optimum Manhole: S16, DS/PN: S2.008, Volume (m³): 4.0

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	4.9	0.800	8.7	2.000	10.9	4.000	15.1	7.000	19.8
0.200	8.6	1.000	7.9	2.200	11.4	4.500	16.0	7.500	20.4
0.300	9.3	1.200	8.6	2.400	11.9	5.000	16.8	8.000	21.1
0.400	9.5	1.400	9.2	2.600	12.3	5.500	17.6	8.500	21.7
0.500	9.5	1.600	9.8	3.000	13.2	6.000	18.4	9.000	22.3
0.600	9.3	1.800	10.4	3.500	14.2	6.500	19.1	9.500	22.9

Storage Structures for S NET -1.SWS

Cellular Storage Manhole: S10, DS/PN: S2.002

Invert Level (m) 109.906 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	40.0	0.0	0.800	40.0	0.0

Cellular Storage Manhole: S12, DS/PN: S2.004

Invert Level (m) 109.737 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	40.0	0.0	0.800	40.0	0.0

Cellular Storage Manhole: S19, DS/PN: S3.002

Invert Level (m) 109.912 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	40.0	0.0	0.800	40.0	0.0

Cellular Storage Manhole: S20, DS/PN: S3.003

Invert Level (m) 109.864 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	40.0	0.0	1.200	40.0	0.0

Cellular Storage Manhole: S14, DS/PN: S2.006

Invert Level (m) 109.652 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	40.0	0.0	1.200	40.0	0.0

Cellular Storage Manhole: S16, DS/PN: S2.008

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

Cellular Storage Manhole: S16, DS/PN: S2.008

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	60.0	0.0	0.800	60.0	0.0

30 Year

Summary of Critical Results by Maximum Level (Rank 1) for S NET -1.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 3 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
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720
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	S1	15 Summer	30	+40%	30/15 Summer				114.472	0.071
S1.001	S2	720 Summer	30	+40%					114.065	-0.148
S1.002	S3	15 Summer	30	+40%	30/15 Summer				112.480	0.115
S1.003	S4	15 Summer	30	+40%					112.170	-0.168
S1.004	S5A	15 Summer	30	+40%					110.258	-0.164
S1.005	S5	60 Summer	30	+40%	30/15 Summer				108.677	0.170
S2.000	S8	180 Winter	30	+40%	30/15 Summer				110.819	0.569
S2.001	S9	180 Winter	30	+40%	30/15 Summer				110.816	0.621
S2.002	S10	180 Winter	30	+40%	30/15 Summer				110.815	0.684
S2.003	S11	180 Winter	30	+40%	30/15 Summer				110.823	0.721
S2.004	S12	240 Winter	30	+40%	30/15 Summer				110.545	0.508
S2.005	S13	240 Winter	30	+40%	30/15 Summer				110.543	0.568
S3.000	S17	240 Winter	30	+40%	30/15 Summer				110.557	0.263
S3.001	S18	240 Winter	30	+40%	30/15 Summer				110.556	0.368
S3.002	S19	240 Winter	30	+40%	30/15 Summer				110.553	0.424
S3.003	S20	240 Winter	30	+40%	30/15 Summer				110.550	0.485
S3.004	S21	240 Winter	30	+40%	30/15 Summer				110.544	0.606
S2.006	S14	240 Winter	30	+40%	30/15 Summer				110.542	0.666
S2.007	S15	15 Winter	30	+40%					109.560	-0.224
S2.008	S16	720 Winter	30	+40%	30/15 Summer				109.100	0.722
S1.006	S6	60 Summer	30	+40%	30/15 Summer				108.533	0.175

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	S1	0.000	1.21			95.3	SURCHARGED	
S1.001	S2	0.000	0.51			95.3	OK	
S1.002	S3	0.000	1.81			96.3	SURCHARGED	
S1.003	S4	0.000	0.38			96.9	OK	

