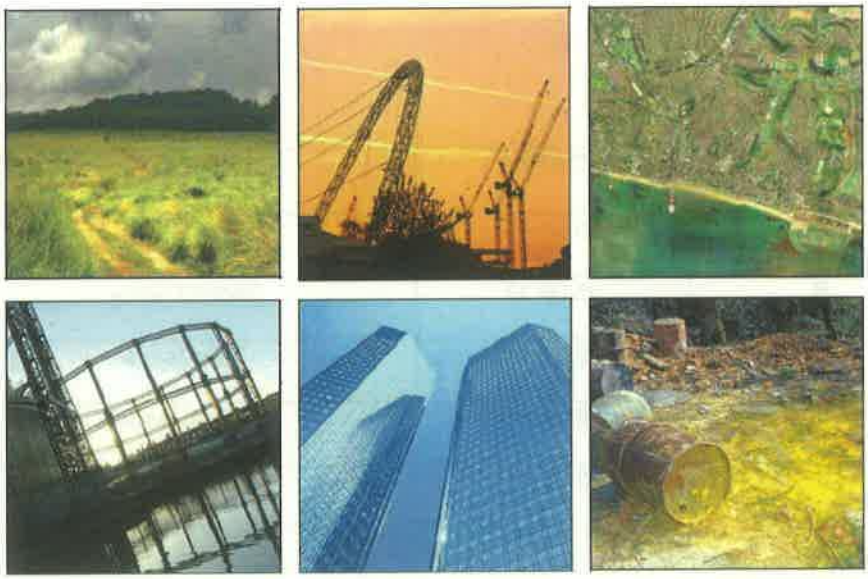
RPS

KINGSMERE PARCELS KM7 AND KM9

SURFACE WATER DRAINAGE DESIGN STRATEGY

SEPTEMBER 2013



RPS

KINGSMERE
PARCELS KM7 AND KM9
SURFACE WATER DRAINAGE
DESIGN STRATEGY

RPS PROJECT No: JKK6647

ISSUE	DATE	REMARKS
A	08.01.13	First Issue
B	05.09.13	Second Issue
C	26.11.13	Third Issue
D	26.03.14	Fourth Issue
E	13.06.14	Fifth Issue

Our Ref: JKK6647

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☒ LOW CARBON ENERGY ASSESSORS CIBSE Registration Number LCEA071057

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1 SUMMARY

1.1 RPS Group has been commissioned to prepare a surface water drainage strategy for proposed residential parcels KM7 and KM9 of the Kingsmere development at Bicester. The proposed strategy is shown on the appended drawing JKK6647 SK01C.

1.2 The overall surface water strategy for Kingsmere was prepared by WSP in consultation with Oxfordshire County Council and the Environment Agency. Each land parcel has been allocated a maximum surface water discharge into the infrastructure surface water system. Where the soil conditions allow, each parcel should utilise soakaways and permeable paving. Drawing 1903/D/006P states *'The on-plot storage equates to 100m3 per hectare of gross parcel area. This storage is designed to attenuate the 1 in 10 year event. The storage can include soakaways where viable'.*

1.3 A ground investigation for KM7 and KM9 and topographical survey has identified that the site has been filled with partly organic material by up to 2.3metres and also that part of the site is underlain clay. The report concludes that these two parcels are not suitable for the use of soakaways. This was agreed in a meeting with Oxfordshire County Council.

1.4 Subsequently, the proposed surface water strategy is to provide a conventional piped surface water system with impermeable roads and paved areas. Attenuation will be provided in the form of below ground attenuation cellular tanks. The tanks have been sized to attenuate the 1 in 10 year rainfall event. Rainfall events in excess of the 1 in 10 event year are allowed to overflow into the infrastructure surface water system, with 100 year plus climate change attenuation provided within Detention Basin 4 in the south-west corner of The Development.

1.5 In accordance with the WSP strategy, the surface water discharge from KM7 and KM9 will be restricted to a total of 24.3 litres per second. KM7 has been restricted to 11.6 l/s and KM9 to 12.7 l/s. Micro-drainage calculations appended to this report demonstrate that the system will not flood during a 1 in 10 or 30 year event. KM9 has one attenuation tank sized 11m x 10m x 1.6m deep. KM 7 has two tanks. The main tank is 11m x 11m x 1.2m deep. This provides a total attenuation volume of 305 cubic metres (allowing for 95% void ratio). In addition to the two cellular tanks, two areas of tanked permeable paving have been added to ensure that there will be no surface flooding during the thirty year event. The permeable paving will provide an additional 65 cubic metres of attenuation giving a total volume of 370 cubic metres. The total site area measures 3.98 Hectares. Thus, the attenuation volume in the tanks equates to 93 cubic metres per hectare.

1.6 The rate of surface water discharge will be restricted by a hydrobrake at the proposed points of connection to the infrastructure surface water system. The control chambers will include an overflow that will reduce surface water flooding through the manhole covers. However, if there was to be a blocked pipe, there could be a situation where there will be surface water flows. Drawing SK01 shows indicative routes that surface flow would take demonstrating that there would be no risk of flooding to the proposed dwellings.

1.7 The proposed surface water drainage system including the attenuation tanks would be offered for adoption by Oxfordshire County Council. The areas of permeable paving will be maintained by a Management Company.

1.8 WSP have checked the previous version of this report and have made some comments in a letter dated 18 November 2013. The letter is appended to this report with our comments.

APPENDIX A

PROPOSED SURFACE WATER DESIGN

DRAWING JKK6647 SK01B and SK02B

Notes:

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2. If in doubt please contact us. Only written dimensions should be used.
3. This drawing should be read in conjunction with all other relevant drawings and specifications.

Key

- 100 — 100 — 100 Year + CC Flood Extent
- 30 — 30 — 30 Year Flood Extent
- Site Boundary
- 1.894 / 1370 / 2272m² Catchment Area

C	TWO AREAS OF TANKED PERMEABLE PAVING ADDED TANK 2 REMOVED	IM	KMc 26.03.19
B	TANK 3 ADDED TO NETWORK 2	IM	KMc 26.11.18
A	FIRST ISSUE	IM	KMc 18/06/18
Rev	Description	By	Chk'd Date

If in guidance only. Do not scale off this drawing.

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Client: Bellway

Project: KINGSMERE, BICESTER

Title: PROPOSED SURFACE WATER DRAINAGE AND CATCHMENTS AREA

Status: Preliminary	Scale: 1:500 @A0	Date Created: 19/06/18
Project Leader: KMc	Drawn By: IM	Checked by: KMc

Drawing Number: JKK6647 _01

Rev: C

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3. This drawing should be read in conjunction with all other relevant drawings and specifications.

LEGEND

- MANHOLES AFFECTED IN 100 YR PLUS 30% CLIMATE CHANGE
- DIRECTION OF FLOW
- FLOOD FLOW FROM MANHOLE DURING 100 YR PLUS 30% CC
- CUMULATIVE FLOW
- ADOPTABLE SURFACE WATER SEWERS
- EXISTING DRAINS
- EXISTING GROUND LEVELS
- PROPOSED FINISHED LEVELS
- BUILDING FINISHED FLOOR LEVEL

Critical results for 100 year storm plus 30% climate change for Network 1

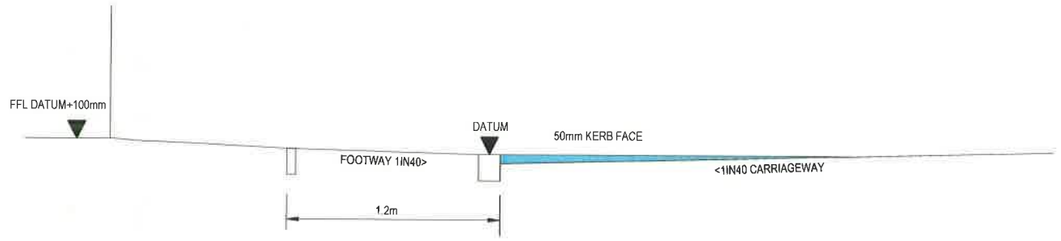
MH No.	Storm Duration (mins)	Flooded Volume (m³)	Flood flow (l/s)
118	15	7.915	8.794
119	15	4.655	5.172
120	30	7.273	4.041
121	30	7.732	4.296
122	60	7.379	2.050
106	60	0.543	0.151
107	60	3.127	0.869
108	60	0.015	0.004
109	60	0.096	0.027
125	240	159.925	11.106
TANK 2	120	0.075	0.010

