RPS

KINGSMERE PARCELS KM7 AND KM9

SURFACE WATER DRAINAGE DESIGN STRATEGY

JANUARY 2013

KINGSMERE
PARCELS KM7 AND KM9
SURFACE WATER DRAINAGE
DESIGN STRATEGY

RPS PROJECT No: JKK6647

ISSUE	DATE	REMARKS
A	08.01.13	First Issue

Our Ref: JKK6647

RPS Planning & Development
Noble House,
Capital Drive,
Linford Wood,
Milton Keynes,
MK14 6QP

Tel: 01908 669898
Fax: 01908 669899
Email: **rpsmks**@rpsgroup.com

QUALITY MANAGEMENT

Author	Qualifications	Signature
Kevin McEvaddy	BEng	

Registration Number LCEA071057

DISCLAIMER

The opinions and interpretations presented in this report represent our best technical interpretation of the data made available to us. However, due to the uncertainty inherent in the estimation of all parameters, we cannot, and do not guarantee the accuracy or correctness of any interpretation and we shall not, except in the case of gross or wilful negligence on our part, be liable or responsible for any loss, cost damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees.

Except for the provision of professional services on a fee basis, RPS does not have a commercial arrangement with any other person or company involved in the interests that are the subject of this report.

RPS cannot accept any liability for the correctness, applicability or validity for the information they have provided, or indeed for any consequential costs or losses in this regard. Our efforts have been made on a "best endeavours" basis and no responsibility or liability is warranted or accepted by RPS.

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 SK01.

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

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 11.6 and 12.7 litres per second respectively. Micro-drainage calculations appended to this report demonstrate that the system will not flood during a 1 in 10 year event.

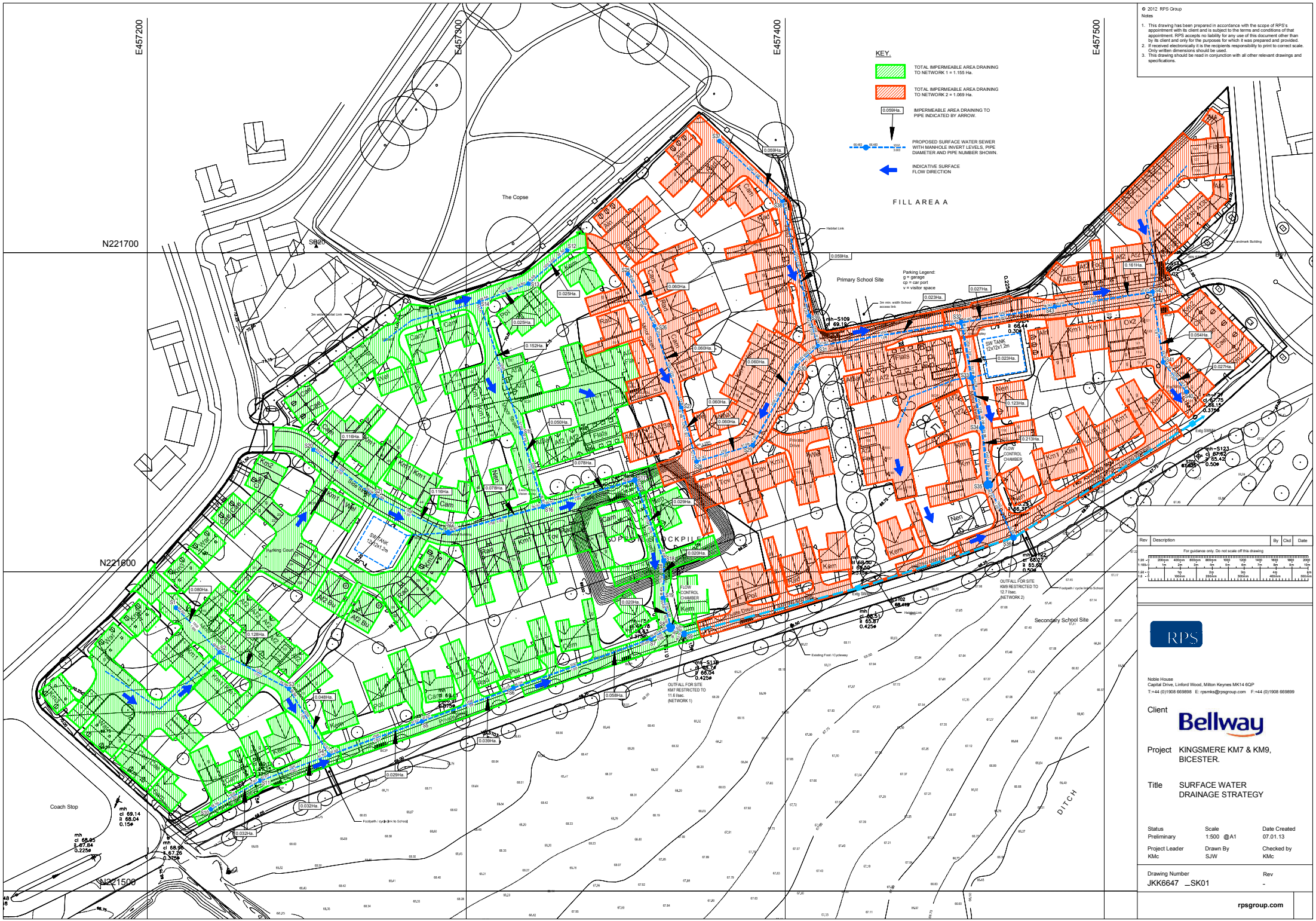
1.6 The rate of surface water discharge will be restricted by a flow control device such as a hydrobrake at the proposed points of connection to the infrastructure surface water system. The control chambers will include an overflow that will prevent surface water flooding through the manhole covers. 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 or a Management Company.