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.004	S5A	0.000	0.39			96.4	OK	
S1.005	S5	0.000	1.00			96.5	SURCHARGED	
S2.000	S8	0.000	0.23			2.9	SURCHARGED	
S2.001	S9	0.000	0.18			6.4	SURCHARGED	
S2.002	S10	0.000	0.11		166	3.3	SURCHARGED	
S2.003	S11	0.000	0.11			4.0	SURCHARGED	
S2.004	S12	0.000	0.06		179	4.0	SURCHARGED	
S2.005	S13	0.000	0.05			4.1	SURCHARGED	
S3.000	S17	0.000	0.06			0.9	SURCHARGED	
S3.001	S18	0.000	0.56			7.1	SURCHARGED	
S3.002	S19	0.000	0.28		148	9.7	SURCHARGED	
S3.003	S20	0.000	0.30		157	11.3	SURCHARGED	
S3.004	S21	0.000	0.24			15.1	SURCHARGED	
S2.006	S14	0.000	0.13		198	9.5	SURCHARGED	
S2.007	S15	0.000	0.14			30.4	OK	
S2.008	S16	0.000	0.19		199	9.5	SURCHARGED	
S1.006	S6	0.000	2.01			123.3	SURCHARGED	

100 Year

Summary of Critical Results by Maximum Level (Rank 1) for S NET -1.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 3 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
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720
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	S1	15 Summer	100	+40%	100/15 Summer				114.408	0.007
S1.001	S2	720 Summer	100	+40%					114.053	-0.160
S1.002	S3	15 Summer	100	+40%	100/15 Summer				112.443	0.078
S1.003	S4	15 Summer	100	+40%					112.161	-0.177
S1.004	S5A	15 Summer	100	+40%					110.248	-0.174
S1.005	S5	30 Summer	100	+40%	100/15 Summer				108.663	0.156
S2.000	S8	240 Winter	100	+40%	100/15 Summer				111.205	0.955
S2.001	S9	240 Winter	100	+40%	100/15 Summer				111.203	1.008
S2.002	S10	240 Winter	100	+40%	100/15 Summer				111.200	1.069
S2.003	S11	240 Winter	100	+40%	100/15 Summer				111.202	1.100
S2.004	S12	360 Winter	100	+40%	100/15 Summer				110.896	0.859
S2.005	S13	360 Winter	100	+40%	100/15 Summer				110.894	0.919
S3.000	S17	360 Winter	100	+40%	100/15 Summer				110.910	0.616
S3.001	S18	360 Winter	100	+40%	100/15 Summer				110.910	0.722
S3.002	S19	360 Winter	100	+40%	100/15 Summer				110.906	0.777
S3.003	S20	360 Winter	100	+40%	100/15 Summer				110.902	0.837
S3.004	S21	360 Winter	100	+40%	100/15 Summer				110.895	0.957
S2.006	S14	360 Winter	100	+40%	100/15 Summer				110.892	1.016
S2.007	S15	15 Winter	100	+40%					109.568	-0.216
S2.008	S16	480 Winter	100	+40%	100/15 Summer				109.117	0.739
S1.006	S6	30 Summer	100	+40%	100/15 Summer				108.532	0.174

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	S1	0.000	1.06			83.6	SURCHARGED	
S1.001	S2	0.000	0.45			83.6	OK	
S1.002	S3	0.000	1.59			84.4	SURCHARGED	
S1.003	S4	0.000	0.33			84.9	OK	

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.004	S5A	0.000	0.34			84.5	OK	
S1.005	S5	0.000	0.87			84.6	SURCHARGED	
S2.000	S8	0.000	0.25			3.2	SURCHARGED	
S2.001	S9	0.000	0.20			6.9	SURCHARGED	
S2.002	S10	0.000	0.12		257	3.5	SURCHARGED	
S2.003	S11	0.000	0.12			4.3	SURCHARGED	
S2.004	S12	0.000	0.06		276	4.0	SURCHARGED	
S2.005	S13	0.000	0.05			4.1	FLOOD RISK	
S3.000	S17	0.000	0.05			0.8	SURCHARGED	
S3.001	S18	0.000	0.55			6.9	SURCHARGED	
S3.002	S19	0.000	0.24		243	8.2	SURCHARGED	
S3.003	S20	0.000	0.26		252	10.0	SURCHARGED	
S3.004	S21	0.000	0.21			13.1	SURCHARGED	
S2.006	S14	0.000	0.13		295	9.5	SURCHARGED	
S2.007	S15	0.000	0.17			36.7	OK	
S2.008	S16	0.000	0.19		546	9.5	SURCHARGED	
S1.006	S6	0.000	2.00			122.4	SURCHARGED	

