APPENDIX E
FOUL & SURFACE DRAINAGE STRATEGY LAYOUT

NOTES:

The foul & surface water design has been based on the approved principles outlined within the Flood Risk Assessment & Drainage Strategy undertaken by Forge Engineering Design Solutions together with the MJA Consulting FRA Addendum.

Foul Water:
The foul water flows from each property will drain via gravity through the private house drainage before out-falling to a new sewer located typically within the development road network. All foul flow from the development gravitates in a southerly direction to a new foul outfall sewer constructed as part of the adjacent Cala Homes Development.

The development foul drainage network will be offered to Thames Water for adoption under a Section 104 agreement of the Water Industry Act 1991.

Surface Water:
The surface water drainage strategy sets of general principles for the designs. The sub strata is unsuitable for infiltration type SUDs and will therefore require a more traditional approach.

Due to the steepness of the development roads and drives permeable type paving is unsuitable. The surface water flows from each property will drain via gravity through the private house drainage before out-falling to a new storm drain located typically within the development road network. The development storm drainage discharges to an attenuation tank located towards the southern end of the site within the open space. Storage cells to be placed below POS avoiding LEAP and to be an off line design. Detail design to be subject to Thames Water approval.

The controlled surface water discharge from the development will outfall to a new surface water outfall sewer constructed as part of the adjacent Cala Homes Development.

The following SUDs techniques are proposed for the development site and form part of the drainage treatment train.

- Piped storm drainage with associated deep trapped gullies and catchpits
- Cellular attenuation (1 in 100 + 40% climate change)
- Flow control
- Downstream defender

The final surface water runoff from the development will be strictly controlled via the above Sustainable Drainage Systems. The runoff rate is at the equivalent agreed Greenfield runoff rate and be designed to manage the 1 in 100 year return storm plus an extra allowance of 40% for the potential predicted increase in peak rainfall up to 2115.

KEY:

Proposed Adoptable Sewers:

Foul sewer

Storm sewer

Road Gully
(no distinction between private or adopted at this time)

Proposed Private Drainage:

Foul drain

Storm drain

Storm Attenuation
(see plan for details)

Diversionary Works to Existing:

RAW Water Main
(subject to Thames Water approval)

Private Storm

Highway DN300

ROUTE OF RAW WATER MAIN DIVERSION T.B.C.

TERMINATION OF EXISTING SEWER DIVERSION T.B.C.

HYDROBRAKE MANHOLE LIMITING DISCHARGE TO 10.5 LITRES PER SECOND

DOWNSTREAM DEFENDER

NB: Hydrobrake Cover Level connected with tanked construction for attenuation

STORM & FOUL OUTFALLS IN ACCORDANCE WITH CALA HOMES'S SECTION 104 PROPOSALS

PRELIMINARY

REV. No.	DATE	DESCRIPTION	INITIALS

Client: CREST NICHOLSON

Project: Bodicote, Banbury

Title: Proposed Drainage Strategy Plan

MJA CONSULTING
CIVIL AND STRUCTURAL ENGINEERS
Monarch House, Barton Lane,
Abingdon, Oxon, OX14 3NB
Tel: 01235 555173
Fax: 01235 523226

Scale: 1:500 @A1 | Date: Nov' 2017 | Drawing No.: 5692:DS | Rev:

Checked: KTG | Drawn: AJW

Notes:

Key:

Flood Flow Route

PRELIMINARY

REV. No.	DATE	DESCRIPTION	INITIALS

Client: CREST NICHOLSON

Project: Bodicote, Banbury

Title: Flood Exceedance Route Plan

MJA CONSULTING
CIVIL AND STRUCTURAL ENGINEERS
Monarch House, Barton Lane,
Abingdon, Oxon, OX14 3NB
Tel: 01235 555173
Fax: 01235 523226

Scale	Date	Drawing No.	Rev
1:500 @A1	Nov' 2017	5692:FE	
Checked: KTG	Drawn: AJW		

APPENDIX F
DEVELOPMENT DRAINAGE CALCULATIONS

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.800	Add Flow / Climate Change (%)	0
Ratio R	0.404	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	550	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.854	4-8	0.605

Total Area Contributing (ha) = 1.459

Total Pipe Volume (m³) = 66.908

Network Design Table for Storm

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	38.625	0.624	61.9	0.039	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.001	13.106	0.479	27.4	0.064	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	14.956	0.339	44.1	0.015	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	12.517	0.338	37.0	0.066	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	32.393	2.086	15.5	0.088	5.00	0.0	0.600	o	300	Pipe/Conduit	
S2.001	29.226	2.329	12.5	0.040	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	68.06	5.32	107.420	0.039	0.0	0.0	0.0	2.00	141.5	7.2
S1.001	67.66	5.39	106.796	0.103	0.0	0.0	0.0	3.02	213.3	18.9
S1.002	67.09	5.50	106.317	0.118	0.0	0.0	0.0	2.37	167.8	21.4
S1.003	66.66	5.58	105.978	0.184	0.0	0.0	0.0	2.59	183.2	33.2
S2.000	69.12	5.13	110.055	0.088	0.0	0.0	0.0	4.01	283.4	16.5
S2.001	68.50	5.24	107.969	0.128	0.0	0.0	0.0	4.46	315.4	23.7

