Raven House
29 Linkfield Lane
Redhill
Surrey
RH1 1SS

T: +44(0)1737 784 500
F: +44(0)1737 784 501
E: surrey@campbellreith.com

CampbellReith
consulting engineers

Technical Note

Surface Water Drainage Summary

The following document has been produced to summarise the Flood Risk Assessment (FRA), and the subsequent design works, in order to demonstrate the compliance of the proposed surface water drainage strategy for the Greenwood Community Resource Centre with Condition 19 of the London Borough of Camden Planning Consent (2013/5947/P). This document should be read in conjunction with the FRA prepared for the site (BSF11167-100315-Level 2 FRA F2).

Condition 19: *The development hereby approved shall not be commenced, other than for site clearance & preparation, relocation of services, utilities and public infrastructure and demolition, until details of a surface water drainage scheme for the site, aiming by reasonable endeavours towards at least a 50% reduction from the current brownfield discharge rate, shall be submitted to and approved by the local planning authority in consultation with Thames Water. The development shall not be implemented other than in complete accordance with the surface water drainage scheme that has been approved.*

Flood Risk Assessment

In August 2013, the London Borough of Camden (LBC) commissioned Campbell Reith Hill LLP (CampbellReith), as part of the Tibbalds Multi-Disciplinary team, to prepare a FRA in support of the Planning Application for the proposed redevelopment of Greenwood Place, London. The latest revision of the FRA, F2, was issued in March 2015 (BSF11167-100315-Level 2 FRA F2).

As part of the FRA process, a proposed surface water management strategy for the development was proposed. This strategy was designed to prevent flooding of buildings up to the 1 in 100 year storm event including an allowance of +20% for future climate change.

Surface Water Runoff Betterment

As the development is on a brownfield site, in accordance with the Mayor's London Plan and the North London SFRA, the proposed peak surface water discharges are to be limited to 50% of the peak surface runoff from the existing site, for the 1 in 1 year event.

The current peak discharge from the existing buildings and surrounding hard landscaping were calculated in Windes and were included in Appendix C of the FRA. These are summarised, along with the proposed peak surface water flow to be discharged from the proposed building and hardstanding area in the table below:

Return Period	Existing Peak Discharge (l/s)	Proposed Peak Flow (50% of Existing) (l/s)
1 in 1 year	26.6	**13.3**
1 in 2 year	30.1	15.1
1 in 30 year	37.7	18.9
1 in 100 year	37.8	18.9
1 in 100 year +20%		18.9

In order to limit the sites surface water discharge to the peak flows listed in the above table, attenuation storage was deemed to be required.

Surface Water Drainage Strategy and Calculations

A preliminary surface water drainage strategy for the proposed development, including a proposed layout and calculations, was developed for the site as part of the FRA. This strategy proposes to limit the peak surface water discharge of the proposed development to the 1 in 1 year flow (13.3 l/s) for all events up to the 1 in 100 year storm event, including an allowance of +20% for climate change. Subsequently the proposed storm water layout and calculations for the development have been updated and refined at later design stages, in accordance with the above surface water drainage strategy.

The surface water drainage strategy consists of runoff generated from roof and external hardstanding areas, being collected via rain water pipes and linear channels respectively, before discharging into storm water sewer, where it is conveyed via gravity to a flow control manhole (hydrobrake). The restricted outfall from the hydrobrake (13.3 l/s) causes runoff to back up into the system during high flows and discharge into the offline 32m^3 cellular attenuation tank. Downstream of the hydrobrake, the storm water discharges into a combined water manhole and sewer before outfalling to the existing combined manhole located within Highgate Road carriageway. The latest issue of the Proposed Storm Water Drainage Layout (12291-CRH-GC-XX-DR-C-5055 P3) drawing is appended to this Technical Note.