200 Year

Summary of Critical Results by Maximum Level (Rank 1) for S NET -1.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 3 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
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720
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	S1	15 Summer	200	+40%	200/15 Summer				114.472	0.071
S1.001	S2	720 Summer	200	+40%					114.065	-0.148
S1.002	S3	15 Summer	200	+40%	200/15 Summer				112.480	0.115
S1.003	S4	15 Summer	200	+40%					112.170	-0.168
S1.004	S5A	15 Summer	200	+40%					110.258	-0.164
S1.005	S5	30 Summer	200	+40%	200/15 Summer				108.749	0.242
S2.000	S8	240 Winter	200	+40%	200/15 Summer				111.488	1.238
S2.001	S9	240 Winter	200	+40%	200/15 Summer				111.485	1.290
S2.002	S10	240 Winter	200	+40%	200/15 Summer				111.483	1.352
S2.003	S11	240 Winter	200	+40%	200/15 Summer				111.492	1.390
S2.004	S12	360 Winter	200	+40%	200/15 Summer				111.145	1.108
S2.005	S13	360 Winter	200	+40%	200/15 Summer				111.143	1.168
S3.000	S17	360 Winter	200	+40%	200/15 Summer				111.161	0.867
S3.001	S18	360 Winter	200	+40%	200/15 Summer				111.160	0.972
S3.002	S19	360 Winter	200	+40%	200/15 Summer				111.156	1.027
S3.003	S20	360 Winter	200	+40%	200/15 Summer				111.152	1.087
S3.004	S21	360 Winter	200	+40%	200/15 Summer				111.144	1.206
S2.006	S14	360 Winter	200	+40%	200/15 Summer				111.141	1.265
S2.007	S15	600 Winter	200	+40%					109.599	-0.185
S2.008	S16	600 Winter	200	+40%	200/15 Summer	200/480 Winter			109.587	1.209
S1.006	S6	30 Summer	200	+40%	200/15 Summer				108.605	0.247

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	S1	0.000	1.21			95.3	SURCHARGED	
S1.001	S2	0.000	0.51			95.3	OK	
S1.002	S3	0.000	1.81			96.3	SURCHARGED	
S1.003	S4	0.000	0.38			96.9	OK	

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.004	S5A	0.000	0.39			96.4	OK	
S1.005	S5	0.000	1.00			96.6	SURCHARGED	
S2.000	S8	0.000	0.29			3.7	SURCHARGED	
S2.001	S9	0.000	0.23			8.0	SURCHARGED	
S2.002	S10	0.000	0.13		287	3.9	FLOOD RISK	
S2.003	S11	0.000	0.13			4.6	FLOOD RISK	
S2.004	S12	0.000	0.07		323	4.5	SURCHARGED	
S2.005	S13	0.000	0.05			4.6	FLOOD RISK	
S3.000	S17	0.000	0.05			0.8	SURCHARGED	
S3.001	S18	0.000	0.63			8.0	FLOOD RISK	
S3.002	S19	0.000	0.24		287	8.4	SURCHARGED	
S3.003	S20	0.000	0.26		298	9.7	SURCHARGED	
S3.004	S21	0.000	0.21			13.4	SURCHARGED	
S2.006	S14	0.000	0.13		343	9.5	SURCHARGED	
S2.007	S15	0.000	0.06			13.3	OK	
S2.008	S16	9.281	0.19		127	9.5	FLOOD	3
S1.006	S6	0.000	2.28			139.7	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	2.6	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	1.151	27.4	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	0.034	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	7.354	1.262	5.8	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	2.6	0.0	0.0	1.41	11.1	2.6
S1.001	50.00	5.77	112.727	0.000	2.6	0.0	0.0	1.85	14.6	2.6
S1.002	50.00	5.87	111.248	0.000	2.6	0.0	0.0	1.41	11.0	2.6
S1.003	50.00	6.12	110.983	0.000	2.6	0.0	0.0	2.20	17.3	2.6
S1.004	50.00	6.48	108.267	0.000	2.6	0.0	0.0	1.48	11.6	2.6
S2.000	50.00	5.30	108.849	0.046	0.0	0.0	0.0	0.99	17.5	6.2
S2.001	50.00	5.39	108.678	0.080	0.0	0.0	0.0	1.87	33.0	10.8
S2.002	50.00	5.42	108.328	0.080	0.0	0.0	0.0	4.20	74.3	10.8
S1.005	50.00	6.62	106.991	0.080	2.6	0.0	0.0	0.92	36.6	13.4