Network Design Table for Storm

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
S1.004	24.205	0.650	37.2	0.037	0.00	0.0	0.600	o	375	Pipe/Conduit	
S3.000	55.141	2.979	18.5	0.100	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	34.396	0.153	224.8	0.099	0.00	0.0	0.600	o	450	Pipe/Conduit	
S4.000	20.657	0.838	24.7	0.046	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	30.680	0.137	223.9	0.066	0.00	0.0	0.600	o	450	Pipe/Conduit	
S5.000	32.241	3.928	8.2	0.052	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.007	24.318	0.182	133.6	0.010	0.00	0.0	0.600	o	450	Pipe/Conduit	
S6.000	30.768	3.134	9.8	0.113	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.008	6.883	0.033	208.6	0.009	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.009	45.635	1.285	35.5	0.019	0.00	0.0	0.600	o	450	Pipe/Conduit	
S7.000	7.034	0.036	195.4	0.015	5.00	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)
S1.004	65.95	5.71	105.565	0.349	0.0	0.0	0.0	2.98	328.8	62.3
S3.000	68.46	5.25	107.969	0.100	0.0	0.0	0.0	3.67	259.5	18.5
S1.005	63.83	6.14	104.840	0.548	0.0	0.0	0.0	1.35	215.0	94.7
S4.000	69.28	5.11	105.675	0.046	0.0	0.0	0.0	3.18	224.8	8.6
S1.006	62.08	6.52	104.687	0.660	0.0	0.0	0.0	1.35	215.4	111.0
S5.000	69.34	5.10	108.628	0.052	0.0	0.0	0.0	5.52	390.2	9.8
S1.007	61.06	6.75	104.550	0.722	0.0	0.0	0.0	1.76	279.5	119.4
S6.000	69.32	5.10	107.727	0.113	0.0	0.0	0.0	5.05	356.7	21.2
S1.008	60.71	6.83	104.368	0.844	0.0	0.0	0.0	1.40	223.3	138.8
S1.009	59.77	7.05	104.335	0.863	0.0	0.0	0.0	3.42	544.0	139.7
S7.000	69.30	5.10	103.311	0.015	0.0	0.0	0.0	1.12	79.3	2.8

Network Design Table for Storm

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
S1.010	11.751	0.130	90.4	0.005	0.00	0.0	0.600	o	450	Pipe/Conduit	
S8.000	44.965	2.462	18.3	0.084	5.00	0.0	0.600	o	225	Pipe/Conduit	
S9.000	21.388	0.120	178.2	0.085	5.00	0.0	0.600	o	225	Pipe/Conduit	
S9.001	22.722	0.125	181.8	0.040	0.00	0.0	0.600	o	225	Pipe/Conduit	
S8.001	33.206	0.138	240.6	0.025	0.00	0.0	0.600	o	300	Pipe/Conduit	
S8.002	25.135	0.111	226.4	0.056	0.00	0.0	0.600	o	300	Pipe/Conduit	
S8.003	7.826	0.085	92.1	0.027	0.00	0.0	0.600	o	300	Pipe/Conduit	
S10.000	24.178	0.350	69.1	0.032	5.00	0.0	0.600	o	225	Pipe/Conduit	
S10.001	33.145	1.410	23.5	0.049	0.00	0.0	0.600	o	225	Pipe/Conduit	
S8.004	43.294	3.929	11.0	0.058	0.00	0.0	0.600	o	300	Pipe/Conduit	
S8.005	41.544	1.743	23.8	0.023	0.00	0.0	0.600	o	300	Pipe/Conduit	
S8.006	23.635	0.994	23.8	0.063	0.00	0.0	0.600	o	300	Pipe/Conduit	
S8.007	12.871	0.886	14.5	0.034	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.011	2.818	0.017	165.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.012	8.681	0.047	184.7	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)
S1.010	59.40	7.14	103.050	0.883	0.0	0.0	0.0	2.14	340.2	142.0
S8.000	68.50	5.24	111.871	0.084	0.0	0.0	0.0	3.08	122.3	15.6
S9.000	67.82	5.37	109.654	0.085	0.0	0.0	0.0	0.98	38.8	15.6
S9.001	65.73	5.76	109.534	0.125	0.0	0.0	0.0	0.97	38.4	22.3
S8.001	63.05	6.31	109.334	0.234	0.0	0.0	0.0	1.01	71.3	40.0
S8.002	61.23	6.71	109.196	0.290	0.0	0.0	0.0	1.04	73.6	48.1
S8.003	60.88	6.79	109.085	0.317	0.0	0.0	0.0	1.64	115.9	52.3
S10.000	68.43	5.26	110.835	0.032	0.0	0.0	0.0	1.58	62.6	5.9
S10.001	67.30	5.46	110.485	0.081	0.0	0.0	0.0	2.71	107.8	14.8
S8.004	60.24	6.94	109.000	0.456	0.0	0.0	0.0	4.76	336.6	74.4
S8.005	59.35	7.15	105.071	0.479	0.0	0.0	0.0	3.23	228.6	77.0
S8.006	58.87	7.27	103.328	0.542	0.0	0.0	0.0	3.24	228.9	86.4
S8.007	58.66	7.33	102.334	0.576	0.0	0.0	0.0	4.15	293.1	91.5
S1.011	69.64	5.05	101.373	0.000	10.5	0.0	0.0	1.01	40.3	10.5
S1.012	68.76	5.20	101.356	0.000	10.5	0.0	0.0	0.96	38.1	10.5