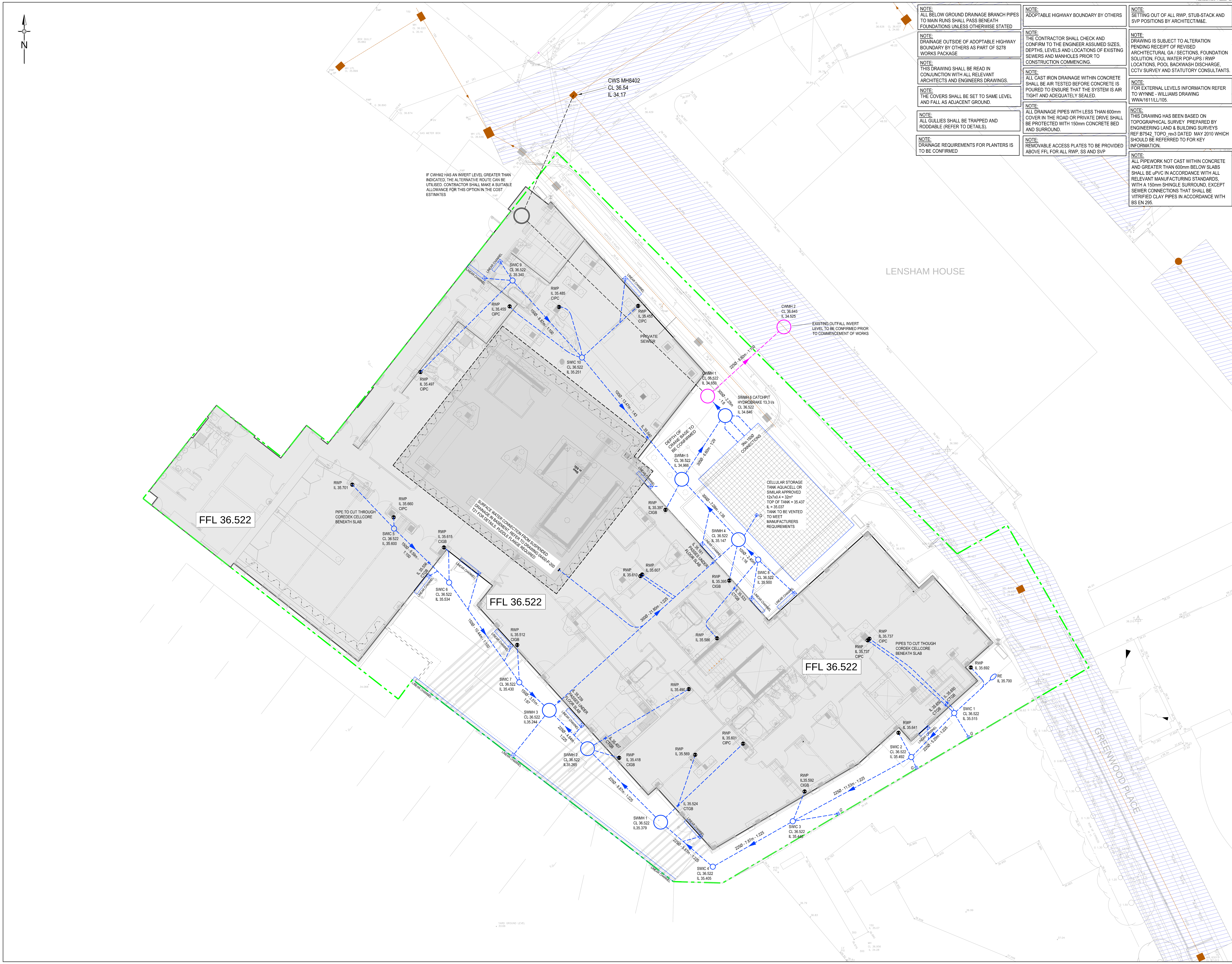
The accompanying calculations for the developed scenario have been updated since the FRA, and are also appended to this Technical Note.

Planning Condition 19 Compliance

The proposed storm water drainage strategy has achieved a 50% reduction from the current brownfield discharge rate through SuDs recognised attenuation devices, flow control and cellular storage, therefore is considered to have complied with the requirement to be '*aiming by reasonable endeavours towards at least a 50% reduction from the current brownfield discharge rate'*.

Please consider this Technical Note, and the appended Storm Water Drainage Layout and calculations, as evidence of compliance for the approval of the local planning authority in consultation with Thames Water, in regards to the requirements of Condition 19 of the London Borough of Camden Planning Consent (2013/5947/P).