APPENDIX A

PROPOSED SURFACE WATER DESIGN

DRAWING JKK6647 SK01



Notes

1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
3. This drawing should be read in conjunction with all other relevant drawings and specifications.

Rev	Description	By	Ckd	Date

For guidance only. Do not scale off this drawing

RPS

Noble House
Capital Drive, Linford Wood, Milton Keynes MK14 6QP
T:+44 (0)1908 669898 E: rpsmks@rpsgroup.com F:+44 (0)1908 669899

Client Bellway

Project KINGSMERE KM7 & KM9, BICESTER.

Title SURFACE WATER DRAINAGE STRATEGY

Status	Scale	Date Created
Preliminary	1:500 @A1	07.01.13
Project Leader	Drawn By	Checked by
KMc	SJW	KMc

Drawing Number JKK6647 _SK01

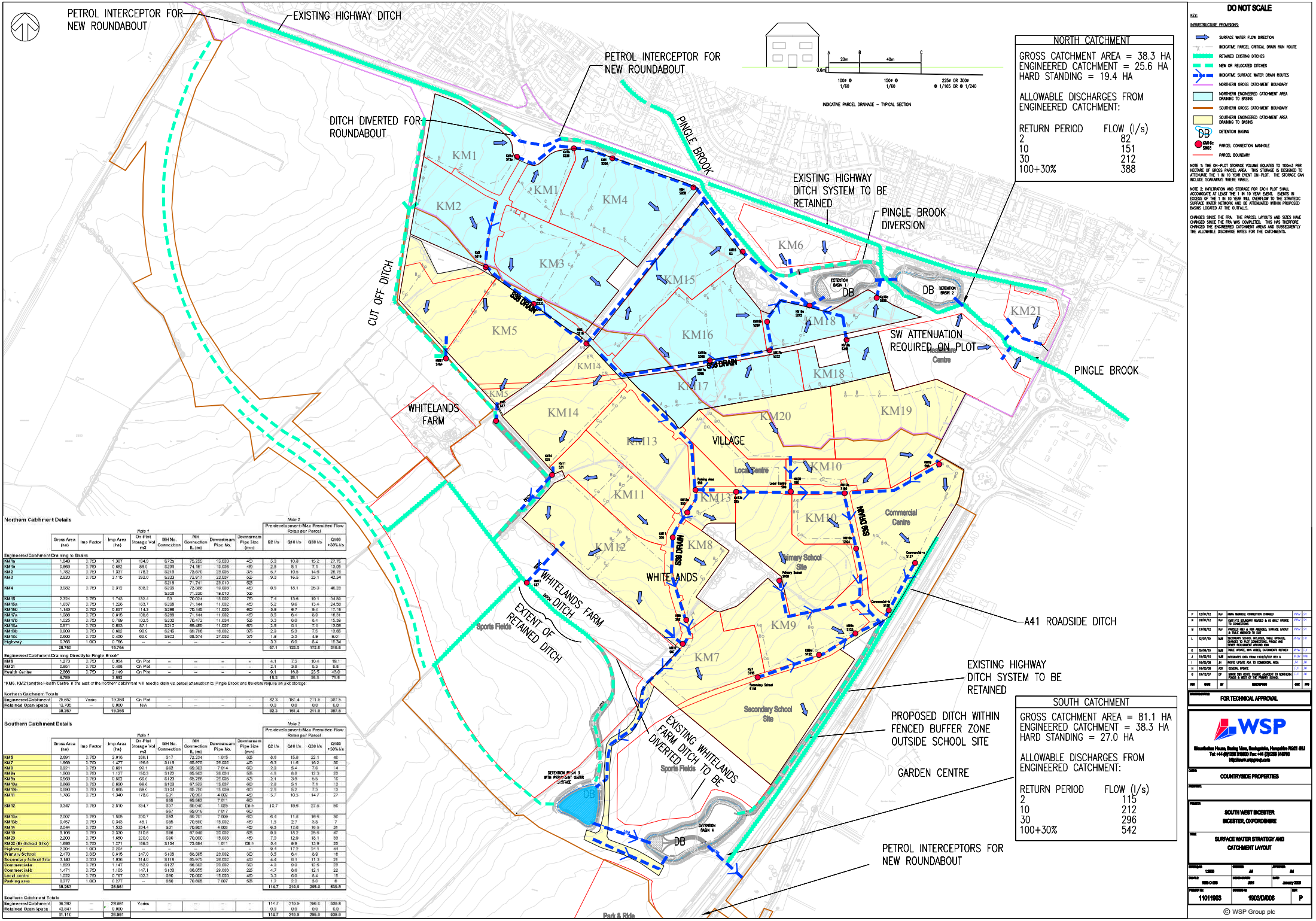
Rev -

rpsgroup.com

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

KEY:

INFRASTRUCTURE PROVISIONS:

- SURFACE WATER FLOW DIRECTION
- INDICATIVE PARCEL CRITICAL DRAIN RUN ROUTE
- RETAINED EXISTING DITCHES
- NEW OR RELOCATED DITCHES
- INDICATIVE SURFACE WATER DRAIN ROUTES
- NORTHERN GROSS CATCHMENT BOUNDARY
- NORTHERN ENGINEERED CATCHMENT AREA DRAINING TO BASINS
- SOUTHERN GROSS CATCHMENT BOUNDARY
- SOUTHERN ENGINEERED CATCHMENT AREA DRAINING TO BASINS
- DB DETENTION BASINS
- KM16c S803 PARCEL CONNECTION MANHOLE
- PARCEL BOUNDARY

NOTE 1: THE ON-PLOT STORAGE VOLUME EQUATES TO 100m3 PER HECTARE OF GROSS PARCEL AREA. THIS STORAGE IS DESIGNED TO ATTENUATE THE 1 IN 10 YEAR EVENT ON-PLOT. THE STORAGE CAN INCLUDE SOAKAWAYS WHERE VIABLE.