Online Controls for S NET -2.SWS

Hydro-Brake® Optimum Manhole: S31, DS/PN: S2.002, Volume (m³): 1.7

Unit Reference	MD-SHE-0072-2400-1100-2400
Design Head (m)	1.100
Design Flow (l/s)	2.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	72
Invert Level (m)	108.328
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.100	2.4	Kick-Flo®	0.645	1.9
Flush-Flo™	0.318	2.3	Mean Flow over Head Range	-	2.1

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)
0.100	1.9	0.800	2.1	2.000	3.2	4.000	4.4	7.000	5.7
0.200	2.2	1.000	2.3	2.200	3.3	4.500	4.6	7.500	5.9
0.300	2.3	1.200	2.5	2.400	3.4	5.000	4.8	8.000	6.0
0.400	2.3	1.400	2.7	2.600	3.6	5.500	5.1	8.500	6.2
0.500	2.2	1.600	2.8	3.000	3.8	6.000	5.3	9.000	6.4
0.600	2.0	1.800	3.0	3.500	4.1	6.500	5.5	9.500	6.5

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) 17.400	Cv (Summer) 0.750
Region England and Wales		Ratio R 0.243	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)	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)
S1.000	S22	15 Summer	1	+0%					114.286	-0.067	0.000
S1.001	S23	180 Winter	1	+0%					112.756	-0.071	0.000
S1.002	S24	60 Summer	1	+0%					111.284	-0.064	0.000
S1.003	S25	15 Summer	1	+0%					111.011	-0.072	0.000
S1.004	S26	180 Winter	1	+0%					108.300	-0.067	0.000
S2.000	S29	15 Winter	1	+0%					108.904	-0.095	0.000
S2.001	S30	15 Winter	1	+0%					108.727	-0.101	0.000
S2.002	S31	60 Winter	1	+0%	1/30 Winter				108.494	0.016	0.000
S1.005	S27	60 Winter	1	+0%					107.051	-0.165	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S22	0.24			2.6	OK	
S1.001	S23	0.18			2.6	OK	
S1.002	S24	0.26			2.6	OK	
S1.003	S25	0.16			2.6	OK	
S1.004	S26	0.23			2.6	OK	
S2.000	S29	0.28			4.6	OK	
S2.001	S30	0.24		9	7.0	OK	
S2.002	S31	0.03		28	2.2	SURCHARGED	
S1.005	S27	0.16			4.8	OK	

30 Year

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)	17.400
Region	England and Wales	Ratio R	0.243
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	60 Summer	30	+40%					114.302	-0.051
S1.001	S23	15 Summer	30	+40%					112.772	-0.055
S1.002	S24	60 Winter	30	+40%					111.300	-0.049
S1.003	S25	60 Summer	30	+40%					111.024	-0.059
S1.004	S26	180 Summer	30	+40%					108.315	-0.052
S2.000	S29	180 Winter	30	+40%	30/120 Winter				109.028	0.029
S2.001	S30	180 Winter	30	+40%	30/30 Summer				109.023	0.195
S2.002	S31	180 Winter	30	+40%	30/15 Summer				109.016	0.538
S1.005	S27	360 Summer	30	+40%					107.067	-0.148

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	0.48			5.2	OK	
S1.001	S23	0.000	0.37			5.2	OK	
S1.002	S24	0.000	0.51			5.2	OK	
S1.003	S25	0.000	0.31			5.2	OK	
S1.004	S26	0.000	0.46			5.2	OK	
S2.000	S29	0.000	0.32			5.2	SURCHARGED	
S2.001	S30	0.000	0.27		96	7.9	SURCHARGED	
S2.002	S31	0.000	0.04		144	2.3	SURCHARGED	
S1.005	S27	0.000	0.26			7.5	OK	