Critical results for 100 year storm plus 30% climate change for Network 2

MH No.	Storm Duration (mins)	Flooded Volume (m³)	Flood flow (l/s)
4	15	0.275	0.306
5	30	29.64	16.467
12	15	5.017	5.574
19	15	0.059	0.066

Flood flow calculation:
e.g. S5

Flow in l/s
29.64m³ / 30min = 0.988m³/min
0.988m³ / 60s = 0.0164m³/s
0.0164 x 1000 = 16.47l/s



Proposed Road with Crossfall

The Windes calculations demonstrate that the proposed road will retain the flooding generated in a 100 year event plus 30% allowance for climate change will be contained within the 50mm kerb face.
Proposed Finished Floor Levels are set a minimum of 100mm above the kerb level.

Rev	Description	By	Chkd	Date
D	PROPOSED LEVELS AND FLOOD VOLUMES UPDATED CROSS SECTIONS AMENDED	SJW	KMc	18.09.14
C	TWO AREAS OF TANKED PERMEABLE PAVING ADDED TANK 3 REMOVED	KMc	TD	26.09.14
B	Critical storm results amended & Tank 3 added	IM	KMc	26.11.13
A	FIRST ISSUE	IM	KMc	19.09.13

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Client: Bellway

Project: KINGSMERE, BICESTER

Title: FLOOD ROUTE LAYOUT

Status	Scale	Date Created
Preliminary	1:500 @A0	19/09/13
Project Leader: KMc	Drawn By: IM	Checked by: KMc

Drawing Number: JKK6647 _SK 02
Rev: D

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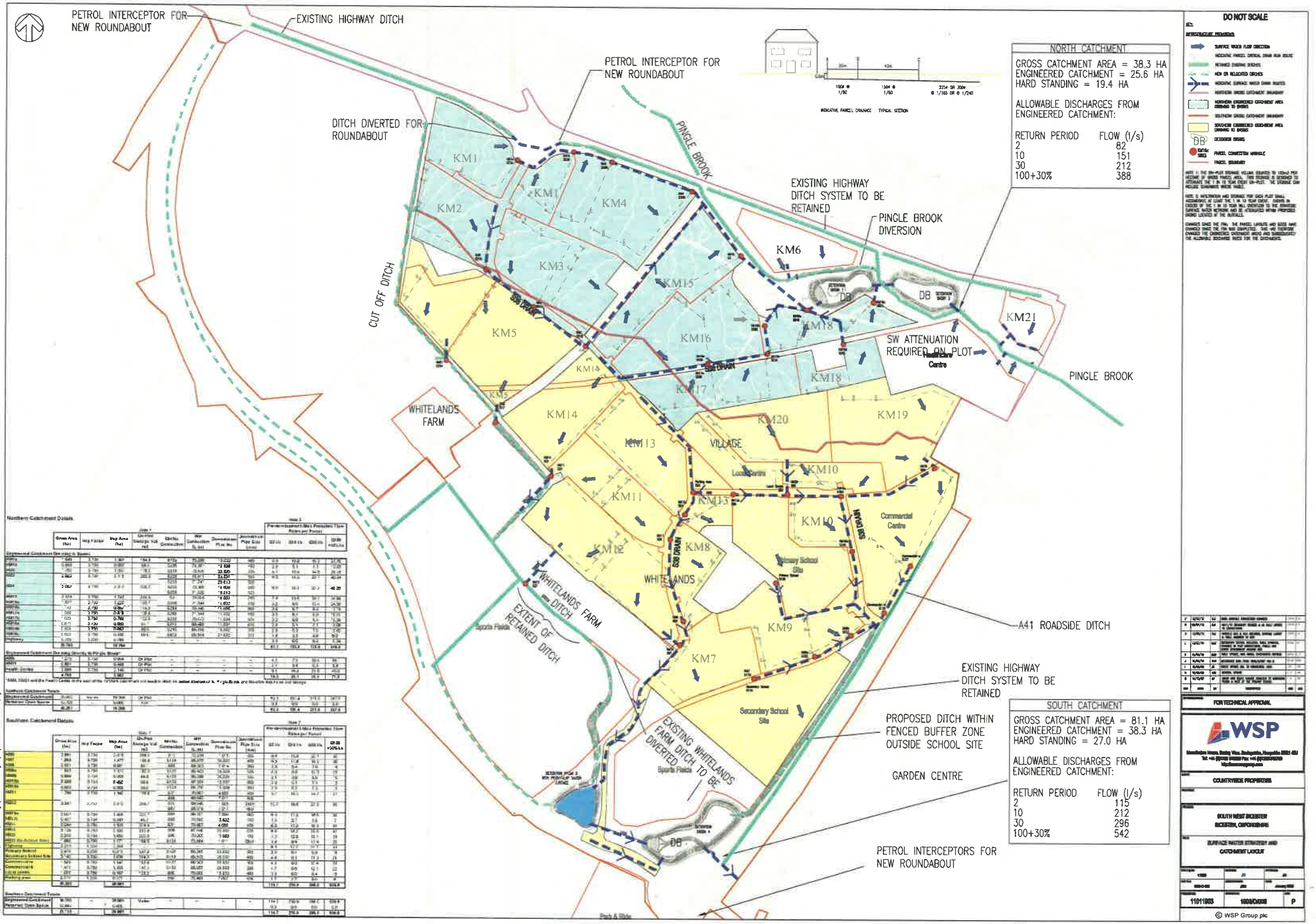
APPENDIX B

WSP DRAINAGE STRATEGY

DRAWING 1903/D/006P



NORTH CATCHMENT	
GROSS CATCHMENT AREA = 38.3 HA	
ENGINEERED CATCHMENT = 25.6 HA	
HARD STANDING = 19.4 HA	
ALLOWABLE DISCHARGES FROM ENGINEERED CATCHMENT:	
RETURN PERIOD	FLOW (l/s)
2	82
10	151
30	212
100+30%	388

SOUTH CATCHMENT	
GROSS CATCHMENT AREA = 81.1 HA	
ENGINEERED CATCHMENT = 38.3 HA	
HARD STANDING = 27.0 HA	
ALLOWABLE DISCHARGES FROM ENGINEERED CATCHMENT:	
RETURN PERIOD	FLOW (l/s)
2	115
10	212
30	296
100+30%	542

DO NOT SCALE

FOR TECHNICAL APPROVAL

WSP

COUNTRYSIDE PROPERTIES

SOUTH WEST BICESTER
BICESTER, OXFORDSHIRE

SURFACE WATER STRATEGY AND CATCHMENT LAYOUT

11011803 | 1003/DR/008 | P

APPENDIX C

EXTRACTS FROM HYDROCK

GROUND INVESTIGATION REPORT

Hydrock

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Desk Study and Ground Investigation at KM7 & KM9, Kingsmere, Bicester

Final Report

Prepared by

G Jenkins

&

C Vincett

for

Bellway (Northern Home Counties) Ltd

Hydrock Ref: R/12460/001/Rev002

November 2012

Soakaways & Drainage	Hydrock do not believe soakaways are suitable on K7 & K9 due to: • the presence of clay soils; • the soil infiltration rate testing indicated highly variable infiltration rates; • there is a significant thickness of Made Ground, part organic and placed by others, across the site; and • the groundwater at the site is shallow in the Cornbrash Formation. In addition, anecdotal evidence from the local farmer indicates standing water levels at approximately 0.50m bgl in some land drainage ditches, precludes the use of soakaways.