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.039	0.039	0.039
1.001	-	-	100	0.064	0.064	0.064
1.002	-	-	100	0.015	0.015	0.015
1.003	-	-	100	0.066	0.066	0.066
2.000	-	-	100	0.088	0.088	0.088
2.001	-	-	100	0.040	0.040	0.040
1.004	-	-	100	0.037	0.037	0.037
3.000	-	-	100	0.100	0.100	0.100
1.005	-	-	100	0.099	0.099	0.099
4.000	-	-	100	0.046	0.046	0.046
1.006	-	-	100	0.066	0.066	0.066
5.000	-	-	100	0.052	0.052	0.052
1.007	-	-	100	0.010	0.010	0.010
6.000	-	-	100	0.113	0.113	0.113
1.008	-	-	100	0.009	0.009	0.009
1.009	-	-	100	0.019	0.019	0.019
7.000	-	-	100	0.015	0.015	0.015
1.010	-	-	100	0.005	0.005	0.005
8.000	-	-	100	0.084	0.084	0.084
9.000	-	-	100	0.085	0.085	0.085
9.001	-	-	100	0.040	0.040	0.040
8.001	-	-	100	0.025	0.025	0.025
8.002	-	-	100	0.056	0.056	0.056
8.003	-	-	100	0.027	0.027	0.027
10.000	-	-	100	0.032	0.032	0.032
10.001	-	-	100	0.049	0.049	0.049
8.004	-	-	100	0.058	0.058	0.058
8.005	-	-	100	0.023	0.023	0.023
8.006	-	-	100	0.063	0.063	0.063
8.007	-	-	100	0.034	0.034	0.034
1.011	-	-	100	0.000	0.000	0.000
1.012	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.459	1.459	1.459

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.012	S	104.225	101.309	0.000	0	0

Simulation Criteria for Storm

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.800	Storm Duration (mins)	30
Ratio R	0.404		

Online Controls for Storm

Complex Manhole: S19, DS/PN: S1.011, Volume (m³): 7.4

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0137-1050-1825-1050
Design Head (m)	1.825
Design Flow (l/s)	10.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	137
Invert Level (m)	101.373
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.825	10.5
Flush-Flo™	0.538	10.5
Kick-Flo®	1.114	8.3
Mean Flow over Head Range	-	9.2

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)
0.100	4.9	1.200	8.6	3.000	13.3	7.000	19.9
0.200	9.0	1.400	9.3	3.500	14.3	7.500	20.6
0.300	9.9	1.600	9.9	4.000	15.2	8.000	21.2
0.400	10.3	1.800	10.4	4.500	16.1	8.500	21.8
0.500	10.5	2.000	11.0	5.000	16.9	9.000	22.4
0.600	10.5	2.200	11.5	5.500	17.7	9.500	23.0
0.800	10.2	2.400	11.9	6.000	18.5		
1.000	9.3	2.600	12.4	6.500	19.2		

Weir

Discharge Coef 0.544 Width (m) 0.500 Invert Level (m) 103.198

Storage Structures for Storm

Cellular Storage Manhole: S19, DS/PN: S1.011

Invert Level (m) 101.373 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	500.0	500.0	1.300	500.0	616.3
0.100	500.0	508.9	1.400	500.0	625.2
0.200	500.0	517.9	1.500	500.0	634.2
0.300	500.0	526.8	1.600	500.0	643.1
0.400	500.0	535.8	1.700	500.0	652.1
0.500	500.0	544.7	1.800	500.0	661.0
0.600	500.0	553.7	1.900	500.0	669.9
0.700	500.0	562.6	2.000	500.0	678.9
0.800	500.0	571.6	2.100	500.0	687.8
0.900	500.0	580.5	2.200	500.0	696.8
1.000	500.0	589.4	2.300	500.0	705.7
1.100	500.0	598.4	2.400	500.0	714.7
1.200	500.0	607.3	2.500	500.0	723.6

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.409
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	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, 30, 100
Climate Change (%)	0, 0, 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	S1	15 Winter	1	+0%					107.459
S1.001	S2	15 Winter	1	+0%	100/15 Winter				106.851
S1.002	S3	15 Winter	1	+0%	100/15 Summer				106.382
S1.003	S4	15 Winter	1	+0%	100/15 Summer				106.057
S2.000	S5	15 Winter	1	+0%					110.097
S2.001	S6	15 Winter	1	+0%					108.017
S1.004	S7	15 Winter	1	+0%	100/15 Summer				105.664
S3.000	S8	15 Winter	1	+0%					108.015
S1.005	S9	15 Winter	1	+0%	30/15 Summer				105.030
S4.000	S10	15 Winter	1	+0%	100/15 Summer				105.710
S1.006	S11	15 Winter	1	+0%	30/15 Summer				104.897
S5.000	S12	15 Winter	1	+0%					108.657
S1.007	S13	15 Winter	1	+0%	30/15 Summer				104.743
S6.000	S14	15 Winter	1	+0%					107.770
S1.008	S15	15 Winter	1	+0%	30/15 Summer				104.658
S1.009	S16	15 Winter	1	+0%	100/15 Summer				104.476
S7.000	S17	15 Winter	1	+0%	100/15 Summer				103.348
S1.010	S18	15 Winter	1	+0%	30/15 Summer				103.284
S8.000	S21	15 Winter	1	+0%					111.919