FILE LOCATION: F:\12250 - 12499\12291 - THE GREENWOOD CENTRE\2-CIVILS\1-AUTOCAD\1-WORKING DRAWINGS\12291-CRH-GC-XX-DR-C-5055



NOTE:
ALL BELOW GROUND DRAINAGE BRANCH PIPES TO MAIN RUNS SHALL PASS BENEATH FOUNDATIONS UNLESS OTHERWISE STATED

NOTE:
DRAINAGE OUTSIDE OF ADOPTABLE HIGHWAY BOUNDARY BY OTHERS AS PART OF S278 WORKS PACKAGE

NOTE:
THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS.

NOTE:
THE COVERS SHALL BE SET TO SAME LEVEL AND FALL AS ADJACENT GROUND.

NOTE:
ALL GULLIES SHALL BE TRAPPED AND RODDABLE (REFER TO DETAILS).

NOTE:
DRAINAGE REQUIREMENTS FOR PLANTERS IS TO BE CONFIRMED

NOTE:
ADOPTABLE HIGHWAY BOUNDARY BY OTHERS

NOTE:
THE CONTRACTOR SHALL CHECK AND CONFIRM TO THE ENGINEER ASSUMED SIZES, DEPTHS, LEVELS AND LOCATIONS OF EXISTING SEWERS AND MANHOLES PRIOR TO CONSTRUCTION COMMENCING.

NOTE:
ALL CAST IRON DRAINAGE WITHIN CONCRETE SHALL BE AIR TESTED BEFORE CONCRETE IS POURED TO ENSURE THAT THE SYSTEM IS AIR TIGHT AND ADEQUATELY SEALED.

NOTE:
ALL DRAINAGE PIPES WITH LESS THAN 600mm COVER IN THE ROAD OR PRIVATE DRIVE SHALL BE PROTECTED WITH 150mm CONCRETE BED AND SURROUND.

NOTE:
REMOVABLE ACCESS PLATES TO BE PROVIDED ABOVE FFL FOR ALL RWP, SS AND SVP

NOTE:
SETTING OUT OF ALL RWP, STUB-STACK AND SVP POSITIONS BY ARCHITECT/M&E.

NOTE:
DRAWING IS SUBJECT TO ALTERATION PENDING RECEIPT OF REVISED ARCHITECTURAL GA / SECTIONS, FOUNDATION SOLUTION, FOUL WATER POP-UPS / RWP LOCATIONS, POOL BACKWASH DISCHARGE, CCTV SURVEY AND STATUTORY CONSULTANTS.

NOTE:
FOR EXTERNAL LEVELS INFORMATION REFER TO WYNNE - WILLIAMS DRAWING WWA/1611/LL/105.

NOTE:
THIS DRAWING HAS BEEN BASED ON TOPOGRAPHICAL SURVEY PREPARED BY ENGINEERING LAND & BUILDING SURVEYS REF:B7542_TOPO_rev3 DATED MAY 2010 WHICH SHOULD BE REFERRED TO FOR KEY INFORMATION.

NOTE:
ALL PIPEWORK NOT CAST WITHIN CONCRETE AND GREATER THAN 600mm BELOW SLABS SHALL BE uPVC IN ACCORDANCE WITH ALL RELEVANT MANUFACTURING STANDARDS, WITH A 150mm SHINGLE SURROUND, EXCEPT SEWER CONNECTIONS THAT SHALL BE VITRIFIED CLAY PIPES IN ACCORDANCE WITH BS EN 295.

NOTES

1. DO NOT SCALE THIS DRAWING ON PRINT OR ELECTRONICALLY. WORK FROM FIGURED DIMENSIONS ONLY.
2. No deviation from the details shown on this drawing is allowed without CampbellReith's prior permission in writing.
3. Read this drawing with all Architects, Service Engineers and CampbellReith's relevant details and drawings. **NB.** Setting-out dimensions as per the Architect's drawings take precedence.
4. All work is to be in accordance with the relevant specifications issued by CampbellReith, British Standard Codes of Practice, Statutory requirements and the Contract Documents.
5. DRAWING STATUS

   P : **PRELIMINARY** - Evolving drawings for approvals,Tenders, Billings, etc.

   C : **CONSTRUCTION** - Fully developed drawings issued under instruction for construction.