NOTE 2: INFILTRATION AND STORAGE FOR EACH PLOT SHALL ACCOMODATE AT LEAST THE 1 IN 10 YEAR EVENT. EVENTS IN EXCESS OF THE 1 IN 10 YEAR WILL OVERFLOW TO THE STRATEGIC SURFACE WATER NETWORK AND BE ATTENUATED WITHIN PROPOSED BASINS LOCATED AT THE OUTFALLS.

CHANGES SINCE THE FRA: THE PARCEL LAYOUTS AND SIZES HAVE CHANGED SINCE THE FRA WAS COMPLETED. THIS HAS THEREFORE CHANGED THE ENGINEERED CATCHMENT AREAS AND SUBSEQUENTLY THE ALLOWABLE DISCHARGE RATES FOR THE CATCHMENTS.

Northern Catchment Details

	Gross Area (ha)	Imp Factor	Imp Area (ha)	Note 1 On-Plot Storage Vol m3	MH No. Connection	MH Connection IL (m)	Downstream Pipe No.	Downstream Pipe Size (mm)	Note 2 Pre-development Max Permitted Flow Rates per Parcel Q2 l/s	Q10 l/s	Q30 l/s	Q100 +30% l/s
Engineered Catchment Draining to Basins												
KM1a	1.840	0.750	1.387	184.0	S735	75.266	15.033	450	5.9	10.8	16.2	27.75
KM1b	0.899	0.750	0.662	89.9	S239	74.161	15.036	450	2.8	5.1	7.1	13.05
KM2	1.762	0.750	1.321	176.2	S215	75.616	23.035	375	5.7	10.5	14.5	26.16
KM3	2.820	0.750	2.115	282.0	S233	72.872	23.037	525	9.3	16.2	23.1	42.54
KM4	3.992	0.750	2.312	399.2	S219	71.741	23.010	525	9.9	16.1	25.3	46.28
					S220	71.226	15.010	525				
KM5	2.304	0.750	1.743	230.4	S3	70.024	15.032	750	7.4	13.4	19.1	34.86
KM15a	1.637	0.750	1.228	163.7	S269	71.144	11.032	450	3.2	9.6	13.4	24.56
KM15b	1.143	0.750	0.857	114.3	S269	70.145	11.035	900	3.8	6.7	9.4	17.15
KM17a	1.096	0.750	0.815	109.6	S288	71.144	11.032	450	3.5	6.4	8.9	16.31
KM17b	1.025	0.750	0.769	102.5	S232	70.472	11.034	525	3.3	6.0	8.4	15.38
KM18a	0.871	0.750	0.653	87.1	S212	69.465	11.037	675	2.8	5.1	7.1	13.08
KM18b	0.900	0.750	0.662	90.0	S245	69.706	15.032	375	2.9	5.3	7.5	13.65
KM18c	0.600	0.750	0.450	60.0	S803	68.514	21.032	375	1.9	3.5	4.9	9.07
Highway	0.766	1.000	0.766	--	--	--	--	-	3.3	6.0	8.4	15.34
	20.762		16.764						67.1	122.3	172.6	316.8
Engineered Catchment Draining Directly to 'Pingle Brook'												
KM6	1.273	0.750	0.954	On Plot	--	--	--	-	4.1	7.5	10.6	19.1
KM21	0.651	0.750	0.488	On Plot	--	--	--	-	2.1	3.8	5.3	9.8
Health Centre	2.996	0.750	2.140	On Plot	--	--	--	-	9.1	16.8	23.5	43.0
	4.769		3.582						15.3	28.1	39.5	71.8

*KM6, KM21 and the Health Centre in the east of the northern catchment will needle claim via parcel attenuation to 'Pingle Brook' and therefore require on plot storage

Northern Catchment Totals

Engineered Catchment	25.852	Varies	19.398	On Plot	--	--	--	-	82.3	151.4	211.8	387.5
Retained Open Space	12.705	--	0.000	N/A	--	--	--	-	0.0	0.0	0.0	0.0
	38.257		19.398						82.3	151.4	211.8	387.5