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.261	0.000	0.04		5.4	OK	
S1.001	S2	-0.245	0.000	0.07		12.9	OK	
S1.002	S3	-0.235	0.000	0.11		14.8	OK	
S1.003	S4	-0.221	0.000	0.16		22.6	OK	
S2.000	S5	-0.258	0.000	0.05		12.3	OK	
S2.001	S6	-0.252	0.000	0.06		17.0	OK	
S1.004	S7	-0.276	0.000	0.16		44.0	OK	
S3.000	S8	-0.254	0.000	0.06		14.0	OK	
S1.005	S9	-0.260	0.000	0.37		69.3	OK	
S4.000	S10	-0.265	0.000	0.03		6.5	OK	
S1.006	S11	-0.240	0.000	0.44		81.8	OK	
S5.000	S12	-0.271	0.000	0.02		7.3	OK	
S1.007	S13	-0.257	0.000	0.38		89.7	OK	
S6.000	S14	-0.257	0.000	0.05		15.8	OK	
S1.008	S15	-0.160	0.000	0.74		104.0	OK	
S1.009	S16	-0.309	0.000	0.22		105.7	OK	
S7.000	S17	-0.263	0.000	0.04		2.1	OK	
S1.010	S18	-0.216	0.000	0.53		107.1	OK	
S8.000	S21	-0.177	0.000	0.10		11.8	OK	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S9.000	S22	15 Winter	1	+0%	30/15 Summer	100/15 Summer		
S9.001	S23	15 Winter	1	+0%	30/15 Summer			
S8.001	S24	15 Winter	1	+0%	30/15 Summer			
S8.002	S25	15 Winter	1	+0%	30/15 Summer			
S8.003	S26	15 Winter	1	+0%	30/15 Summer			
S10.000	S19	15 Winter	1	+0%				
S10.001	S20	15 Winter	1	+0%				
S8.004	S27	15 Winter	1	+0%				
S8.005	S28	15 Winter	1	+0%	100/15 Summer	100/15 Winter		
S8.006	S29	15 Winter	1	+0%	100/15 Summer			
S8.007	S30	15 Winter	1	+0%	100/15 Summer			
S1.011	S19	240 Winter	1	+0%	1/30 Winter			
S1.012	S20	240 Winter	1	+0%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S9.000	S22	109.744	-0.135	0.000	0.33		11.7	OK	2
S9.001	S23	109.643	-0.116	0.000	0.47		16.4	OK	
S8.001	S24	109.479	-0.155	0.000	0.46		30.2	OK	
S8.002	S25	109.356	-0.140	0.000	0.55		36.3	OK	
S8.003	S26	109.241	-0.144	0.000	0.53		38.7	OK	
S10.000	S19	110.877	-0.183	0.000	0.08		4.4	OK	
S10.001	S20	110.533	-0.177	0.000	0.10		10.2	OK	
S8.004	S27	109.084	-0.216	0.000	0.17		54.1	OK	
S8.005	S28	105.176	-0.195	0.000	0.27		56.4	OK	1
S8.006	S29	103.442	-0.186	0.000	0.31		62.9	OK	
S8.007	S30	102.442	-0.192	0.000	0.28		66.3	OK	
S1.011	S19	101.714	0.116	0.000	0.36		9.7	SURCHARGED	
S1.012	S20	101.443	-0.138	0.000	0.32		9.7	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.409
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	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, 30, 100
Climate Change (%)	0, 0, 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	S1	15 Winter	30	+0%					107.484
S1.001	S2	15 Winter	30	+0%	100/15 Winter				106.890
S1.002	S3	15 Winter	30	+0%	100/15 Summer				106.430
S1.003	S4	15 Winter	30	+0%	100/15 Summer				106.121
S2.000	S5	15 Winter	30	+0%					110.123
S2.001	S6	15 Winter	30	+0%					108.048
S1.004	S7	15 Winter	30	+0%	100/15 Summer				105.740
S3.000	S8	15 Winter	30	+0%					108.044
S1.005	S9	15 Winter	30	+0%	30/15 Summer				105.452
S4.000	S10	15 Winter	30	+0%	100/15 Summer				105.732
S1.006	S11	15 Winter	30	+0%	30/15 Summer				105.324
S5.000	S12	15 Winter	30	+0%					108.671
S1.007	S13	15 Winter	30	+0%	30/15 Summer				105.152
S6.000	S14	15 Winter	30	+0%					107.796
S1.008	S15	15 Winter	30	+0%	30/15 Summer				104.980
S1.009	S16	15 Winter	30	+0%	100/15 Summer				104.572
S7.000	S17	15 Winter	30	+0%	100/15 Summer				103.577
S1.010	S18	15 Winter	30	+0%	30/15 Summer				103.575
S8.000	S21	15 Winter	30	+0%					111.947