Hydrock Site Works	The initial Hydrock Ground investigation undertaken in September 2012 comprised: • 30 trial pits to a maximum depth of 3.90m bgl; • 2 dynamic percussive sampling/rotary open holed boreholes to 12.00m bgl; • 24 TRL Dynamic Continuous Probe tests; • 5 soakaway tests; • installation of monitoring wells; • monitoring of ground gas concentrations and groundwater levels; • chemical testing of soils; and • geotechnical testing of soils.

Soakaway Potential

The Kellaways Clay Member is not considered suitable for conventional soakaways.

The results of soakaway trials undertaken in the weathered Cornbrash Formation indicate infiltration rates in the order of between 10^{-4} and 10^{-5}. In less weathered Cornbrash Formation strata similar results were achieved although in two of the trials it was not possible to calculate an infiltration rate due to the relatively slow information.

Although the Cornbrash Formation is considered suitable for soakaway design the presence of shallow groundwater (as identified by the WSP 2007 report) may preclude such design. The Pell Frischmann report also indicates anecdotal evidence from the local farmer which indicates standing water levels at approximately 0.50m bgl in some land drainage ditches.

5.5.1 Infiltration Tests

The results of soakaway testing are summarised in Table 5.10. The results sheets are given in Appendix D.

Table 5.10: Infiltration Test Results

Stratum	Trial Pit No.	Depth	Infiltration Rate (m/s)		
			Test 1	Test 2	Test 3
Cornbrash Formation	SA1	2.40	$1.62x10^{-5}$	n/a	n/a
Cornbrash Formation	SA2	1.90	$1.38x10^{-4}$	n/a	n/a
Kellaways Clay Member/Cornbrash Formation	SA3	2.00	Non calculable	n/a	n/a
Kellaways Clay Member/Cornbrash Formation	SA4	2.20	Non calculable	n/a	n/a
Cornbrash Formation	SA5	2.60	Non calculable	n/a	n/a

9.7 Soakaways and Drainage

Infiltration rate testing indicates that the Made Ground and Kellaways Clay Member are not suitable for soil infiltration.

With regards to the Cornbrash Formation, Hydrock do not believe soakaways are suitable on K7 & K9 as:

- the soil infiltration rate testing indicated highly variable infiltration rates;
- there is a significant thickness of Made Ground, part organic and placed by others, across the site;
- only 1 run could be undertaken, so test results are not in accordance with BRE 364; and
- the groundwater at the site is shallow in the Cornbrash Formation.

In addition, anecdotal evidence from the local farmer indicates standing water levels at approximately 0.50m bgl in some land drainage ditches, precludes the use of soakaways.

APPENDIX D

MICRO DRAINAGE CALCULATIONS

Existing Network Details for NETWORK 1 REV A.SWS

* - Indicates pipe has been modified outside of System 1

	PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)
*	1.000	16.521	0.183	90.3	0.058	5.00	0.600	o	150
*	1.001	55.215	0.608	90.8	0.042	0.00	0.600	o	225
*	1.002	22.062	0.297	74.3	0.013	0.00	0.600	o	225
*	1.003	32.650	0.359	90.9	0.020	0.00	0.600	o	225
*	1.004	47.186	0.596	79.2	0.076	0.00	0.600	o	300
*	2.000	27.866	0.385	72.4	0.099	5.00	0.600	o	150
*	2.001	29.572	0.292	101.3	0.097	0.00	0.600	o	225
*	2.002	15.247	0.173	88.1	0.017	0.00	0.600	o	225
*	2.003	29.597	0.282	105.0	0.043	0.00	0.600	o	225
*	2.004	8.043	0.076	105.8	0.057	0.00	0.600	o	225
*	1.005	22.639	0.117	193.5	0.048	0.00	0.600	o	300
*	1.006	3.163	0.020	158.2	0.000	0.00	0.600	o	300
*	1.007	27.102	0.230	117.8	0.012	0.00	0.600	o	300
*	1.008	15.953	0.750	21.3	0.000	0.00	0.600	o	300
*	3.000	10.762	0.043	250.3	0.084	5.00	0.600	o	300
*	3.001	25.640	0.087	294.7	0.027	0.00	0.600	o	300
*	3.002	28.952	0.068	425.8	0.145	0.00	0.600	o	300
*	3.003	11.220	0.030	374.0	0.071	0.00	0.600	o	300
	3.004	14.503	0.192	75.5	0.017	0.00	0.600	o	300

	PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
*	1.000	101	70.871	69.510	1.211	70.709	69.327	1.232		1200
*	1.001	102	70.709	69.252	1.232	70.173	68.644	1.304		1200
*	1.002	103	70.173	68.644	1.304	69.905	68.347	1.333		1200
*	1.003	104	69.905	68.347	1.333	69.588	67.988	1.375		1200
*	1.004	105	69.588	67.913	1.375	69.129	67.317	1.512		1200
*	2.000	118	70.167	68.675	1.342	69.776	68.290	1.336		1200
*	2.001	119	69.776	68.215	1.336	69.482	67.923	1.334		1200
*	2.002	120	69.482	67.923	1.334	69.363	67.750	1.388		1200
*	2.003	121	69.363	67.750	1.388	69.179	67.468	1.486		1200
*	2.004	122	69.179	67.468	1.486	69.129	67.392	1.512		1200
*	1.005	106	69.129	67.317	1.512	68.943	67.200	1.443		1200
*	1.006	107	68.943	67.200	1.443	68.963	67.180	1.483		1200
*	1.007	108	68.963	67.180	1.483	68.761	66.950	1.511		1200
*	1.008	109	68.761	66.950	1.511	68.500	66.200	2.000		1200
*	3.000	123	68.200	66.620	1.280	68.200	66.577	1.323		1200
*	3.001	124	68.200	66.577	1.323	67.974	66.490	1.184		1200
*	3.002	125	67.974	66.490	1.184	68.573	66.422	1.851		1200
*	3.003	126	68.573	66.422	1.851	68.638	66.392	1.946		1200
	3.004	110	68.638	66.392	1.946	68.500	66.200	2.000		1500

Existing Network Details for NETWORK 1 REV A.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)
* 1.009	10.160	0.067	151.6	0.000	0.00	0.600	o	450
* 1.010	9.800	0.049	200.0	0.010	0.00	0.600	o	450
* 1.011	20.124	0.101	199.2	0.104	0.00	0.600	o	450
* 1.012	8.311	0.042	197.9	0.016	0.00	0.600	o	450
* 1.013	12.914	0.065	198.7	0.018	0.00	0.600	o	450
* 1.014	6.175	0.031	199.2	0.067	0.00	0.600	o	225

PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
* 1.009	TANK 2	68.500	66.200	1.850	68.861	66.133	2.278		1
* 1.010	112	68.861	66.133	2.278	68.946	66.084	2.412		1500
* 1.011	113	68.946	66.084	2.412	68.792	65.983	2.359		1500
* 1.012	114	68.792	65.983	2.359	68.607	65.941	2.216		1500
* 1.013	115	68.607	65.941	2.216	68.301	65.876	1.975		1500
* 1.014	116	68.301	65.876	2.200	68.270	65.845	2.200	Hydro-Brake®	1800

Free Flowing Outfall Details for NETWORK 1 REV A.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.014	EX117	68.270	65.845	65.620	1800	0

Simulation Criteria for NETWORK 1 REV A.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	1.000
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	1	Number of Time/Area Diagrams	0
Number of Offline Controls	1	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)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

Online Controls for NETWORK 1 REV A.SWS

Hydro-Brake® Manhole: 116, DS/PN: 1.014, Volume (m³): 8.0

Design Head (m) 1.800 Hydro-Brake® Type Md4 Invert Level (m) 65.876
Design Flow (l/s) 12.7 Diameter (mm) 110