ONLY STATUS C DRAWINGS TO BE USED FOR CONSTRUCTION.

6. SUITABILITY CODE

   WORK IN PROGRESS:

   S0 - Work in progress

   SHARED (NON-CONTRACTUAL):

   S1 - For coordination, **S2** - For information, **S3** - For internal review and comment, **S4** - For construction approval.

   DOCUMENTATION (FOR CONTRACTOR PURPOSES):

   D1 - For costing, **D2** - For Tender, **D3** - For contractor design, **D4** - For manufacture / procurement.

   CONSTRUCTION:

   A - For construction, **B** - For construction but with comments (i.e. areas in abeyance), **C** - Comprehensive revisions required.

6 Existing details shown on this drawing including kerblines, sewerage pipework, stub connections, levels & inverts etc. Must be confirmed on site by the contractor for their accuracy. If any discrepancies occur the engineer must be informed.

7 The proposed building outlines shown on this drawing are indicative only. Refer to architects layouts for exact external outline of proposed blds.

8 External rain water pipes, & internal svp's, ss's, dp's & floor gully locations/connections etc. Shown on this drawing are approximate/ indicative only. Refer to archs drgs for their exact locations & types.

9 All external adoptable storm pipework & lateral connections shown falls of 1:120 unless stated otherwise.

10 All external private storm pipework & lateral connections shown on this drawing are to be 100Ø & are to have minimum falls of 1:100 unless stated otherwise. All external private foul pipework & lateral connections shown on this drg are to be 100Ø & are to have minimum falls of 1:80 unless stated otherwise.

11 Existing adopted/non-adopted storm & foul water mh's & sewers which have been made redundant by new storm/foul systems, shall be abandoned/removed. Existing sewer & manholes are to be abandoned/ /removed in compliance with L.A. specifications.

12 Cover levels shown on this drawing are approximate & are to be adjusted to suit finished pavement levels on site by contractor. Covers shall be orientated to suit pavement finishes.

13 UNDERSLAB DRAINAGE CONNECTIONS:

a) All underslab foul connections upto first external inspection chamber/ manhole are to be 100Ø & are to have a minimum fall of 1:40 unless stated otherwise. After first external inspection chamber/manhole connections are to be 100Ø & have a minimum fall of 1:80 unless stated otherwise.

b) All underslab storm connections upto first external inspection chamber/ manhole are to be 100Ø & are to have a minimum fall of 1:40 unless stated otherwise. After first external inspection chamber/manhole connections are to be 100Ø & have a minimum fall of 1:100 unless stated otherwise.

c) Final orientation & position of first external chambers receiving underslab connections are to be determined on site by contractor.

d) Bends along underslab connections are to be long radius 5-45°. Bends at bottom of stacks/soil vent pipes are to be long radius 90°.

e) All under slab drainage connections are to be clear of unit foundations unless unavoidable. Refer to CRH structural drawings for exact location of unit foundations.

f) Finished underslab drainage route connections ie. Bend & straight combinations are to be determined on site to suit the number of bends in each connection is to be kept to a minimum.

14 All adoptable storm sewerage runs to be laid soffit to soffit unless stated otherwise. All Adoptable foul sewerage runs to be laid soffit to soffit unless stated otherwise. All non-adoptable storm/foul sewerage to be laid soffit to soffit unless stated otherwise.

15 External rainwater pipes are to be roddable above ground (refer to details).

16 All works are non-adoptable unless stated otherwise.

17 Adoptable pipe work to be concrete or unified clay.

18 Class Z concrete encasement required where vertical clearance between two pipes is less than 300mm.

19 For the provision of land drainage if required refer to landscape architect for details/specification.

20 At least one soil pipe at at the head of each run shall vent to the atmosphere.

21 All adoptable drainage shown on this drawing shall be constructed in accordance with water authorities association sewers for adoption 7th edition.