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.236	0.000	0.10		13.3	OK	
S1.001	S2	-0.206	0.000	0.21		36.7	OK	
S1.002	S3	-0.187	0.000	0.30		42.0	OK	
S1.003	S4	-0.157	0.000	0.45		66.1	OK	
S2.000	S5	-0.232	0.000	0.12		30.3	OK	
S2.001	S6	-0.221	0.000	0.16		44.8	OK	
S1.004	S7	-0.200	0.000	0.44		123.9	OK	
S3.000	S8	-0.225	0.000	0.14		34.5	OK	
S1.005	S9	0.162	0.000	0.94		176.0	SURCHARGED	
S4.000	S10	-0.243	0.000	0.08		15.8	OK	
S1.006	S11	0.187	0.000	1.10		204.5	SURCHARGED	
S5.000	S12	-0.257	0.000	0.05		17.9	OK	
S1.007	S13	0.152	0.000	0.96		223.8	SURCHARGED	
S6.000	S14	-0.231	0.000	0.12		39.0	OK	
S1.008	S15	0.162	0.000	1.85		259.3	SURCHARGED	
S1.009	S16	-0.213	0.000	0.54		264.2	OK	
S7.000	S17	-0.034	0.000	0.08		4.5	OK	
S1.010	S18	0.075	0.000	1.31		267.1	SURCHARGED	
S8.000	S21	-0.149	0.000	0.25		28.9	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S9.000	S22	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
S9.001	S23	15 Winter	30	+0%	30/15 Summer			
S8.001	S24	15 Winter	30	+0%	30/15 Summer			
S8.002	S25	15 Winter	30	+0%	30/15 Summer			
S8.003	S26	15 Winter	30	+0%	30/15 Summer			
S10.000	S19	15 Winter	30	+0%				
S10.001	S20	15 Winter	30	+0%				
S8.004	S27	15 Winter	30	+0%				
S8.005	S28	15 Winter	30	+0%	100/15 Summer	100/15 Winter		
S8.006	S29	15 Winter	30	+0%	100/15 Summer			
S8.007	S30	15 Winter	30	+0%	100/15 Summer			
S1.011	S19	240 Winter	30	+0%	1/30 Winter			
S1.012	S20	960 Winter	30	+0%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S9.000	S22	109.960	0.081	0.000	0.73		26.0	SURCHARGED	2
S9.001	S23	109.897	0.138	0.000	1.03		36.4	SURCHARGED	
S8.001	S24	109.760	0.126	0.000	1.05		68.8	SURCHARGED	
S8.002	S25	109.600	0.104	0.000	1.26		83.1	SURCHARGED	
S8.003	S26	109.415	0.030	0.000	1.23		89.6	SURCHARGED	
S10.000	S19	110.902	-0.158	0.000	0.19		10.9	OK	
S10.001	S20	110.567	-0.143	0.000	0.28		28.8	OK	
S8.004	S27	109.136	-0.164	0.000	0.41		127.9	OK	
S8.005	S28	105.249	-0.122	0.000	0.63		133.9	OK	1
S8.006	S29	103.529	-0.099	0.000	0.75		153.0	OK	
S8.007	S30	102.522	-0.112	0.000	0.69		163.9	OK	
S1.011	S19	102.279	0.681	0.000	0.38		10.5	SURCHARGED	
S1.012	S20	101.447	-0.134	0.000	0.34		10.5	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.409
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	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, 30, 100
Climate Change (%)	0, 0, 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	S1	15 Winter	100	+40%					107.508
S1.001	S2	15 Winter	100	+40%	100/15 Winter				107.162
S1.002	S3	15 Winter	100	+40%	100/15 Summer				107.127
S1.003	S4	15 Winter	100	+40%	100/15 Summer				107.082
S2.000	S5	15 Winter	100	+40%					110.149
S2.001	S6	15 Winter	100	+40%					108.079
S1.004	S7	15 Winter	100	+40%	100/15 Summer				106.977
S3.000	S8	15 Winter	100	+40%					108.072
S1.005	S9	15 Winter	100	+40%	30/15 Summer				106.739
S4.000	S10	15 Winter	100	+40%	100/15 Summer				106.430
S1.006	S11	15 Winter	100	+40%	30/15 Summer				106.407
S5.000	S12	15 Winter	100	+40%					108.689
S1.007	S13	15 Winter	100	+40%	30/15 Summer				105.968
S6.000	S14	15 Winter	100	+40%					107.822
S1.008	S15	15 Winter	100	+40%	30/15 Summer				105.529
S1.009	S16	15 Winter	100	+40%	100/15 Summer				104.952
S7.000	S17	15 Winter	100	+40%	100/15 Summer				103.967
S1.010	S18	15 Winter	100	+40%	30/15 Summer				103.963
S8.000	S21	15 Winter	100	+40%					111.977

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.212	0.000	0.18		24.1	OK	
S1.001	S2	0.066	0.000	0.37		63.4	SURCHARGED	
S1.002	S3	0.510	0.000	0.49		68.7	SURCHARGED	
S1.003	S4	0.804	0.000	0.67		98.1	SURCHARGED	
S2.000	S5	-0.206	0.000	0.21		55.2	OK	
S2.001	S6	-0.190	0.000	0.28		81.4	OK	
S1.004	S7	1.037	0.000	0.62		176.6	SURCHARGED	
S3.000	S8	-0.197	0.000	0.26		62.7	OK	
S1.005	S9	1.449	0.000	1.50		281.4	SURCHARGED	
S4.000	S10	0.455	0.000	0.13		25.8	SURCHARGED	
S1.006	S11	1.270	0.000	1.77		329.0	SURCHARGED	
S5.000	S12	-0.239	0.000	0.09		32.6	OK	
S1.007	S13	0.968	0.000	1.55		361.3	SURCHARGED	
S6.000	S14	-0.205	0.000	0.22		70.8	OK	
S1.008	S15	0.711	0.000	3.04		424.7	SURCHARGED	
S1.009	S16	0.167	0.000	0.88		432.6	SURCHARGED	
S7.000	S17	0.356	0.000	0.12		7.2	SURCHARGED	
S1.010	S18	0.463	0.000	2.16		438.5	SURCHARGED	
S8.000	S21	-0.119	0.000	0.45		52.6	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S9.000	S22	15 Winter	100	+40%	30/15 Summer	100/15 Summer		
S9.001	S23	15 Winter	100	+40%	30/15 Summer			
S8.001	S24	15 Winter	100	+40%	30/15 Summer			
S8.002	S25	15 Winter	100	+40%	30/15 Summer			
S8.003	S26	15 Winter	100	+40%	30/15 Summer			
S10.000	S19	15 Winter	100	+40%				
S10.001	S20	15 Winter	100	+40%				
S8.004	S27	15 Winter	100	+40%				
S8.005	S28	15 Winter	100	+40%	100/15 Summer	100/15 Winter		
S8.006	S29	15 Winter	100	+40%	100/15 Summer			
S8.007	S30	480 Winter	100	+40%	100/15 Summer			
S1.011	S19	480 Winter	100	+40%	1/30 Winter			
S1.012	S20	15 Summer	100	+40%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S9.000	S22	111.062	1.183	1.117	1.34		47.4	FLOOD	2
S9.001	S23	110.976	1.217	0.000	1.80		63.4	SURCHARGED	
S8.001	S24	110.674	1.040	0.000	1.77		115.5	SURCHARGED	
S8.002	S25	110.227	0.731	0.000	2.17		142.4	SURCHARGED	
S8.003	S26	109.682	0.297	0.000	2.12		155.0	SURCHARGED	
S10.000	S19	110.927	-0.133	0.000	0.34		19.8	OK	
S10.001	S20	110.601	-0.109	0.000	0.52		52.4	OK	
S8.004	S27	109.197	-0.103	0.000	0.75		234.6	OK	
S8.005	S28	106.571	1.200	0.263	1.09		232.9	FLOOD	1
S8.006	S29	104.513	0.885	0.000	1.26		256.2	SURCHARGED	
S8.007	S30	103.254	0.620	0.000	0.16		38.8	SURCHARGED	
S1.011	S19	103.251	1.653	0.000	0.38		10.5	SURCHARGED	
S1.012	S20	101.447	-0.134	0.000	0.34		10.5	OK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm Sys 2