Southern Catchment Details

	Gross Area (ha)	Imp Factor	Imp Area (ha)	Note 1 On-Plot Storage Vol m3	MH No. Connection	MH Connection IL (m)	Downstream Pipe No.	Downstream Pipe Size (mm)	Note 2 Pre-development Max Permitted Flow Rates per Parcel Q2 l/s	Q10 l/s	Q30 l/s	Q100 +30% l/s
KM9	2.991	0.750	2.016	299.1	S17	72.224	1.015	525	6.9	12.6	22.1	40
KM7	1.969	0.750	1.477	196.9	S119	68.576	28.033	450	5.3	11.6	16.2	30
KM8	0.921	0.750	0.691	92.1	S62	69.303	7.014	900	2.8	5.4	7.6	14
KM9a	1.503	0.750	1.127	150.3	S122	68.503	28.034	525	4.8	8.8	12.3	23
KM9b	0.959	0.750	0.902	95.9	S123	68.288	28.035	525	3.1	3.9	5.5	10
KM10a	0.898	0.750	0.690	89.8	S103	67.922	15.037	900	2.8	5.1	7.1	13
KM10b	0.890	0.750	0.668	89.0	S104	68.780	15.034	900	2.9	5.2	7.3	13
KM11	1.780	0.750	1.340	178.0	S31	70.967	4.002	450	5.7	10.5	14.7	27
					S56	69.582	7.001	900				
KM12	3.347	0.750	2.510	334.7	S37	69.046	1.025	Ditch	10.7	19.6	27.5	50
					S67	69.016	7.017	900				
KM13a	2.007	0.750	1.506	200.7	S68	69.701	7.009	900	6.4	11.8	16.5	30
KM13b	0.457	0.750	0.343	45.7	S65	70.586	15.032	450	1.5	2.7	3.8	7
KM14	2.044	0.750	1.533	204.4	S31	70.967	4.002	450	6.5	12.0	16.9	31
KM19	3.106	0.750	2.330	310.6	S96	67.648	28.032	525	9.9	18.2	25.6	47
KM20	2.200	0.750	1.650	220.0	S90	70.000	15.033	450	7.0	12.9	18.1	33
KM22 (Ex-School Site)	1.695	0.750	1.271	169.5	S154	73.664	1.011	Ditch	5.4	9.9	13.9	25
Highway	2.304	1.000	2.304	--	--	--	--	-	9.1	17.2	24.1	44
Primary School	2.670	0.900	2.403	267.0	S123	68.388	28.032	450	8.5	15.6	21.9	40
Secondary School Site	3.140	0.900	2.826	314.0	S119	68.575	28.032	450	4.4	8.1	11.3	21
Commercial-a	1.620	0.750	1.147	162.0	S127	68.503	28.032	900	4.3	9.0	12.6	23
Commercial-b	1.471	0.750	1.103	147.1	S120	68.055	28.033	225	4.7	8.6	12.1	22
Local centre	1.022	0.750	0.767	102.2	S96	70.000	15.033	450	3.3	6.0	8.4	15
Parking area	0.777	1.000	0.777	--	S56	70.665	7.007	525	1.7	3.2	5.0	9
	38.283		28.961						114.7	210.9	295.6	539.8

Southern Catchment Totals

Engineered Catchment	38.283	--	28.961	Varies	--	--	--	-	114.7	210.9	295.6	539.8
Retained Open Space	42.847	--	0.000	--	--	--	--	-	0.0	0.0	0.0	0.0
	81.130		28.961						114.7	210.9	295.6	539.8

REV	DATE	BY	DESCRIPTION	CHK	APP
F	12/07/12	RJJ	KM6 MANHOLE CONNECTION CHANGED	WW	JH
K	13/07/12	RJJ	KM17/18 BOUNDARY REVISED & AS BUILT UPDATE TO CONNECTIONS	WW	JH
M	13/08/12	RJJ	PARCELS KM2 & KM4 AMENDED, SURFACE LAYOUT & TABLE AMENDED TO SUIT	WW	JH
L	12/07/13	MJH	SECONDARY SCHOOL INCLUDED, THREE UPDATES, CHANGES TO PLOT CONNECTIONS, FINAL FRA ISSUE/AMENDMENT AROUND FRA	WW	JH
E	15/04/13	MJH	THREE UPDATES, FRA ISSUED, CATCHMENTS REFINED	WW	JH
J	19/02/13	MJH	INTERFACE DATA FROM 19/02/13/007 REV C	HLW	RW
I	14/02/13	JH	ROUTE UPDATE ADJ. TO COMMERCIAL AREA	JH	JH
H	14/02/13	ADK	GENERAL UPDATE	CJT	JH
G	19/12/07	DP	MINOR DWG ROUTE CHANGE ADJACENT TO NORTHERN POND & WEST OF THE PRIMARY SCHOOL	CJT	JH

FOR TECHNICAL APPROVAL

WSP
Mountbatten House, Basing View, Basingstoke, Hampshire RG21 4HJ
Tel: +44 (0)1256 318800 Fax: +44 (0)1256 318700
http://www.wspgroup.com

CLIENT: COUNTRYSIDE PROPERTIES

PROJECT: SOUTH WEST BICESTER BICESTER, OXFORDSHIRE

TITLE: SURFACE WATER STRATEGY AND CATCHMENT LAYOUT

ORIGINATOR	CHECKED	APPROVED
MJH	JH	JH
SCALE: 1:5000 @ A0	DRAWING DATE: MJH	DATE: January 2013
PROJECT NO: 19011903	DRAWING NO: 1903/D/006	REV: P

APPENDIX C

EXTRACTS FROM HYDROCK

GROUND INVESTIGATION REPORT

Unit 2, Hawthorn Park, Holdenby Road
Spratton, Northampton, NN6 8LD.