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.2	1.200	10.3	3.000	16.3	7.000	24.9
0.200	7.7	1.400	11.2	3.500	17.6	7.500	25.8
0.300	7.3	1.600	11.9	4.000	18.9	8.000	26.7
0.400	6.6	1.800	12.7	4.500	20.0	8.500	27.5
0.500	6.8	2.000	13.3	5.000	21.1	9.000	28.3
0.600	7.3	2.200	14.0	5.500	22.1	9.500	29.1
0.800	8.4	2.400	14.6	6.000	23.1		
1.000	9.4	2.600	15.2	6.500	24.0		

Offline Controls for NETWORK 1 REV A.SWS

Weir Manhole: 116, DS/PN: 1.014, Loop to PN: None

Discharge Coef 0.544 Width (m) 1.800 Invert Level (m) 67.850

Storage Structures for NETWORK 1 REV A.SWS

Porous Car Park Manhole: 124, DS/PN: 3.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	7.0
Membrane Percolation (mm/hr)	1000	Length (m)	35.0
Max Percolation (l/s)	68.1	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	67.400	Cap Volume Depth (m)	0.500

Cellular Storage Manhole: TANK 2, DS/PN: 1.009

Invert Level (m)	66.200	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	110.0	110.0	1.700	0.0	177.2
1.600	110.0	177.2			

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 1 REV A.SWS

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 10, 30, 100
Climate Change (%) 0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	10	0%	30/15 Summer				
1.001	15 Winter	10	0%	100/15 Summer				
1.002	15 Winter	10	0%	100/15 Summer				
1.003	15 Winter	10	0%	30/15 Summer				
1.004	15 Winter	10	0%	30/15 Summer				
2.000	15 Winter	10	0%	10/15 Summer	100/15 Summer			6
2.001	15 Winter	10	0%	10/15 Summer	100/15 Summer			6
2.002	15 Winter	10	0%	10/15 Summer	100/15 Summer			8
2.003	15 Winter	10	0%	10/15 Summer	100/15 Summer			8
2.004	15 Winter	10	0%	10/15 Summer	100/15 Summer			8
1.005	15 Winter	10	0%	10/15 Summer	100/30 Winter			3
1.006	15 Winter	10	0%	10/15 Summer	100/30 Summer			5
1.007	120 Winter	10	0%	10/15 Summer	100/60 Winter			
1.008	120 Winter	10	0%	10/30 Summer	100/60 Winter			
3.000	120 Winter	10	0%	10/15 Summer				
3.001	120 Winter	10	0%	10/15 Summer				
3.002	120 Winter	10	0%	10/15 Summer	100/30 Summer			15
3.003	120 Winter	10	0%	10/15 Summer				
3.004	120 Winter	10	0%	10/15 Summer				
1.009	120 Winter	10	0%	10/15 Summer	100/30 Summer			
1.010	120 Winter	10	0%	10/15 Summer	100/120 Winter			
1.011	120 Winter	10	0%	10/15 Summer				
1.012	120 Winter	10	0%	10/15 Summer				
1.013	120 Winter	10	0%	10/15 Summer				
1.014	120 Winter	10	0%	10/15 Summer		30/60 Winter		22

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m^3)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	101	69.622	-0.038	0.000	0.89	0.0	15.4	OK
1.001	102	69.369	-0.108	0.000	0.51	0.0	26.6	OK
1.002	103	68.764	-0.105	0.000	0.55	0.0	30.1	OK
1.003	104	68.485	-0.087	0.000	0.68	0.0	34.8	OK
1.004	105	68.185	-0.028	0.000	0.43	0.0	51.0	OK
2.000	118	69.231	0.406	0.000	1.09	0.0	21.7	SURCHARGED
2.001	119	68.821	0.381	0.000	0.90	0.0	43.4	SURCHARGED

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 1 REV A.SWS

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m^3)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
2.002	120	68.644	0.496	0.000	0.83	0.0	40.4	SURCHARGED
2.003	121	68.528	0.553	0.000	1.01	0.0	47.7	SURCHARGED
2.004	122	68.240	0.547	0.000	1.47	0.0	57.0	SURCHARGED
1.005	106	68.069	0.452	0.000	1.58	0.0	111.1	SURCHARGED
1.006	107	67.780	0.280	0.000	2.18	0.0	110.5	SURCHARGED
1.007	108	67.621	0.141	0.000	0.53	0.0	49.2	SURCHARGED
1.008	109	67.613	0.363	0.000	0.24	0.0	48.5	SURCHARGED
3.000	123	67.611	0.691	0.000	0.11	0.0	6.1	SURCHARGED
3.001	124	67.611	0.734	0.000	0.13	0.0	7.4	SURCHARGED
3.002	125	67.613	0.823	0.000	0.37	0.0	17.8	SURCHARGED
3.003	126	67.611	0.889	0.000	0.55	0.0	22.7	SURCHARGED
3.004	110	67.610	0.918	0.000	0.22	0.0	23.0	SURCHARGED
1.009	TANK 2	67.606	0.956	0.000	0.14	0.0	24.4	SURCHARGED
1.010	112	67.612	1.029	0.000	0.15	0.0	23.2	SURCHARGED
1.011	113	67.622	1.088	0.000	0.12	0.0	21.7	SURCHARGED
1.012	114	67.628	1.195	0.000	0.12	0.0	18.7	SURCHARGED
1.013	115	67.628	1.237	0.000	0.10	0.0	16.1	SURCHARGED
1.014	116	67.628	1.527	0.000	0.44	0.0	12.4	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 1 REV A.SWS

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 10, 30, 100
Climate Change (%) 0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	30	0%	30/15 Summer				
1.001	15 Winter	30	0%	100/15 Summer				
1.002	15 Winter	30	0%	100/15 Summer				
1.003	15 Winter	30	0%	30/15 Summer				
1.004	15 Winter	30	0%	30/15 Summer				
2.000	15 Winter	30	0%	10/15 Summer	100/15 Summer			6
2.001	15 Winter	30	0%	10/15 Summer	100/15 Summer			6
2.002	15 Winter	30	0%	10/15 Summer	100/15 Summer			8
2.003	15 Winter	30	0%	10/15 Summer	100/15 Summer			8
2.004	15 Winter	30	0%	10/15 Summer	100/15 Summer			8
1.005	15 Winter	30	0%	10/15 Summer	100/30 Winter			3
1.006	120 Winter	30	0%	10/15 Summer	100/30 Summer			5
1.007	120 Winter	30	0%	10/15 Summer	100/60 Winter			
1.008	120 Winter	30	0%	10/30 Summer	100/60 Winter			
3.000	240 Winter	30	0%	10/15 Summer				
3.001	240 Winter	30	0%	10/15 Summer				
3.002	240 Winter	30	0%	10/15 Summer	100/30 Summer			15
3.003	240 Winter	30	0%	10/15 Summer				
3.004	240 Winter	30	0%	10/15 Summer				
1.009	240 Winter	30	0%	10/15 Summer	100/30 Summer			
1.010	240 Winter	30	0%	10/15 Summer	100/120 Winter			
1.011	240 Winter	30	0%	10/15 Summer				
1.012	240 Winter	30	0%	10/15 Summer				
1.013	240 Winter	30	0%	10/15 Summer				
1.014	240 Winter	30	0%	10/15 Summer		30/60 Winter		22

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m^3)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	101	69.704	0.044	0.000	1.12	0.0	19.4	SURCHARGED
1.001	102	69.386	-0.091	0.000	0.63	0.0	33.2	OK
1.002	103	68.787	-0.082	0.000	0.68	0.0	37.4	OK
1.003	104	68.690	0.118	0.000	0.78	0.0	40.0	SURCHARGED
1.004	105	68.512	0.299	0.000	0.46	0.0	53.9	SURCHARGED
2.000	118	69.957	1.132	0.000	1.20	0.0	24.0	FLOOD RISK
2.001	119	69.397	0.957	0.000	0.92	0.0	44.4	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 1 REV A.SWS