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.800	Add Flow / Climate Change (%)	0
Ratio R	0.404	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm Sys 2

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.201	4-8	0.066

Total Area Contributing (ha) = 0.267

Total Pipe Volume (m³) = 53.571

Network Design Table for Storm Sys 2

- Indicates pipe length does not match coordinates

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
S10.000	38.967	3.502	11.1	0.068	5.00	0.0	0.600	o	225	Pipe/Conduit	
S11.000	5.000#	0.050	100.0	0.046	5.00	0.0	0.600	o	150	Pipe/Conduit	
S11.001	5.000#	0.050	100.0	0.000	0.00	0.0	0.600	o	150	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)
S10.000	50.00	5.16	107.448	0.068	0.0	0.0	0.0	3.95	156.9	9.2
S11.000	50.00	5.08	105.750	0.046	0.0	0.0	0.0	1.00	17.8	6.2
S11.001	50.00	5.08	105.700	0.000	1.0	0.0	0.0	1.00	17.8	1.0

Network Design Table for Storm Sys 2

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
S10.001	11.259	2.571	4.4	0.020	0.00	0.0	0.600	o	225	Pipe/Conduit	
S12.000	5.000#	0.050	100.0	0.085	5.00	0.0	0.600	o	150	Pipe/Conduit	
S12.001	5.000#	0.050	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S10.002	40.118	0.150	267.5	0.046	0.00	0.0	0.600	H3	-3	Pipe/Conduit	
S10.003	4.418	0.100	44.2	0.002	0.00	0.0	0.600	oo	225	Double Pipe	

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)
S10.001	50.00	5.19	103.946	0.088	1.0	0.0	0.0	6.30	250.3	12.9
S12.000	50.00	5.08	101.900	0.085	0.0	0.0	0.0	1.00	17.8	11.5
S12.001	50.00	5.08	101.850	0.000	1.0	0.0	0.0	1.00	17.8	1.0
S10.002	50.00	5.49	100.600	0.134	2.0	0.0	0.0	2.29	2909.0	20.1
S10.003	50.00	5.04	100.450	0.000	3.5	0.0	0.0	1.97	156.9	3.5

Conduit Sections for Storm Sys 2

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m²)
-3	H3	1650	1000			1.210	1.268

Area Summary for Storm Sys 2

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
10.000	-	-	100	0.068	0.068	0.068
11.000	-	-	100	0.046	0.046	0.046
11.001	-	-	100	0.000	0.000	0.000
10.001	-	-	100	0.020	0.020	0.020
12.000	-	-	100	0.085	0.085	0.085
12.001	-	-	100	0.000	0.000	0.000
10.002	-	-	100	0.046	0.046	0.046
10.003	-	-	100	0.002	0.002	0.002
				Total	Total	Total
				0.267	0.267	0.267

Free Flowing Outfall Details for Storm Sys 2

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S10.003	S	102.850	100.350	0.000	0	0

Simulation Criteria for Storm Sys 2

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 Storage Structures	2
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.800	Storm Duration (mins)	30
Ratio R	0.404		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm Sys 2

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 Storage Structures	2
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.409
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	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, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S10.000	S32	15 Winter	1	+0%				
S11.000	S2	15 Winter	1	+0%	30/15 Summer			
S11.001	S3	360 Winter	1	+0%	30/30 Summer			
S10.001	S33	15 Winter	1	+0%				
S12.000	S3	360 Winter	1	+0%	1/180 Winter			
S12.001	S4	360 Winter	1	+0%	1/60 Winter			
S10.002	S34A	30 Winter	1	+0%	100/180 Winter			
S10.003	S34B	30 Winter	1	+0%	1/15 Winter			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S10.000	S32	107.485	-0.188	0.000	0.06		9.5	OK	
S11.000	S2	105.822	-0.078	0.000	0.46		6.4	OK	
S11.001	S3	105.809	-0.041	0.000	0.02		0.3	OK	
S10.001	S33	103.981	-0.190	0.000	0.06		11.9	OK	
S12.000	S3	102.063	0.013	0.000	0.12		1.7	SURCHARGED	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm Sys 2