LEGEND

PROPOSED STORM WATER SEWER
PROPOSED STORM WATER MANHOLE AND SEWER.
RWP — PROPOSED RAIN WATER PIPE
IC — PROPOSED STORM WATER INSPECTION CHAMBER.
G — PROPOSED STORM WATER GULLY.
IL 35.650 — PROPOSED STORM WATER PIPE INVERT LEVEL MARKER
LINEAR CHANNEL — PROPOSED LINEAR CHANNEL AND SUMP
PROPOSED COMBINED WATER MANHOLE AND SEWER
STORAGE TANK
150Ø 1:100/10m — PIPE INFO: PIPE DIA. FALL OF PIPE-LENGTH.
DIRECTION OF FLOW ALONG PIPE
3m 3m — EXISTING THAMES COMBINED WATER SEWER WITH 6m WIDE EASMENT
EXTENT OF BUILDING BASEMENT
PROPOSED SITE BOUNDARY
ALTERNATIVE COMBINED WATER SEWER ROUTE

*CIPC - DENOTES CAST IN PILE CAP
*CIGB - DENOTES CAST IN GROUND BEAM
*CTGB - DENOTES CUT THROUGH GROUND BEAM AND CELLCORE LOCALLY REMOVED

NOTE:
ALL PIPES TO PASS BENEATH GROUND BEAMS AND PILECAPS UNLESS NOTED OTHERWISE

Status/Rev	Description	Date	By
P3	ISSUED FOR TENDER	01.12.16	ST
P2	ISSUED FOR TENDER	28.06.16	MG
P1	ISSUED FOR INFORMATION	24.03.16	MG

CampbellReith
consulting engineers

LONDON	020 7340 1700 ☐	☐	MANCHESTER	0161 819 3060
SURREY	01737 784 500 ■	☐	BIRMINGHAM	01675 467 484
BRISTOL	0117 916 1066 ☐	☐	DUBAI	00 971 4345 7088

www.campbellreith.com

Job Title: GREENWOOD CENTRE

Client: KIER

PROPOSED STORM WATER DRAINAGE LAYOUT

drawn	date	scale @ A0	C1 checked	CR Project No.
MG	JUN'16	1:100	RAI	12291

Drg No.	Suitability	Status/Revision
12291-CRH-GC-XX-DR-C-5055	D2	P3

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)	100	PIMP (%)	100
M5-60 (mm)	20.800	Add Flow / Climate Change (%)	0
Ratio R	0.441	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	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

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
1.000	5.253	0.023	225.0	0.014	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	11.533	0.051	225.0	0.014	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	7.870	0.035	225.0	0.010	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	5.866	0.026	225.0	0.001	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	8.868	0.039	225.0	0.017	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	4.637	0.021	225.0	0.012	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	6.592	0.066	100.0	0.029	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	10.437	0.104	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.002	3.508	0.036	97.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.006	21.796	0.097	225.0	0.025	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	2.401	0.153	15.7	0.000	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.007	7.089	0.181	39.2	0.017	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	8.867	0.089	99.6	0.029	5.00	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)
1.000	50.00	5.10	35.515	0.014	0.0	0.0	0.0	0.87	34.5	1.9
1.001	50.00	5.32	35.492	0.028	0.0	0.0	0.0	0.87	34.5	3.8
1.002	50.00	5.47	35.440	0.038	0.0	0.0	0.0	0.87	34.5	5.2
1.003	50.00	5.59	35.405	0.039	0.0	0.0	0.0	0.87	34.5	5.3
1.004	50.00	5.76	35.379	0.056	0.0	0.0	0.0	0.87	34.5	7.6
1.005	50.00	5.83	35.265	0.068	0.0	0.0	0.0	1.04	73.8	9.2
2.000	50.00	5.11	35.600	0.029	0.0	0.0	0.0	1.00	17.8	3.9
2.001	50.00	5.28	35.534	0.029	0.0	0.0	0.0	1.00	17.8	3.9
2.002	50.00	5.34	35.430	0.029	0.0	0.0	0.0	1.02	18.0	3.9
1.006	50.00	6.18	35.244	0.123	0.0	0.0	0.0	1.04	73.8	16.6
3.000	50.00	5.02	35.500	0.000	0.0	0.0	0.0	1.96	15.4	0.0
1.007	50.00	6.23	35.147	0.140	0.0	0.0	0.0	2.52	178.1	18.9
4.000	50.00	5.15	35.340	0.029	0.0	0.0	0.0	1.01	17.8	3.9