Tel: 01454 619533 Fax: 01454 614125

E-mail: northampton@hydrock.com
www.hydrock.com

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

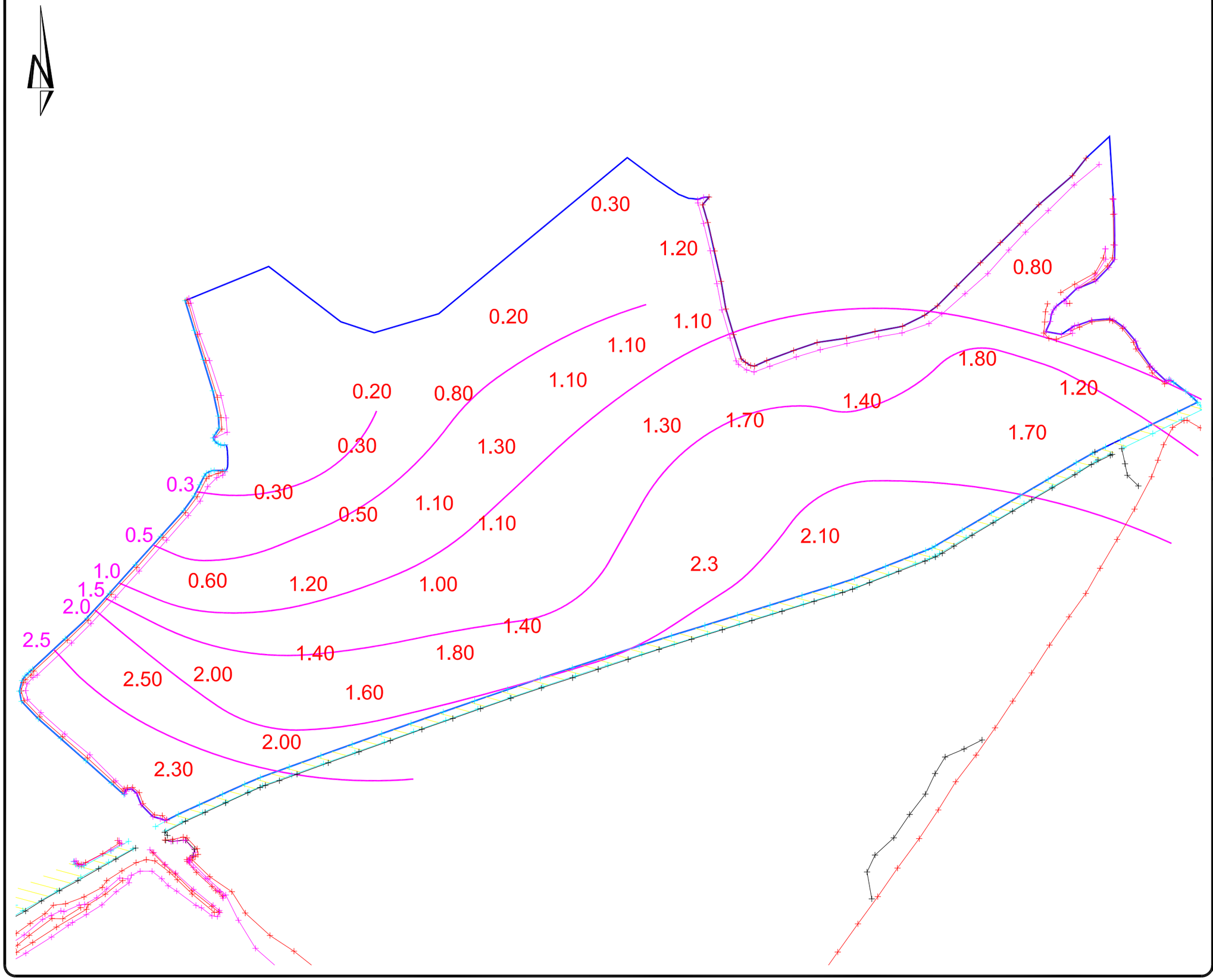
9.7 Soakaways and Drainage

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.



Notes:

1. This drawing has been produced using a topographical survey, drawing no. WSP0503 dated January 2006 by Nationwide Surveys.
2. DO NOT SCALE from this drawing.
3. This drawing is copyright.

Legend

- Site Boundary (Indicative Only)
- Interpolated Contours of Depth of Made Ground
- 1.00 Made Ground Depths

Rev	Date	Description	Ckd	By

Hydrock
Unit 3, Hawthorn Park
Holdenby Road
Spratton
Northampton NN6 8LD
TEL: 01604 842 888
FAX: 01604 842 666
E-Mail: northampton@hydrock.com
or visit www.hydrock.com