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
2.002	120	69.148	1.000	0.000	0.98	0.0	47.7	SURCHARGED
2.003	121	68.988	1.013	0.000	1.19	0.0	56.2	SURCHARGED
2.004	122	68.590	0.897	0.000	1.73	0.0	67.3	SURCHARGED
1.005	106	68.356	0.739	0.000	1.82	0.0	128.2	SURCHARGED
1.006	107	68.009	0.509	0.000	1.21	0.0	61.5	SURCHARGED
1.007	108	67.979	0.499	0.000	0.65	0.0	60.3	SURCHARGED
1.008	109	67.938	0.688	0.000	0.28	0.0	56.4	SURCHARGED
3.000	123	67.943	1.023	0.000	0.09	0.0	5.3	FLOOD RISK
3.001	124	67.942	1.065	0.000	0.11	0.0	6.3	FLOOD RISK
3.002	125	67.939	1.149	0.000	0.29	0.0	14.0	FLOOD RISK
3.003	126	67.933	1.211	0.000	0.44	0.0	17.9	SURCHARGED
3.004	110	67.928	1.236	0.000	0.17	0.0	18.2	SURCHARGED
1.009	TANK 2	67.922	1.272	0.000	0.15	0.0	24.7	SURCHARGED
1.010	112	67.917	1.334	0.000	0.15	0.0	24.0	SURCHARGED
1.011	113	67.912	1.378	0.000	0.12	0.0	21.8	SURCHARGED
1.012	114	67.903	1.470	0.000	0.15	0.0	22.2	SURCHARGED
1.013	115	67.898	1.507	0.000	0.13	0.0	22.5	SURCHARGED
1.014	116	67.891	1.790	0.000	0.48	10.5	13.4	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 1 REV A.SWS

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 10, 30, 100
Climate Change (%) 0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%	30/15 Summer				
1.001	15 Winter	100	+30%	100/15 Summer				
1.002	15 Winter	100	+30%	100/15 Summer				
1.003	15 Winter	100	+30%	30/15 Summer				
1.004	15 Winter	100	+30%	30/15 Summer				
2.000	15 Winter	100	+30%	10/15 Summer	100/15 Summer			6
2.001	15 Winter	100	+30%	10/15 Summer	100/15 Summer			6
2.002	30 Winter	100	+30%	10/15 Summer	100/15 Summer			8
2.003	30 Winter	100	+30%	10/15 Summer	100/15 Summer			8
2.004	60 Winter	100	+30%	10/15 Summer	100/15 Summer			8
1.005	60 Winter	100	+30%	10/15 Summer	100/30 Winter			3
1.006	60 Winter	100	+30%	10/15 Summer	100/30 Summer			5
1.007	60 Winter	100	+30%	10/15 Summer	100/60 Winter			
1.008	60 Winter	100	+30%	10/30 Summer	100/60 Winter			
3.000	240 Winter	100	+30%	10/15 Summer				
3.001	240 Winter	100	+30%	10/15 Summer				
3.002	240 Winter	100	+30%	10/15 Summer	100/30 Summer			15
3.003	60 Summer	100	+30%	10/15 Summer				
3.004	60 Summer	100	+30%	10/15 Summer				
1.009	120 Winter	100	+30%	10/15 Summer	100/30 Summer			
1.010	60 Summer	100	+30%	10/15 Summer	100/120 Winter			
1.011	120 Winter	100	+30%	10/15 Summer				
1.012	120 Winter	100	+30%	10/15 Summer				
1.013	120 Winter	100	+30%	10/15 Summer				
1.014	60 Winter	100	+30%	10/15 Summer		30/60 Winter		22

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	101	70.565	0.905	0.000	1.60	0.0	27.7	SURCHARGED
1.001	102	70.197	0.720	0.000	0.84	0.0	44.4	SURCHARGED
1.002	103	69.859	0.990	0.000	0.80	0.0	44.1	SURCHARGED
1.003	104	69.676	1.104	0.000	0.99	0.0	50.7	FLOOD RISK
1.004	105	69.327	1.114	0.000	0.64	0.0	75.6	FLOOD RISK
2.000	118	70.175	1.350	7.915	1.25	0.0	25.0	FLOOD
2.001	119	69.781	1.341	4.655	1.07	0.0	51.6	FLOOD

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 1 REV A.SWS

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m^3)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
2.002	120	69.489	1.341	7.273	0.94	0.0	45.9	FLOOD
2.003	121	69.371	1.396	7.732	1.23	0.0	58.0	FLOOD
2.004	122	69.186	1.493	7.379	1.65	0.0	64.0	FLOOD
1.005	106	69.130	1.513	0.543	1.68	0.0	118.4	FLOOD
1.006	107	68.946	1.446	3.127	2.29	0.0	116.2	FLOOD
1.007	108	68.849	1.369	0.015	1.28	0.0	117.8	FLOOD
1.008	109	68.669	1.419	0.096	0.57	0.0	116.0	FLOOD
3.000	123	68.138	1.218	0.000	0.16	0.0	9.1	FLOOD RISK
3.001	124	68.137	1.260	0.000	0.21	0.0	11.9	FLOOD RISK
3.002	125	68.134	1.344	159.925	0.53	0.0	25.4	FLOOD
3.003	126	68.260	1.538	0.000	1.91	0.0	78.1	SURCHARGED
3.004	110	68.324	1.632	0.000	0.77	0.0	81.9	SURCHARGED
1.009	TANK 2	68.460	1.810	0.075	0.98	0.0	165.7	FLOOD
1.010	112	68.331	1.748	0.000	0.38	0.0	59.5	SURCHARGED
1.011	113	68.636	2.102	0.000	0.49	0.0	87.7	SURCHARGED
1.012	114	68.547	2.114	0.000	0.70	0.0	106.9	FLOOD RISK
1.013	115	68.296	1.905	0.000	0.81	0.0	137.5	SURCHARGED
1.014	116	67.952	1.851	0.000	0.48	82.4	13.6	SURCHARGED

Existing Network Details for NETWORK 2 REV A.SWS

* - Indicates pipe has been modified outside of System 1

	PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)
*	1.000	16.385	0.349	46.9	0.017	5.00	0.600	o	150
*	1.001	12.225	0.285	42.9	0.029	0.00	0.600	o	150
*	1.002	34.729	0.718	48.4	0.029	0.00	0.600	o	225
*	1.003	17.099	0.692	24.7	0.064	0.00	0.600	o	225
*	1.004	49.398	0.569	86.8	0.221	0.00	0.600	o	300
*	1.005	35.337	0.353	100.1	0.053	0.00	0.600	o	375
*	1.006	15.820	0.158	100.1	0.036	0.00	0.600	o	375
*	1.007	3.802	0.038	100.1	0.017	0.00	0.600	o	375
*	1.008	13.220	0.132	100.2	0.019	0.00	0.600	o	375
*	2.000	23.831	0.300	79.4	0.125	5.00	0.600	o	150
*	2.001	8.361	0.650	12.9	0.045	0.00	0.600	o	150
*	2.002	10.121	0.050	202.4	0.067	0.00	0.600	o	300
*	2.003	12.943	0.200	64.7	0.017	0.00	0.600	o	300
*	2.004	27.517	0.099	277.9	0.014	0.00	0.600	o	300
*	3.000	9.448	0.152	62.2	0.052	5.00	0.600	o	150
*	3.001	33.053	2.137	15.5	0.055	0.00	0.600	o	225
*	2.005	33.645	0.198	169.9	0.088	0.00	0.600	o	300
*	2.006	20.877	0.123	169.7	0.046	0.00	0.600	o	300
*	2.007	25.227	0.148	170.5	0.042	0.00	0.600	o	300

	PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
*	1.000	1	70.984	69.634	1.200	70.635	69.285	1.200		1200
*	1.001	2	70.635	69.285	1.200	70.350	69.000	1.200		1200
*	1.002	3	70.350	68.925	1.200	69.632	68.207	1.200		1200
*	1.003	4	69.632	68.207	1.200	69.250	67.515	1.510		1200
*	1.004	5	69.250	67.440	1.510	69.150	66.871	1.979		1200
*	1.005	6	69.150	66.796	1.979	69.050	66.443	2.232		1200
*	1.006	7	69.050	66.443	2.232	68.894	66.285	2.234		1200
*	1.007	8	68.894	66.285	2.234	68.800	66.247	2.178		1200
*	1.008	9	68.800	66.247	2.178	68.740	66.115	2.250		1200
*	2.000	12	70.853	68.900	1.803	70.300	68.600	1.550		1200
*	2.001	13	70.300	68.600	1.550	70.304	67.950	2.204		1200
*	2.002	TANK 1	70.304	67.050	2.954	70.194	67.000	2.894		1
*	2.003	14	70.194	67.000	2.894	70.194	66.800	3.094		1200
*	2.004	15	70.194	66.800	3.094	69.937	66.701	2.936		1200
*	3.000	20	70.500	69.140	1.210	70.345	68.988	1.207		1200
*	3.001	21	70.345	68.913	1.207	69.937	66.776	2.936		1200
*	2.005	16	69.937	66.701	2.936	69.601	66.503	2.798		1200
*	2.006	17	69.601	66.503	2.798	69.192	66.380	2.512		1200
*	2.007	18	69.192	66.380	2.512	68.766	66.232	2.234		1200

Existing Network Details for NETWORK 2 REV A.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)
* 2.008	5.594	0.033	169.5	0.125	0.00	0.600	o	375
* 1.009	56.450	0.170	332.1	0.000	0.00	0.600	o	450

PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
* 2.008	19	68.766	66.157	2.234	68.740	66.124	2.241		1500
* 1.009	EX10	68.740	66.040	2.250	68.510	65.870	2.190	Hydro-Brake®	1800

Free Flowing Outfall Details for NETWORK 2 REV A.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.009	EX11	68.510	65.870	65.870	1500	0

Simulation Criteria for NETWORK 2 REV A.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	1.000
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	1	Number of Time/Area Diagrams	0
Number of Offline Controls	1	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)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

Online Controls for NETWORK 2 REV A.SWS

Hydro-Brake® Manhole: EX10, DS/PN: 1.009, Volume (m³): 8.6

Design Head (m) 2.260 Hydro-Brake® Type Md4 Invert Level (m) 66.040
Design Flow (l/s) 11.6 Diameter (mm) 99

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.0	1.200	8.4	3.000	13.2	7.000	20.2
0.200	6.1	1.400	9.0	3.500	14.3	7.500	20.9
0.300	5.4	1.600	9.7	4.000	15.3	8.000	21.6
0.400	5.1	1.800	10.2	4.500	16.2	8.500	22.3
0.500	5.5	2.000	10.8	5.000	17.1	9.000	22.9
0.600	5.9	2.200	11.3	5.500	17.9	9.500	23.5
0.800	6.8	2.400	11.8	6.000	18.7		
1.000	7.6	2.600	12.3	6.500	19.5		

Offline Controls for NETWORK 2 REV A.SWS

Weir Manhole: EX10, DS/PN: 1.009, Loop to PN: None

Discharge Coef 0.544 Width (m) 1.800 Invert Level (m) 68.400

Storage Structures for NETWORK 2 REV A.SWS

Cellular Storage Manhole: TANK 1, DS/PN: 2.002

Invert Level (m)	67.050	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	121.0	121.0	1.300	0.0	173.8
1.200	121.0	173.8			

Porous Car Park Manhole: 19, DS/PN: 2.008

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	3.5
Membrane Percolation (mm/hr)	1000	Length (m)	30.0
Max Percolation (l/s)	29.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	67.650	Cap Volume Depth (m)	0.900

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 2 REV A.SWS

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	10, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	10	0%	100/15 Summer				
1.001	15 Winter	10	0%	30/15 Winter				
1.002	30 Winter	10	0%	30/15 Summer				
1.003	30 Winter	10	0%	10/15 Summer	100/15 Summer			2
1.004	30 Winter	10	0%	10/15 Summer	30/15 Winter			9
1.005	30 Winter	10	0%	10/15 Summer				
1.006	30 Winter	10	0%	10/15 Summer				
1.007	30 Winter	10	0%	10/15 Summer				
1.008	30 Winter	10	0%	10/15 Summer				
2.000	15 Winter	10	0%	10/15 Summer	100/15 Summer			4
2.001	15 Winter	10	0%	30/15 Summer				
2.002	120 Winter	10	0%	10/15 Summer				
2.003	120 Winter	10	0%	10/15 Summer				
2.004	120 Winter	10	0%	10/15 Summer				
3.000	15 Winter	10	0%	100/15 Summer				
3.001	15 Winter	10	0%	100/15 Winter				
2.005	120 Winter	10	0%	10/15 Summer				
2.006	120 Winter	10	0%	10/15 Summer				
2.007	120 Winter	10	0%	10/15 Summer				
2.008	30 Winter	10	0%	10/15 Summer	100/15 Winter			1
1.009	30 Winter	10	0%	10/15 Summer		30/15 Summer	32	

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	69.678	-0.106	0.000	0.19	0.0	4.6	OK
1.001	2	69.362	-0.073	0.000	0.52	0.0	12.9	OK
1.002	3	69.017	-0.133	0.000	0.22	0.0	15.8	OK
1.003	4	68.996	0.564	0.000	0.26	0.0	24.3	SURCHARGED
1.004	5	68.971	1.231	0.000	0.56	0.0	62.4	FLOOD RISK
1.005	6	68.851	1.680	0.000	0.39	0.0	70.5	FLOOD RISK
1.006	7	68.718	1.900	0.000	0.48	0.0	75.3	SURCHARGED
1.007	8	68.589	1.929	0.000	0.71	0.0	76.3	SURCHARGED
1.008	9	68.499	1.877	0.000	0.54	0.0	77.4	SURCHARGED
2.000	12	69.556	0.506	0.000	1.62	0.0	30.6	SURCHARGED
2.001	13	68.718	-0.032	0.000	0.95	0.0	41.5	OK

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 2 REV A.SWS

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m^3)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
2.002	TANK 1	68.305	0.955	0.000	0.13	0.0	7.6	SURCHARGED
2.003	14	68.304	1.004	0.000	0.07	0.0	7.7	SURCHARGED
2.004	15	68.302	1.202	0.000	0.13	0.0	7.8	SURCHARGED
3.000	20	69.234	-0.056	0.000	0.70	0.0	14.0	OK
3.001	21	68.988	-0.150	0.000	0.24	0.0	29.7	OK
2.005	16	68.300	1.299	0.000	0.10	0.0	7.9	SURCHARGED
2.006	17	68.295	1.492	0.000	0.11	0.0	8.0	SURCHARGED
2.007	18	68.297	1.617	0.000	0.11	0.0	8.1	SURCHARGED
2.008	19	68.354	1.822	0.000	0.10	0.0	9.7	SURCHARGED
1.009	EX10	68.380	1.890	0.000	0.07	0.0	11.7	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 2 REV A.SWS

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 10, 30, 100
Climate Change (%) 0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	30	0%	100/15 Summer				
1.001	15 Winter	30	0%	30/15 Winter				
1.002	15 Winter	30	0%	30/15 Summer				
1.003	15 Winter	30	0%	10/15 Summer	100/15 Summer			2
1.004	15 Winter	30	0%	10/15 Summer	30/15 Winter			9
1.005	30 Winter	30	0%	10/15 Summer				
1.006	30 Winter	30	0%	10/15 Summer				
1.007	30 Winter	30	0%	10/15 Summer				
1.008	30 Winter	30	0%	10/15 Summer				
2.000	15 Winter	30	0%	10/15 Summer	100/15 Summer			4
2.001	15 Winter	30	0%	30/15 Summer				
2.002	120 Winter	30	0%	10/15 Summer				
2.003	120 Winter	30	0%	10/15 Summer				
2.004	120 Winter	30	0%	10/15 Summer				
3.000	15 Winter	30	0%	100/15 Summer				
3.001	15 Winter	30	0%	100/15 Winter				
2.005	120 Winter	30	0%	10/15 Summer				
2.006	120 Winter	30	0%	10/15 Summer				
2.007	120 Winter	30	0%	10/15 Summer				
2.008	240 Winter	30	0%	10/15 Summer	100/15 Winter			1
1.009	30 Winter	30	0%	10/15 Summer		30/15 Summer	32	