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
4.001	13.469	0.135	99.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.000	3.035	0.379	8.0	0.000	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.008	6.599	0.120	55.0	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.000	6.187	0.041	150.9	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.009	2.253	0.271	8.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.010	8.803	0.325	27.1	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)
4.001	50.00	5.37	35.251	0.029	0.0	0.0	0.0	1.01	17.8	3.9
5.000	50.00	5.02	35.545	0.000	0.0	0.0	0.0	2.75	21.6	0.0
1.008	50.00	6.28	34.966	0.210	0.0	0.0	0.0	2.12	150.2	28.4
6.000	50.00	5.13	35.037	0.000	0.0	0.0	0.0	0.82	14.4	0.0
1.009	50.00	6.28	34.846	0.210	0.0	0.0	0.0	5.48	387.7	28.4
1.010	50.00	6.34	34.650	0.210	0.0	0.0	0.0	2.52	100.4	28.4

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	36.522	1.007	Open Manhole	450	1.000	35.515	225				
2	36.522	1.030	Open Manhole	450	1.001	35.492	225	1.000	35.492	225	
3	36.522	1.082	Open Manhole	450	1.002	35.440	225	1.001	35.440	225	
4	36.522	1.117	Open Manhole	450	1.003	35.405	225	1.002	35.405	225	
5	36.522	1.143	Open Manhole	1200	1.004	35.379	225	1.003	35.379	225	
6	36.522	1.257	Open Manhole	1200	1.005	35.265	300	1.004	35.340	225	
7	36.522	0.922	Open Manhole	450	2.000	35.600	150				
8	36.522	0.988	Open Manhole	450	2.001	35.534	150	2.000	35.534	150	
9	36.522	1.092	Open Manhole	450	2.002	35.430	150	2.001	35.430	150	
10	36.522	1.278	Open Manhole	1200	1.006	35.244	300	1.005	35.244	300	1
								2.002	35.394	150	
11	36.522	1.022	Open Manhole	450	3.000	35.500	100				
12	36.522	1.375	Open Manhole	1200	1.007	35.147	300	1.006	35.147	300	
								3.000	35.347	100	
13	36.522	1.182	Open Manhole	450	4.000	35.340	150				
14	36.522	1.271	Open Manhole	450	4.001	35.251	150	4.000	35.251	150	
15	36.522	0.977	Open Manhole	450	5.000	35.545	100				
16	36.522	1.556	Open Manhole	1200	1.008	34.966	300	1.007	34.966	300	
								4.001	35.116	150	
								5.000	35.166	100	
17	36.522	1.485	Junction	0	6.000	35.037	150				
18	36.522	1.676	Open Manhole	1200	1.009	34.846	300	1.008	34.846	300	
								6.000	34.996	150	
CWMH	36.522	1.947	Open Manhole	1200	1.010	34.650	225	1.009	34.575	300	
	36.575	2.250	Open Manhole	0		OUTFALL		1.010	34.325	225	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	1	36.522	35.515	0.782	Open Manhole	450
1.001	o	225	2	36.522	35.492	0.805	Open Manhole	450
1.002	o	225	3	36.522	35.440	0.857	Open Manhole	450
1.003	o	225	4	36.522	35.405	0.892	Open Manhole	450
1.004	o	225	5	36.522	35.379	0.918	Open Manhole	1200
1.005	o	300	6	36.522	35.265	0.957	Open Manhole	1200
2.000	o	150	7	36.522	35.600	0.772	Open Manhole	450
2.001	o	150	8	36.522	35.534	0.838	Open Manhole	450
2.002	o	150	9	36.522	35.430	0.942	Open Manhole	450
1.006	o	300	10	36.522	35.244	0.978	Open Manhole	1200
3.000	o	100	11	36.522	35.500	0.922	Open Manhole	450
1.007	o	300	12	36.522	35.147	1.075	Open Manhole	1200
4.000	o	150	13	36.522	35.340	1.032	Open Manhole	450
4.001	o	150	14	36.522	35.251	1.121	Open Manhole	450
5.000	o	100	15	36.522	35.545	0.877	Open Manhole	450
1.008	o	300	16	36.522	34.966	1.256	Open Manhole	1200
6.000	o	150	17	36.522	35.037	1.335	Junction	