Client: Bellway

Project: KM7 & KM9 KINGSMERE, BICESTER

Title: Depth of Made Ground Contour Plan

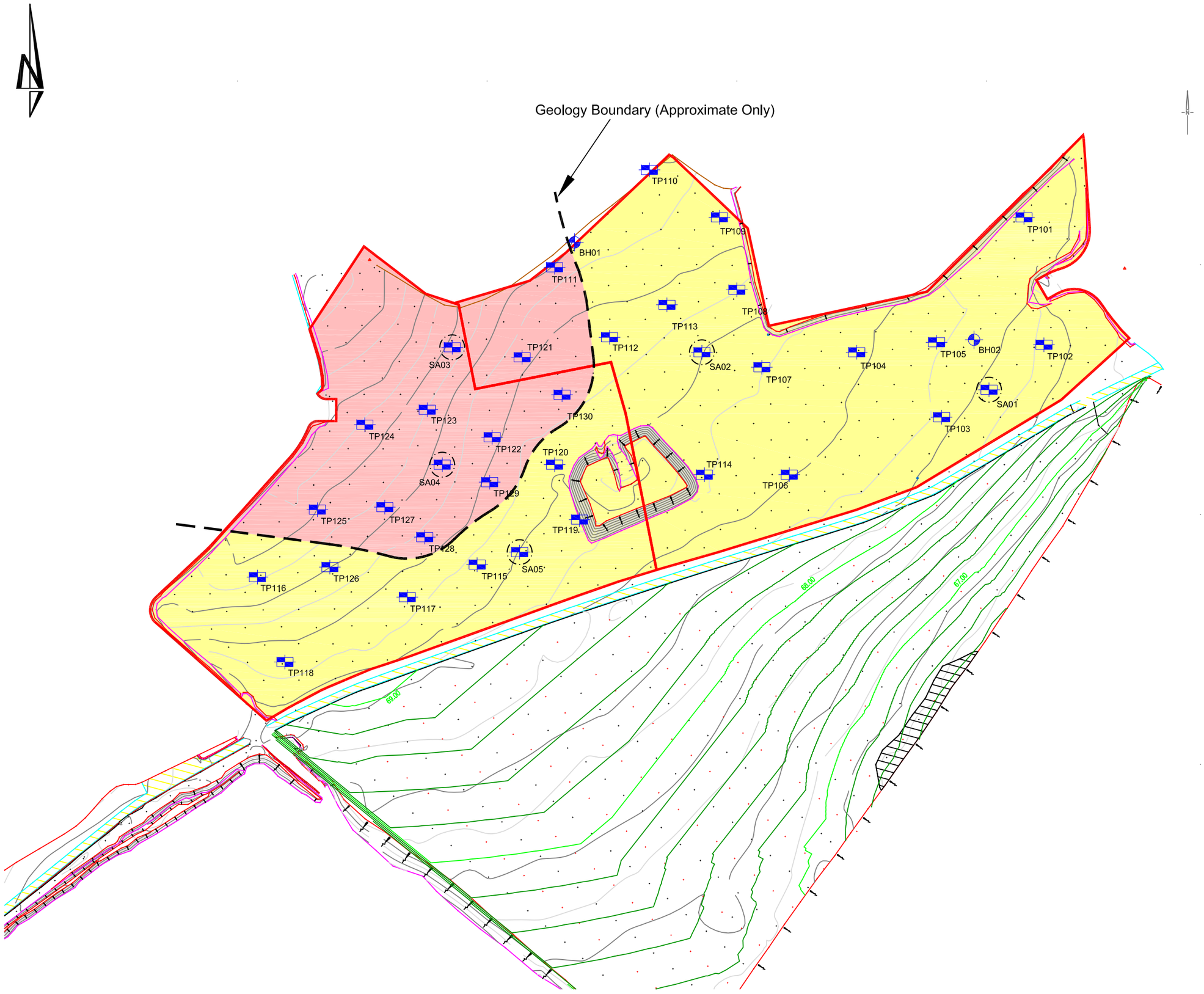
Drawing Status: INFORMATION

Job No.: C/12460

Drawn	Checked	Scale at A3	Date	Issue Date
GJ	AB	1:1250	14/11/12	15/11/12

Drawing No.: 12460/D005

Revision: -



Notes:

1. This drawing has been produced using drawing no. JBC/4300/38 Rev A titled 'Fill Area B & School Area Topographical Survey' by Breheny Civil Engineering.
2. DO NOT SCALE from this drawing.
3. This drawing is copyright.

Legend

- Parcel Boundary
- Trial Pit Location (TP101)
- Borehole Location (BH01)
- Soakaway Location (SA01)
- Cornbrash Formation
- Kellaways Clay Member

Rev	Date	Description	Ckd	By

Hydrock

Unit 3, Hawthorn Park
Holdenby Road
Spratton
Northampton NN6 8LD
TEL: 01604 842 888
FAX: 01604 842 666
E-Mail: northampton@hydrock.com
or visit www.hydrock.com

Client: Bellway

Project: KM7 & KM9, KINGSMERE, BICESTER

Title: Underlying Geology Plan

Drawing Status: INFORMATION

Job No.: C/12460

Drawn	Checked	Scale at A3	Date	Issue Date
GJ	AB	1:1500	14/11/12	15/11/12

Drawing No.: 12460/D006

Revision: -

APPENDIX D

MICRO DRAINAGE CALCULATIONS

Existing Network Details for NETWORK 1.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	19.534	0.512	38.2	0.080	5.00	0.600	o	150
*	1.001	24.578	0.529	46.5	0.128	0.00	0.600	o	225
*	1.002	24.333	0.707	34.4	0.048	0.00	0.600	o	225
*	2.000	17.775	0.173	102.7	0.032	5.00	0.600	o	150
*	2.001	23.184	0.225	103.0	0.032	0.00	0.600	o	150
*	1.003	30.868	0.581	53.1	0.029	0.00	0.600	o	300
	1.004	30.550	0.297	102.9	0.039	0.00	0.600	o	300
	1.005	45.636	0.239	190.9	0.058	0.00	0.600	o	300
	1.006	7.216	0.048	150.3	0.000	0.00	0.600	o	300
*	3.000	15.990	0.155	103.2	0.025	5.00	0.600	o	150
*	3.001	16.468	0.160	102.9	0.025	0.00	0.600	o	150
	3.002	43.038	0.418	103.0	0.152	0.00	0.600	o	225
	3.003	24.065	1.051	22.9	0.050	0.00	0.600	o	225
*	4.000	23.771	0.567	41.9	0.116	5.00	0.600	o	150
*	4.001	26.133	1.928	13.6	0.116	0.00	0.600	o	150
*	4.002	30.782	0.150	205.2	0.078	0.00	0.600	o	375
*	3.004	29.890	0.149	200.6	0.078	0.00	0.600	o	375

	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	70.850	69.500	1.200	70.338	68.988	1.200		1200
*	1.001	2	70.338	68.913	1.200	69.809	68.384	1.200		1200
*	1.002	3	69.809	68.384	1.200	69.312	67.677	1.410		1200
*	2.000	10	69.500	68.150	1.200	69.346	67.977	1.219		1200
*	2.001	11	69.346	67.977	1.219	69.312	67.752	1.410		1200
*	1.003	4	69.312	67.602	1.410	69.158	67.021	1.837		1200
	1.004	5	69.158	67.021	1.837	69.048	66.724	2.024		1200
	1.005	6	69.048	66.724	2.024	68.813	66.485	2.028		1200
	1.006	7	68.813	66.485	2.028	68.802	66.437	2.065		1200
*	3.000	12	70.119	68.760	1.209	70.102	68.605	1.347		1200
*	3.001	13	70.102	68.605	1.347	70.354	68.445	1.759		1200
	3.002	14	70.354	68.370	1.759	69.678	67.952	1.501		1200
	3.003	15	69.678	67.952	1.501	69.393	66.901	2.267		1200
*	4.000	20	70.971	69.621	1.200	70.404	69.054	1.200		1200
*	4.001	21	70.404	69.054	1.200	69.827	67.126	2.551		1200
*	4.002	22	69.827	66.901	2.551	69.393	66.751	2.267		1500
*	3.004	16	69.393	66.751	2.267	69.329	66.602	2.352		1500