100 Year

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) 17.400	Cv (Summer) 0.750
Region England and Wales		Ratio R 0.243	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 Winter	100	+40%					111.311	-0.037
S1.003	S25	60 Summer	100	+40%					111.032	-0.051
S1.004	S26	15 Summer	100	+40%					108.325	-0.042
S2.000	S29	180 Winter	100	+40%	100/15 Summer				109.259	0.260
S2.001	S30	180 Winter	100	+40%	100/15 Summer				109.253	0.425
S2.002	S31	180 Winter	100	+40%	100/15 Summer				109.245	0.767
S1.005	S27	960 Winter	100	+40%					107.078	-0.137

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	0.63			7.2	OK	
S2.000	S29	0.000	0.40			6.6	SURCHARGED	
S2.001	S30	0.000	0.28		135	8.2	SURCHARGED	
S2.002	S31	0.000	0.04		189	2.3	SURCHARGED	
S1.005	S27	0.000	0.32			9.5	OK	

200 Year

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) 17.400	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.243	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

WARNING: Half Drain Time has not been calculated as the structure is too full.

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	200	+40%					114.312	-0.041
S1.001	S23	15 Summer	200	+40%					112.783	-0.044
S1.002	S24	60 Winter	200	+40%					111.311	-0.037
S1.003	S25	60 Summer	200	+40%					111.032	-0.051
S1.004	S26	15 Summer	200	+40%					108.325	-0.042
S2.000	S29	180 Winter	200	+40%	200/15 Summer				109.426	0.427
S2.001	S30	180 Winter	200	+40%	200/15 Summer				109.419	0.591
S2.002	S31	180 Winter	200	+40%	200/15 Summer				109.411	0.933
S1.005	S27	180 Winter	200	+40%					107.079	-0.137

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	0.63			7.2	OK	
S2.000	S29	0.000	0.45			7.4	SURCHARGED	
S2.001	S30	0.000	0.29		138	8.6	SURCHARGED	
S2.002	S31	0.000	0.04			2.4	FLOOD RISK	
S1.005	S27	0.000	0.32			9.6	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:	Development Area

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:	54.53226° N
Longitude:	3.43796° W
Reference:	1206763894
Date:	May 25 2021 08:04

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.87

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):	11.98	11.98
1 in 1 year (l/s):	10.42	10.42
1 in 30 years (l/s):	20.36	20.36
1 in 100 year (l/s):	24.91	24.91
1 in 200 years (l/s):	28.38	28.38

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	William Milne
Site name:	Ennerdale bridge
Site location:	Western 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:	54.53226° N
Longitude:	3.43796° W
Reference:	640590221
Date:	May 25 2021 08:02

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.22

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):	3.03	3.03
1 in 1 year (l/s):	2.63	2.63
1 in 30 years (l/s):	5.15	5.15
1 in 100 year (l/s):	6.3	6.3
1 in 200 years (l/s):	7.18	7.18

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	William Milne
Site name:	Ennerdale bridge
Site location:	Eastern 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:	54.53226° N
Longitude:	3.43796° W
Reference:	287281510
Date:	May 25 2021 07:57

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 2.92

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.