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	5.253	225.0	2	36.522	35.492	0.805	Open Manhole	450
1.001	11.533	225.0	3	36.522	35.440	0.857	Open Manhole	450
1.002	7.870	225.0	4	36.522	35.405	0.892	Open Manhole	450
1.003	5.866	225.0	5	36.522	35.379	0.918	Open Manhole	1200
1.004	8.868	225.0	6	36.522	35.340	0.957	Open Manhole	1200
1.005	4.637	225.0	10	36.522	35.244	0.978	Open Manhole	1200
2.000	6.592	100.0	8	36.522	35.534	0.838	Open Manhole	450
2.001	10.437	100.0	9	36.522	35.430	0.942	Open Manhole	450
2.002	3.508	97.4	10	36.522	35.394	0.978	Open Manhole	1200
1.006	21.796	225.0	12	36.522	35.147	1.075	Open Manhole	1200
3.000	2.401	15.7	12	36.522	35.347	1.075	Open Manhole	1200
1.007	7.089	39.2	16	36.522	34.966	1.256	Open Manhole	1200
4.000	8.867	99.6	14	36.522	35.251	1.121	Open Manhole	450
4.001	13.469	99.4	16	36.522	35.116	1.256	Open Manhole	1200
5.000	3.035	8.0	16	36.522	35.166	1.256	Open Manhole	1200
1.008	6.599	55.0	18	36.522	34.846	1.376	Open Manhole	1200
6.000	6.187	150.9	18	36.522	34.996	1.376	Open Manhole	1200

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.009	o	300	18	36.522	34.846	1.376	Open Manhole	1200
1.010	o	225	CWMH	36.522	34.650	1.647	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.009	2.253	8.3	CWMH	36.522	34.575	1.647	Open Manhole	1200
1.010	8.803	27.1		36.575	34.325	2.025	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.014	0.014	0.014
1.001	User	-	100	0.014	0.014	0.014
1.002	User	-	100	0.010	0.010	0.010
1.003	User	-	100	0.001	0.001	0.001
1.004	User	-	100	0.017	0.017	0.017
1.005	User	-	100	0.012	0.012	0.012
2.000	User	-	100	0.029	0.029	0.029
2.001	-	-	100	0.000	0.000	0.000
2.002	-	-	100	0.000	0.000	0.000
1.006	User	-	100	0.025	0.025	0.025
3.000	-	-	100	0.000	0.000	0.000
1.007	User	-	100	0.007	0.007	0.007
	User	-	100	0.011	0.011	0.017
4.000	User	-	100	0.029	0.029	0.029
4.001	-	-	100	0.000	0.000	0.000
5.000	-	-	100	0.000	0.000	0.000
1.008	User	-	100	0.010	0.010	0.010
	User	-	100	0.032	0.032	0.041
6.000	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.210	0.210	0.210

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)
1.010		36.575	34.325	34.525	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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FSR	Profile Type Summer
Return Period (years)		100	Cv (Summer) 0.750
Region	England and Wales		Cv (Winter) 0.840
M5-60 (mm)	20.800	Storm Duration (mins)	30
Ratio R	0.441		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 18, DS/PN: 1.009, Volume (m³): 2.4

Unit Reference	MD-SHE-0163-1330-1200-1330
Design Head (m)	1.200
Design Flow (l/s)	13.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	163
Invert Level (m)	34.846
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	13.3	Kick-Flo®	0.801	11.0
Flush-Flo™	0.364	13.3	Mean Flow over Head Range	-	11.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.8	0.800	11.0	2.000	16.9	4.000	23.6	7.000	30.9
0.200	12.5	1.000	12.2	2.200	17.7	4.500	25.0	7.500	31.9
0.300	13.2	1.200	13.3	2.400	18.5	5.000	26.3	8.000	32.9
0.400	13.3	1.400	14.3	2.600	19.2	5.500	27.5	8.500	33.9
0.500	13.1	1.600	15.2	3.000	20.6	6.000	28.7	9.000	34.9
0.600	12.8	1.800	16.1	3.500	22.1	6.500	29.8	9.500	35.8