Existing Network Details for NETWORK 1.SWS

	PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)
*	3.005	26.813	0.134	200.1	0.029	0.00	0.600	o	375
*	3.006	11.732	0.059	198.8	0.020	0.00	0.600	o	375
*	3.007	9.449	0.047	201.0	0.020	0.00	0.600	o	375
*	1.007	4.798	0.047	102.1	0.000	0.00	0.600	o	150

	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)
*	3.005	17	69.329	66.602	2.352	69.007	66.468	2.164		1500
*	3.006	18	69.007	66.468	2.164	68.892	66.409	2.108		1500
*	3.007	19	68.892	66.409	2.108	68.802	66.362	2.065		1500
*	1.007	8	68.802	66.362	2.290	68.739	66.315	2.274	Hydro-Brake®	2700

Free Flowing Outfall Details for NETWORK 1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.007	9	68.739	66.315	66.040	1800	0

Simulation Criteria for NETWORK 1.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	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)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

Online Controls for NETWORK 1.SWS

Hydro-Brake® Manhole: 8, DS/PN: 1.007, Volume (m³): 15.2

Design Head (m) 1.800 Hydro-Brake® Type Md4 Invert Level (m) 66.362
Design Flow (l/s) 11.6 Diameter (mm) 105

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.1	1.200	9.4	3.000	14.9	7.000	22.7
0.200	7.0	1.400	10.2	3.500	16.1	7.500	23.5
0.300	6.4	1.600	10.9	4.000	17.2	8.000	24.3
0.400	5.9	1.800	11.5	4.500	18.2	8.500	25.0
0.500	6.2	2.000	12.2	5.000	19.2	9.000	25.8
0.600	6.7	2.200	12.7	5.500	20.1	9.500	26.5
0.800	7.7	2.400	13.3	6.000	21.0		
1.000	8.6	2.600	13.9	6.500	21.9		

Storage Structures for NETWORK 1.SWS

Cellular Storage Manhole: 22, DS/PN: 4.002

Invert Level (m) 67.000 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	144.0	144.0	1.300	0.0	201.6
1.200	144.0	201.6			

Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 1.SWS

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

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

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%					
1.001	15 Winter	10	0%					
1.002	15 Winter	10	0%					
2.000	15 Winter	10	0%					
2.001	15 Winter	10	0%					
1.003	15 Winter	10	0%					
1.004	15 Winter	10	0%					
1.005	15 Winter	10	0%					
1.006	120 Winter	10	0%					
3.000	15 Winter	10	0%					
3.001	15 Winter	10	0%					
3.002	15 Winter	10	0%					
3.003	120 Winter	10	0%	10/120 Winter				
4.000	15 Winter	10	0%					
4.001	15 Winter	10	0%					
4.002	120 Winter	10	0%					
3.004	120 Winter	10	0%					
3.005	120 Winter	10	0%					
3.006	120 Winter	10	0%					
3.007	120 Winter	10	0%					
1.007	120 Winter	10	0%					

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	69.602	-0.048	0.000	0.79	0.0	21.5	OK
1.001	2	69.130	-0.008	0.000	0.82	0.0	58.1	OK
1.002	3	68.896	0.287	0.000	0.81	0.0	65.9	SURCHARGED
2.000	10	68.720	0.420	0.000	0.46	0.0	7.6	SURCHARGED
2.001	11	68.694	0.567	0.000	0.90	0.0	14.9	SURCHARGED
1.003	4	68.606	0.704	0.000	0.55	0.0	75.9	SURCHARGED
1.004	5	68.470	1.149	0.000	0.73	0.0	72.9	SURCHARGED
1.005	6	68.316	1.292	0.000	1.08	0.0	80.9	SURCHARGED
1.006	7	68.181	1.396	0.000	0.54	0.0	33.2	SURCHARGED
3.000	12	68.828	-0.082	0.000	0.41	0.0	6.6	OK
3.001	13	68.769	0.014	0.000	0.84	0.0	13.7	SURCHARGED
3.002	14	68.681	0.086	0.000	1.09	0.0	53.0	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 1.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
3.003	15	68.196	0.019	0.000	0.21	0.0	21.4	SURCHARGED
4.000	20	70.199	0.428	0.000	1.00	0.0	26.1	SURCHARGED
4.001	21	69.641	0.437	0.000	1.09	0.0	50.7	SURCHARGED
4.002	22	68.190	0.914	0.000	0.10	0.0	11.8	SURCHARGED
3.004	16	68.189	1.063	0.000	0.09	0.0	11.4	SURCHARGED
3.005	17	68.186	1.209	0.000	0.09	0.0	11.3	SURCHARGED
3.006	18	68.183	1.340	0.000	0.10	0.0	11.1	SURCHARGED
3.007	19	68.180	1.396	0.000	0.11	0.0	10.9	SURCHARGED
1.007	8	68.178	1.666	0.000	0.85	0.0	11.6	SURCHARGED