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S12.001	S4	102.062	0.062	0.000	0.03		0.4	SURCHARGED	
S10.002	S34A	100.707	-0.893	0.000	0.01		13.1	OK	
S10.003	S34B	100.707	0.032	0.000	0.04		3.5	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm Sys 2

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 Storage Structures	2
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.409
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	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, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S10.000	S32	15 Winter	30	+0%				
S11.000	S2	240 Winter	30	+0%	30/15 Summer			
S11.001	S3	240 Winter	30	+0%	30/30 Summer			
S10.001	S33	15 Winter	30	+0%				
S12.000	S3	360 Winter	30	+0%	1/180 Winter			
S12.001	S4	360 Winter	30	+0%	1/60 Winter			
S10.002	S34A	60 Winter	30	+0%	100/180 Winter			
S10.003	S34B	60 Winter	30	+0%	1/15 Winter			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S10.000	S32	107.508	-0.165	0.000	0.16		23.4	OK	
S11.000	S2	105.963	0.063	0.000	0.20		2.8	SURCHARGED	
S11.001	S3	105.962	0.112	0.000	0.03		0.4	SURCHARGED	
S10.001	S33	104.003	-0.168	0.000	0.14		30.7	OK	
S12.000	S3	102.364	0.314	0.000	0.27		3.8	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm Sys 2

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S12.001	S4	102.362	0.362	0.000	0.04		0.6	SURCHARGED	
S10.002	S34A	100.992	-0.608	0.000	0.01		21.6	OK	
S10.003	S34B	100.992	0.317	0.000	0.04		3.5	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm Sys 2

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 Storage Structures	2
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.409
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	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, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S10.000	S32	15 Winter	100	+40%				
S11.000	S2	360 Winter	100	+40%	30/15 Summer			
S11.001	S3	360 Winter	100	+40%	30/30 Summer			
S10.001	S33	15 Winter	100	+40%				
S12.000	S3	480 Winter	100	+40%	1/180 Winter			
S12.001	S4	480 Winter	100	+40%	1/60 Winter			
S10.002	S34A	180 Winter	100	+40%	100/180 Winter			
S10.003	S34B	180 Winter	100	+40%	1/15 Winter			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S10.000	S32	107.530	-0.143	0.000	0.29		42.6	OK	
S11.000	S2	106.209	0.309	0.000	0.27		3.8	SURCHARGED	
S11.001	S3	106.207	0.357	0.000	0.04		0.6	SURCHARGED	
S10.001	S33	104.025	-0.146	0.000	0.26		55.9	OK	
S12.000	S3	102.844	0.794	0.000	0.39		5.5	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm Sys 2

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S12.001	S4	102.842	0.842	0.000	0.06		0.8	SURCHARGED	
S10.002	S34A	101.607	0.007	0.000	0.01		18.8	SURCHARGED	
S10.003	S34B	101.607	0.932	0.000	0.04		3.6	SURCHARGED	

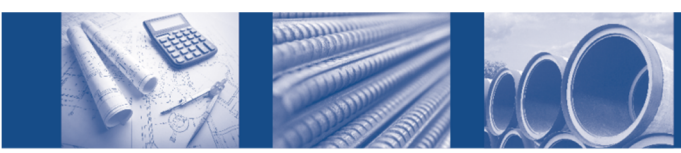
APPENDIX G
SUDS MANAGEMENT & MAINTENANCE PLAN

OXFORD ROAD,
BODICOTE
OXON

SUDS MANAGEMENT
&
MAINTENANCE PLAN

Crest NICHOLSON

Date: 4th October 2018
Ref: AMc/18/**5627**
Rev: -



DOCUMENT CONTROL RECORD

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-	04.10.17	First Issue	A. Mcshane	C. Pendle

References:

The SUDS manual – CIRIA C753 (2015) ISBN 9780-86017-760-9

National Planning Policy Framework (NPPF) – Communities and Local Government
Technical Guidance - Flood Risk & Coastal Change (March 2012)

1 Introduction

1.1 This document sets out the principles for the long term management and maintenance of the proposed surface water Sustainable Drainage Systems (SuDS) installed at the residential development located at Oxford Road, Bodicote, Oxon for Crest Nicholson Midlands.

1.2 The purpose of this document is to set out the basis of the development SUDs Maintenance Plan and to ensure that the adopting management company is entrusted with a robust inspection and maintenance programme, ensuring the optimum operation of the surface water drainage network is continually maintained for the lifetime of the development and to prevent the increased risk of flooding both on and off site in accordance with The National Planning Policy Framework (NPPF).

1.3 The principle storm water drainage strategy for the development is to utilise an attenuated and controlled discharge to the existing surface water outfall sewer for all surface water runoff generated from the site.

1.4 This document details the SuDS structures within development and their required maintenance processes to ensure that no polluted runoff is discharged downstream.

1.5 This plan has been comprised of and is directly referenced from the latest technical SuDS guidance within the *CIRIA Report C753 The SuDS Manual* (2015) and other applicable guidance.

1.6 The activities listed are specific to the relative SuDS types and represent the minimum maintenance and inspection requirements, however additional tasks or varied maintenance frequency may be instructed by the maintenance company as required.
Specific maintenance needs of the SuDS elements to be monitored and maintenance schedules adjusted to suit requirements.