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	69.684	-0.100	0.000	0.24	0.0	5.8	OK
1.001	2	69.439	0.004	0.000	0.66	0.0	16.3	SURCHARGED
1.002	3	69.388	0.238	0.000	0.35	0.0	24.6	SURCHARGED
1.003	4	69.345	0.913	0.000	0.40	0.0	37.1	FLOOD RISK
1.004	5	69.250	1.510	0.089	0.83	0.0	93.7	FLOOD
1.005	6	68.995	1.824	0.000	0.49	0.0	88.4	FLOOD RISK
1.006	7	68.840	2.022	0.000	0.61	0.0	95.1	FLOOD RISK
1.007	8	68.706	2.046	0.000	0.92	0.0	98.4	FLOOD RISK
1.008	9	68.613	1.991	0.000	0.72	0.0	102.0	FLOOD RISK
2.000	12	70.050	1.000	0.000	1.94	0.0	36.7	SURCHARGED
2.001	13	68.904	0.154	0.000	1.11	0.0	48.3	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 2 REV A.SWS

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
2.002	TANK 1	68.682	1.332	0.000	0.22	0.0	13.4	SURCHARGED
2.003	14	68.676	1.376	0.000	0.12	0.0	13.2	SURCHARGED
2.004	15	68.667	1.567	0.000	0.21	0.0	12.5	SURCHARGED
3.000	20	69.251	-0.039	0.000	0.89	0.0	17.7	OK
3.001	21	68.998	-0.140	0.000	0.30	0.0	37.7	OK
2.005	16	68.653	1.652	0.000	0.26	0.0	20.2	SURCHARGED
2.006	17	68.628	1.825	0.000	0.29	0.0	21.7	SURCHARGED
2.007	18	68.572	1.892	0.000	0.31	0.0	23.3	SURCHARGED
2.008	19	68.513	1.981	0.000	0.27	0.0	26.1	FLOOD RISK
1.009	EX10	68.490	2.000	0.000	0.07	75.7	11.9	FLOOD RISK

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 2 REV A.SWS

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 10, 30, 100
Climate Change (%) 0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%	100/15 Summer				
1.001	15 Winter	100	+30%	30/15 Winter				
1.002	15 Winter	100	+30%	30/15 Summer				
1.003	15 Winter	100	+30%	10/15 Summer	100/15 Summer			2
1.004	30 Winter	100	+30%	10/15 Summer	30/15 Winter			9
1.005	15 Winter	100	+30%	10/15 Summer				
1.006	15 Winter	100	+30%	10/15 Summer				
1.007	15 Winter	100	+30%	10/15 Summer				
1.008	15 Winter	100	+30%	10/15 Summer				
2.000	15 Winter	100	+30%	10/15 Summer	100/15 Summer			4
2.001	60 Winter	100	+30%	30/15 Summer				
2.002	60 Winter	100	+30%	10/15 Summer				
2.003	60 Winter	100	+30%	10/15 Summer				
2.004	60 Winter	100	+30%	10/15 Summer				
3.000	15 Winter	100	+30%	100/15 Summer				
3.001	60 Winter	100	+30%	100/15 Winter				
2.005	60 Winter	100	+30%	10/15 Summer				
2.006	60 Winter	100	+30%	10/15 Summer				
2.007	60 Winter	100	+30%	10/15 Summer				
2.008	15 Winter	100	+30%	10/15 Summer	100/15 Winter			1
1.009	15 Winter	100	+30%	10/15 Summer		30/15 Summer	32	

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	70.140	0.356	0.000	0.42	0.0	10.0	SURCHARGED
1.001	2	70.094	0.659	0.000	0.92	0.0	22.8	SURCHARGED
1.002	3	69.839	0.689	0.000	0.52	0.0	36.4	SURCHARGED
1.003	4	69.632	1.200	0.275	0.73	0.0	68.1	FLOOD
1.004	5	69.280	1.540	29.640	0.82	0.0	92.3	FLOOD
1.005	6	69.109	1.938	0.000	0.65	0.0	117.2	FLOOD RISK
1.006	7	68.961	2.143	0.000	0.87	0.0	135.2	FLOOD RISK
1.007	8	68.843	2.183	0.000	1.33	0.0	143.0	FLOOD RISK
1.008	9	68.723	2.101	0.000	1.06	0.0	150.1	FLOOD RISK
2.000	12	70.858	1.808	5.017	2.47	0.0	46.7	FLOOD
2.001	13	69.896	1.146	0.000	1.07	0.0	46.7	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 2 REV A.SWS

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m^3)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
2.002	TANK 1	69.570	2.220	0.000	0.76	0.0	46.6	SURCHARGED
2.003	14	69.487	2.187	0.000	0.41	0.0	45.9	SURCHARGED
2.004	15	69.338	2.238	0.000	0.79	0.0	47.3	SURCHARGED
3.000	20	69.478	0.188	0.000	1.45	0.0	28.9	SURCHARGED
3.001	21	69.307	0.169	0.000	0.26	0.0	32.3	SURCHARGED
2.005	16	69.257	2.256	0.000	1.03	0.0	80.1	SURCHARGED
2.006	17	69.045	2.242	0.000	1.17	0.0	87.4	SURCHARGED
2.007	18	68.875	2.195	0.000	1.24	0.0	94.2	SURCHARGED
2.008	19	68.766	2.234	0.059	1.03	0.0	99.7	FLOOD
1.009	EX10	68.578	2.088	0.000	0.07	232.7	12.1	FLOOD RISK

Existing Network Details for Storm

* - Indicates pipe has been modified outside of System 1

	PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)
*	1.000	27.866	0.391	71.3	0.000	5.00	0.600		-1
*	1.001	29.572	0.294	100.6	0.000	0.00	0.600		-1
*	1.002	15.247	0.119	128.1	0.000	0.00	0.600		-1
*	1.003	29.597	0.184	160.9	0.000	0.00	0.600		-1
*	1.004	8.043	0.050	160.9	0.000	0.00	0.600		-1
*	1.005	22.639	0.186	121.7	0.000	0.00	0.600		-1
*	1.006	3.163	0.026	121.7	0.000	0.00	0.600		-1
*	1.007	27.102	0.156	173.7	0.000	0.00	0.600		-1
*	1.008	52.942	0.787	67.3	0.000	0.00	0.600		-1
*	1.009	20.000	0.200	100.0	0.000	0.00	0.600		-1

	PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
*	1.000	118	70.227	70.147	0.000	69.836	69.756	0.000		0
*	1.001	119	69.836	69.756	0.000	69.542	69.462	0.000		0
*	1.002	120	69.542	69.462	0.000	69.423	69.343	0.000		0
*	1.003	121	69.423	69.343	0.000	69.239	69.159	0.000		0
*	1.004	122	69.239	69.159	0.000	69.189	69.109	0.000		0
*	1.005	106	69.189	69.109	0.000	69.003	68.923	0.000		0
*	1.006	107	69.003	68.923	0.000	68.977	68.897	0.000		0
*	1.007	108	68.977	68.897	0.000	68.821	68.741	0.000		0
*	1.008	109	68.821	68.741	0.000	68.034	67.954	0.000		0
*	1.009	125	68.034	67.954	0.000	67.834	67.754	0.000		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	0.000
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	0
Number of Online Controls	0	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)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