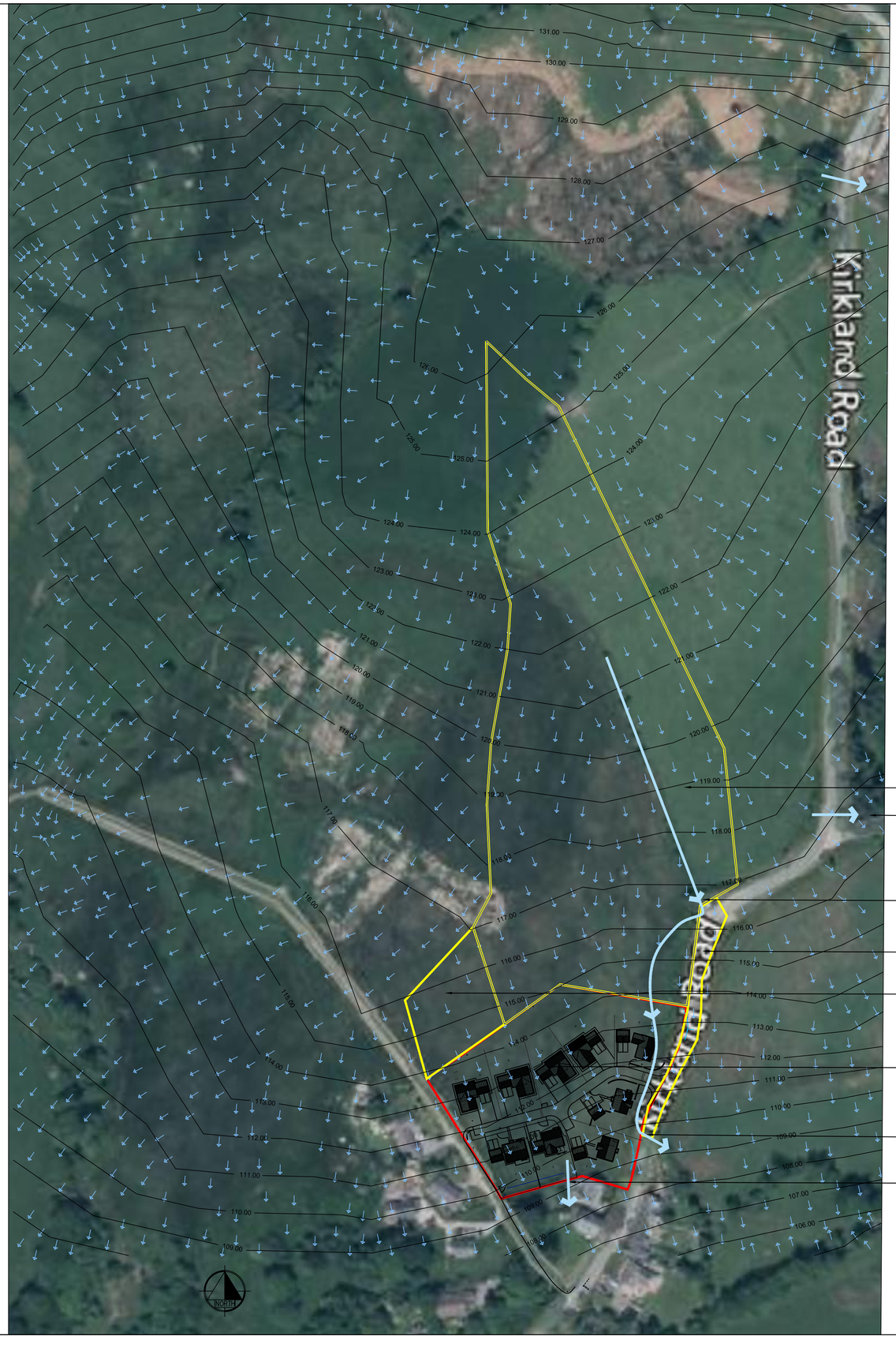
(3) Is SPR/SPRHOST ≤ 0.3?

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):	40.19	40.19
1 in 1 year (l/s):	34.97	34.97
1 in 30 years (l/s):	68.33	68.33
1 in 100 year (l/s):	83.6	83.6
1 in 200 years (l/s):	95.26	95.26

Catchment Plan



NOTES.

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
3. ALL MATERIALS AND WORKMANSHIP ARE TO BE IN ACCORDANCE WITH "SEWERS FOR ADOPTION" (EIGHTH EDITION)

Rev.	Amendment	By	Checked	Approved	Date

FOR INFORMATION

Status | Appd. | Date

Client: **GENESIS HOMES Ltd**

Project: **PROPOSED HOUSING DEVELOPMENT, KIRKLAND ROAD, ENNERDALE BRIDGE.**

Title: **CATCHMENT PLAN**

Drawn	Date	Checked	Date	Approved	Date
RJ	24.05.21	WAM	24.05.21	WAM	24.05.21

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Scales: 1:1250 @ A1

Job No.: AA6874

Client Drawing No.

Rev.

Drawing No.: AA6874/EW/05