1.7 All those responsible for maintenance must follow relevant health and safety legislation for all activities listed within this report (including lone working and confined space if relevant) and risk assessments for inspections and maintenance activities must always be undertaken.

1.8 This report is to read in conjunction with the Engineering design layouts for the type and location of all SuDS systems present on this site.

2 SuDS Layout & Design

2.1 The installed SuDS system at this development are the responsibility of Crest Nicholson Midlands Ltd and their appointed Management Company.

2.2 Following installation and after transfer, all SuDS are to be maintained in perpetuity by the Management Company and shall ensure that it or any contractor employed by it carries out periodic maintenance of all such SuDS in accordance with the schedules listed in this report. Inspection checks shall be carried out by a qualified and competent person, at the minimum intervals listed within the schedules and the appropriate work carried out.

2.3 In terms of water quality, the proposed surface water system offers a suitable level of mitigation in accordance with the Environment Agency pollution prevention guidance GP3, NPPF, CIRIA C753 and DEFRA guidance.

2.4 There are three categories of maintenance activities referred to in this report:

- **Regular maintenance** (including inspections and monitoring).
  Consists of basic tasks done on a frequent and predictable schedule, including vegetation management, litter and debris removal, inspections and sampling.

- **Occasional maintenance**
  Comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example).

- **Remedial maintenance**
  Comprises intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design.
  Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict.

3 SUDS Management & Maintenance

Storm water pipework and road gullies

3.1 The key maintenance requirement for the surface water drainage system includes the removal of sediments and debris from the system as required.

3.2 All storm water pipe work should be visually inspected a minimum of monthly for the first three months after installation and then a minimum of once year.

As road gullies are the first on the treatment train and susceptible to higher silt loadings, these will need to be inspected a minimum of monthly for the first three months after installation and then a minimum of every four months.

3.3 During this inspection identify any gully pots or pipes that require remedial maintenance such removal of sediment, debris, leaves and litter as required.
This involves the removal all protective covers and grids and the cleaning out of channels or gully pots by hand or with suitable jetting equipment.

3.4 The main highways will be offered to OCC for adoption. As part of this adoption the associated gullies and any highway drainage pipework will transfer to OCC ownership and be maintained as part of the standard highway maintenance procedures.

3.5 The main storm drainage will be offered to Thames Water for adoption. As part of this adoption the associated pipework and manholes will transfer to Thames Water Utilities ownership and be maintained as part of their term maintenance procedures.

Parking Court Drainage

3.6 General yard gully and linear channel maintenance involves the removal of dead leaves, soil, litter from the gratings and sediments from the sump within the gully pot or channel.
This involves the removal all protective covers and grids and the cleaning out of channels or gully pots by hand or with suitable jetting equipment.
During the first year of operation each gully and channel to be inspected every 3 months, and every 6 months thereafter for structural integrity and cleaned out as required.

Cellular Attenuation Tank

3.7 The key maintenance requirement for the cellular attenuation tank will be the visual inspection of the internal units via built in access chambers and integral maintenance tunnel for the removal of sediment and jetting as required.

A visual inspection of the impermeable geomembrane that envelopes the structure should also be carried out to check for structural integrity.

3.8 The attenuation tank is to be constructed from cellular units that allow internal CCTV and jetting access for inspection and maintenance (Hydro StormBloc, Aco Stormbrixx, Wavin Aquacell or similar approved).

The built in modular inspection unit and maintenance tunnels within the attenuation tank allow almost the entire volume of the structure to be inspected via CCTV camera and flushed through.
A catchpit chamber is to be installed immediately upstream of the attenuation tank to reduce the amount of silt entering the tank and it will generally only be necessary to ensure that the upstream catchpits / silt traps are free from debris such as leaves or sediment.

3.9 It is recommended that the attenuation tank system be inspected no less frequently than at monthly intervals for the first 3 months and thereafter at 6 monthly intervals.
In addition, it is suggested that the installation is inspected immediately following the first storm event, whenever this should occur post installation.

3.10 It should also be noted that more regular inspections may be required should the catchpit(s) fill more frequently and/or if the initial inspections reveal that maintenance / cleaning will be required more regularly than at six month intervals.

3.11 Any silt & debris should be flushed to the inspection or catchpit manhole and removed in accordance with the Management Company policy for waste management.

Cellular Systems - Operation and Maintenance Requirements

Maintenance schedule	**Required action**	**Recommended Frequency**
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly
	Debris removal from catchment surface (where may cause risks to performance)	Monthly
	Where rainfall infiltrates into blocks from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary.	Monthly (and after large storms)
	Remove sediment from pre-treatment structures	Annually, or as required
Remedial actions	Repair/rehabilitation of inlets, outlet , overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually and after large storms

Flow Control Chamber

3.12 The key maintenance requirement for the flow control chambers will be the inspection of the units for blockages of the vortex flow control unit and silt removal from sump of chamber.

3.13 The hydraulic vortex flow control unit has no moving parts and is self-activating, requiring minimal maintenance. After initial installation, it is recommended that the unit be inspected monthly for three months.

3.14 Thereafter the manhole chamber and control device should be inspected at least every six months to verify the condition and operation of the unit and check for blockages within the inlet of the chamber and of the flow control device.
During these inspections, accumulated silts should be removed and the sump cleaned out using a conventional sump vacuum cleaner.
Flow Controls are fitted with a pivoting by-pass door, which allows the manhole chamber to be drained down should blockages occur.

3.15 As part of the main storm pipework adoption the flow control will be included and transfer to Thames Water Utilities ownership. Management & maintenance will be included within the term maintenance procedures.

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