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

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, 240, 360, 480, 960, 1440
Return Period(s) (years) 100
Climate Change (%) 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	60 Summer	100	+30%					
1.001	120 Summer	100	+30%					
1.002	120 Summer	100	+30%					
1.003	240 Summer	100	+30%					
1.004	360 Winter	100	+30%					
1.005	360 Summer	100	+30%					
1.006	240 Summer	100	+30%					
1.007	240 Winter	100	+30%					
1.008	360 Summer	100	+30%					
1.009	360 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m^3)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	118	70.173	-0.054	0.000	0.06	0.0	8.8	FLOOD RISK*
1.001	119	69.789	-0.047	0.000	0.10	0.0	14.0	FLOOD RISK*
1.002	120	69.502	-0.040	0.000	0.15	0.0	18.0	FLOOD RISK*
1.003	121	69.387	-0.036	0.000	0.21	0.0	22.3	FLOOD RISK*
1.004	122	69.205	-0.034	0.000	0.23	0.0	24.3	FLOOD RISK*
1.005	106	69.153	-0.036	0.000	0.20	0.0	24.4	FLOOD RISK*
1.006	107	68.967	-0.036	0.000	0.30	0.0	25.3	FLOOD RISK*
1.007	108	68.945	-0.032	0.000	0.25	0.0	25.3	FLOOD RISK*
1.008	109	68.781	-0.040	0.000	0.15	0.0	25.4	FLOOD RISK*
1.009	125	68.004	-0.030	0.000	0.27	0.0	36.4	FLOOD RISK*

Noble House
Capital Drive Linford Wood
Milton Keynes MK14 6QP

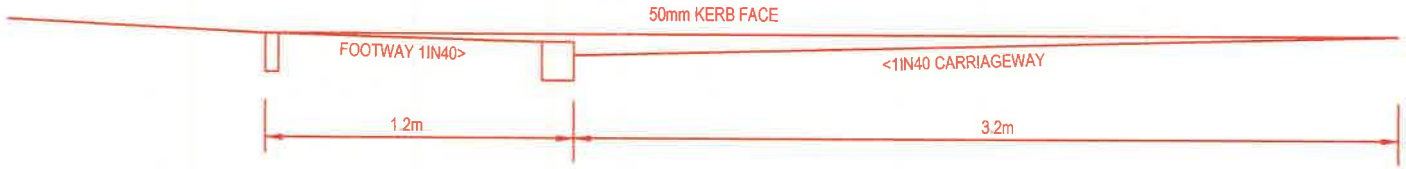
Date 13/06/2014 09:18
File Cross Fall Road.mdx

Designed by teodor.dmytrenko
Checked by

XP Solutions | Network W.12.6

Conduits

Section		Input	Depth (%)	Wetted Area (m^2)	Wetted Perimeter (m)	Base Coordinates X (m)	Base Coordinates Y (m)	Cover Coordinates X (m)	Cover Coordinates Y (m)
1	Symbol		10	0.001	0.328	0.000	0.080		
	Width (mm)	4400	30	0.012	0.984	1.200	0.050		
	Height (mm)	80	50	0.032	1.640	1.201	0.000		
	C.Height (mm)	80	70	0.063	2.530	4.400	0.080		
	Side Angle (°)	0.0	90	0.113	3.810				
	Splay (mm)	0	100	0.146	4.450				
	Open Section	Yes							



APPENDIX E

WSP LETTER AND RPS COMMENTS IN BLUE AND FURTHER COMMENTS IN RED

Our ref: MHW/paw/11012748/C

18 November 2013

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Bellway Homes Limited
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NE13 6BE

Dear Sirs

Kingsmere, Bicester
Drainage Review for KM7 and KM9

We have been commissioned by Countryside Properties (Bicester) Ltd to review parcel drainage designs at Kingsmere to ensure compliance with the requirements of the overall site drainage and attenuation basin system. We also review the likely acceptability of the proposed parcel drainage strategy with regards to the Kingsmere Design Code and other requirements of the regulatory and adopting authorities. The requirements are provided in the parcel sales packs and the WSP Parcel Drainage Design Guide.

For the hydraulic review, no MicroDrainage results have been provided for the current layout. The ones provided are for January and are for a different layout. However, the RPS Report states that the 10 year event discharge from KM7 is 13.3 l/s (the MicroDrainage input states 13.8 l/s). This exceeds the required 11.6 l/s stated on WSP Drawing 1903/D/006 and in the sales pack. We also note that the volume provided by the cellular storage is less than the required amount and, in particular for KM7, the tank is remote from the outfall.

This version (Rev C) includes the current layout. The total discharge from KM7 and KM9 is restricted to 24.3 litres per second. The proposed layout did not allow space for an attenuation tank near the outfall. An additional small tank has been added near the outfall. The micro-drainage calculations demonstrate that there will be no flooding during a 10 year storm. The discharge rates now tally with the strategy.

The summary output for the 100 year event appears to show that the discharge is being limited by the Hydrobrakes. This is not required as the site-wide system is designed to take all flows above the 10 year event (these should be allowed to overflow the control device) and it will cause excessive flooding of the parcel leading to overland flow to downstream parcels. The control of this is made more difficult because the system does not follow the distributed source-control philosophy of the Kingsmere Design Code and SuDS policy, but provides all control as an 'end-of-pipe' solution.

The flow control manholes will have a weir overflow. The weirs have been added to the micro-drainage calculations.

We understand the proposed surface water drainage system has been approved and accepted for adoption by Oxfordshire county Council (OCC). This has been agreed on the basis that the site is not suitable for infiltration. However, this is not a reason to preclude the use of the preferred permeable paving for attenuation storage and if there is a risk of weakening of soils these can be tanked (as is shown for the proposed cellular storage). No detail of the soakage testing has been provided: the non-compliance with BRE365 noted is only because sufficient time was not allowed to do 3 tests where infiltration was reasonable. We also note that no results of the site investigation are provided: high water table is assumed based on a general statement in another report and anecdotal evidence of a farmer! The full results of the Hydrock SI report should be provided.

A meeting with OCC concluded that due to the depth of fill and the poor percolation values, the use of permeable roads was not suitable for the site. Extracts from the Hydrock SI report are included in Appendix C. The full report can be made available. Further trial holes in December 2013 demonstrated that the ground water level precludes the use of soakaways.

Other items for which evidence of adopting authority acceptance is required are as follows:

- It is proposed to install a Hydrobrake and make an additional connection to existing Manhole S118 (S10 on Drawing RPS Drawing JKK6647-101C). This manhole must also retain its branch for connection of the secondary school downstream of the Hydrobrake.
- There are numerous surface water sewers, manholes and gullies shown within the Thames Water easement for the 375 mm diameter foul sewer. These are located between manholes Sc and S123 along the southern boundary of the site.
- A new connection at existing manhole F104 and a new manhole F305 on the 375 mm diameter foul sewer are proposed.

An urgent designer's response to the above issues is required, which should be submitted to Countryside Properties.

Yours faithfully

Martin Wheeler
Digitally signed by Martin Wheeler
Date: 2013.11.18 12:33:30 Z

Martin Wheeler
Associate Director
DDI 01256 318806

- The connection from the school will be retained downstream of the hydrobrake.
- There are existing and proposed surface water sewers located within the Thames Water easement for the 375mm diameter foul sewer. Thames Water has approved the proposed adoptable foul drainage for the development.
- The new connections to the foul sewer have been approved by Thames Water.

Our ref: MHW/paw/11012748/C

31 March 2014

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Bellway Homes Limited
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Dear Sirs

Kingsmere, Bicester
Drainage Review for KM7 and KM9

We refer to our letter dated 18 November 2013 and the submission of several items of additional information culminating in a revised strategy submitted to us by your consultants RPS on 26 March 2014. This has now been reviewed.

We note that some permeable pavement has now been introduced, but we remain of the view that the strategy does not accord with the SuDS philosophy promoted by the Kingsmere Design Code. However as we understand Oxfordshire County Council, who is a party to the Code, has agreed to adopt the system, we accept this position.

The modelled 10 year discharge for KM 7 is now acceptable. The modelled flow rate of 11.7 l/s is marginally outside the specified limit of 11.6 l/s. However, this is considered to be within the limits of the accuracy of a surface water drainage model. It is noted that there is now no flooding predicted for the 1 in 30 year event and that flooding for the 1 in 100 year event is significantly reduced.

In summary, we now find the proposed strategy acceptabe with respect to the discharges to the site-wise drainage system.

Yours faithfully

Wheeler, Martin
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