Existing Network Details for NETWORK 2.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	18.276	0.195	93.7	0.060	5.00	0.600	o	150
*	1.001	26.979	0.300	89.9	0.060	0.00	0.600	o	225
*	1.002	17.538	0.177	99.1	0.060	0.00	0.600	o	225
*	1.003	18.372	0.136	135.1	0.060	0.00	0.600	o	225
*	1.004	28.481	0.067	425.1	0.060	0.00	0.600	o	300
*	1.005	9.072	0.021	432.0	0.000	0.00	0.600	o	300
*	2.000	27.386	0.283	96.8	0.059	5.00	0.600	o	150
*	2.001	36.754	0.124	296.4	0.059	0.00	0.600	o	225
*	2.002	9.849	0.720	13.7	0.000	0.00	0.600	o	225
	1.006	45.567	0.980	46.5	0.023	0.00	0.600	o	300
*	3.000	11.788	0.065	181.4	0.027	5.00	0.600	o	225
*	3.001	22.236	0.075	296.5	0.054	0.00	0.600	o	225
	3.002	31.033	0.073	426.5	0.161	0.00	0.600	o	300
*	3.003	29.647	0.059	502.5	0.027	0.00	0.600	o	300
*	1.007	17.617	0.035	503.3	0.023	0.00	0.600	o	450
*	1.008	16.006	0.032	500.2	0.123	0.00	0.600	o	450
*	1.009	17.944	0.036	498.4	0.213	0.00	0.600	o	450
*	1.010	18.330	0.260	70.5	0.000	0.00	0.600	o	150

	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	25	69.859	68.509	1.200	69.664	68.314	1.200		1200
*	1.001	26	69.664	68.239	1.200	69.364	67.939	1.200		1200
*	1.002	27	69.364	67.939	1.200	69.187	67.762	1.200		1200
*	1.003	28	69.187	67.762	1.200	69.051	67.626	1.200		1200
*	1.004	29	69.051	67.551	1.200	69.142	67.484	1.358		1200
*	1.005	30	69.142	67.484	1.358	69.328	67.463	1.565		1200
*	2.000	37	70.090	68.740	1.200	69.807	68.457	1.200		1200
*	2.001	38	69.807	68.382	1.200	69.720	68.258	1.237		1200
*	2.002	39	69.720	68.258	1.237	69.328	67.538	1.565		1200
	1.006	31	69.328	67.463	1.565	68.897	66.483	2.114		1200
*	3.000	40	67.829	66.830	0.774	68.003	66.765	1.013		1200
*	3.001	41	68.003	66.765	1.013	68.416	66.690	1.501		1200
	3.002	42	68.416	66.615	1.501	68.550	66.542	1.708		1200
*	3.003	43	68.550	66.542	1.708	68.897	66.483	2.114		1200
*	1.007	32	68.897	66.333	2.114	68.690	66.298	1.942		1500
*	1.008	33	68.690	66.298	1.942	68.637	66.266	1.921		1500
*	1.009	34	68.637	66.266	1.921	68.533	66.230	1.853		1500
*	1.010	35	68.533	66.230	2.153	68.202	65.970	2.082	Hydro-Brake®	2700

Free Flowing Outfall Details for NETWORK 2.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.010	36	68.202	65.970	65.620	1800	0

Simulation Criteria for NETWORK 2.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	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)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

Online Controls for NETWORK 2.SWS

Hydro-Brake® Manhole: 35, DS/PN: 1.010, Volume (m³): 15.7

Design Head (m) 1.800 Hydro-Brake® Type Md4 Invert Level (m) 66.230
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		

Storage Structures for NETWORK 2.SWS

Cellular Storage Manhole: 33, DS/PN: 1.008

Invert Level (m) 66.400 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	144.0	144.0	1.300	0.0	201.6
1.200	144.0	201.6			

Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 2.SWS

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

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

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%					
1.001	15 Winter	10	0%	10/15 Winter				
1.002	15 Winter	10	0%	10/15 Summer				
1.003	15 Winter	10	0%	10/15 Summer				
1.004	15 Winter	10	0%	10/15 Summer				
1.005	15 Winter	10	0%	10/15 Summer				
2.000	15 Winter	10	0%					
2.001	15 Winter	10	0%	10/15 Summer				
2.002	15 Winter	10	0%					
1.006	15 Winter	10	0%					
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				
3.003	120 Winter	10	0%	10/15 Summer				
1.007	120 Winter	10	0%	10/15 Summer				
1.008	120 Winter	10	0%	10/15 Summer				
1.009	120 Winter	10	0%	10/15 Summer				
1.010	120 Winter	10	0%	10/15 Summer				

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	25	68.629	-0.030	0.000	0.93	0.0	15.9	OK
1.001	26	68.483	0.019	0.000	0.60	0.0	30.3	SURCHARGED
1.002	27	68.387	0.223	0.000	0.91	0.0	42.7	SURCHARGED
1.003	28	68.240	0.253	0.000	1.39	0.0	55.7	SURCHARGED
1.004	29	67.969	0.118	0.000	1.42	0.0	68.7	SURCHARGED
1.005	30	67.825	0.041	0.000	2.03	0.0	69.0	SURCHARGED
2.000	37	68.863	-0.027	0.000	0.91	0.0	15.6	OK
2.001	38	68.630	0.023	0.000	1.07	0.0	30.5	SURCHARGED
2.002	39	68.336	-0.147	0.000	0.26	0.0	30.2	OK
1.006	31	67.646	-0.117	0.000	0.68	0.0	103.7	OK
3.000	40	67.594	0.539	0.000	0.06	0.0	1.9	FLOOD RISK
3.001	41	67.593	0.603	0.000	0.20	0.0	5.5	SURCHARGED
3.002	42	67.591	0.676	0.000	0.35	0.0	17.2	SURCHARGED
3.003	43	67.588	0.746	0.000	0.42	0.0	18.7	SURCHARGED
1.007	32	67.586	0.803	0.000	0.59	0.0	56.3	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for NETWORK 2.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
1.008	33	67.583	0.835	0.000	0.44	0.0	38.9	SURCHARGED
1.009	34	67.597	0.881	0.000	0.33	0.0	32.2	SURCHARGED
1.010	35	67.599	1.219	0.000	0.55	0.0	11.0	SURCHARGED