Storage Structures for Storm

Tank or Pond Manhole: 17, DS/PN: 6.000

Invert Level (m) 35.037

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	80.0	0.400	80.0	0.401	0.0

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

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.800
Region	England and Wales	Ratio R	0.441
Cv (Summer)	0.750		
Cv (Winter)	0.840		

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)	1, 30, 100
Climate Change (%)	0, 0, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	1	15 Winter	1	+0%	30/15 Winter				35.561	-0.179	0.000	0.08
1.001	2	15 Winter	1	+0%	30/15 Summer				35.546	-0.171	0.000	0.13
1.002	3	15 Winter	1	+0%	30/15 Summer				35.507	-0.159	0.000	0.19
1.003	4	15 Winter	1	+0%	30/15 Summer				35.476	-0.155	0.000	0.20
1.004	5	15 Winter	1	+0%	30/15 Summer				35.458	-0.147	0.000	0.26
1.005	6	15 Winter	1	+0%	30/15 Summer				35.358	-0.207	0.000	0.18
2.000	7	15 Winter	1	+0%	30/15 Winter				35.655	-0.095	0.000	0.29
2.001	8	15 Winter	1	+0%	30/15 Summer				35.588	-0.096	0.000	0.27
2.002	9	15 Winter	1	+0%	30/15 Summer				35.493	-0.086	0.000	0.37
1.006	10	15 Winter	1	+0%	30/15 Summer				35.345	-0.199	0.000	0.25
3.000	11	60 Winter	1	+0%	30/15 Summer				35.500	-0.100	0.000	0.00
1.007	12	15 Winter	1	+0%	30/15 Summer				35.261	-0.186	0.000	0.17
4.000	13	15 Winter	1	+0%	30/15 Summer				35.394	-0.096	0.000	0.28
4.001	14	15 Winter	1	+0%	30/15 Summer				35.304	-0.097	0.000	0.26
5.000	15	60 Winter	1	+0%	30/15 Winter				35.545	-0.100	0.000	0.00
1.008	16	15 Winter	1	+0%	30/15 Summer				35.252	-0.013	0.000	0.30
6.000	17	15 Winter	1	+0%	30/15 Summer				35.081	-0.106	0.000	0.18
1.009	18	15 Winter	1	+0%	1/15 Summer				35.240	0.094	0.000	0.10
1.010	CWMH	60 Summer	1	+0%					34.711	-0.164	0.000	0.16

PN	US/MH Name	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1		2.1	OK	
1.001	2		3.8	OK	
1.002	3		5.2	OK	
1.003	4		5.3	OK	
1.004	5		7.4	OK	
1.005	6		8.8	OK	
2.000	7		4.4	OK	
2.001	8		4.3	OK	

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

PN	US/MH Name	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
2.002	9		4.4	OK	
1.006	10		16.1	OK	
3.000	11		0.0	OK	
1.007	12		17.7	OK	
4.000	13		4.3	OK	
4.001	14		4.3	OK	
5.000	15		0.0	OK	
1.008	16		26.0	OK	
6.000	17		2.2	OK*	
1.009	18		13.3	SURCHARGED	
1.010	CWMH		13.3	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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.800	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.441	Cv (Winter) 0.840

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)	1, 30, 100
Climate Change (%)	0, 0, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	1	15 Winter	30	+0%	30/15 Winter				35.774	0.034	0.000	0.19
1.001	2	15 Winter	30	+0%	30/15 Summer				35.770	0.054	0.000	0.33
1.002	3	15 Winter	30	+0%	30/15 Summer				35.759	0.094	0.000	0.47
1.003	4	15 Winter	30	+0%	30/15 Summer				35.749	0.118	0.000	0.47
1.004	5	15 Winter	30	+0%	30/15 Summer				35.740	0.136	0.000	0.62
1.005	6	15 Winter	30	+0%	30/15 Summer				35.723	0.158	0.000	0.36
2.000	7	15 Winter	30	+0%	30/15 Winter				35.781	0.031	0.000	0.70
2.001	8	15 Winter	30	+0%	30/15 Summer				35.760	0.076	0.000	0.62
2.002	9	15 Winter	30	+0%	30/15 Summer				35.730	0.150	0.000	0.76
1.006	10	15 Winter	30	+0%	30/15 Summer				35.716	0.173	0.000	0.48
3.000	11	15 Winter	30	+0%	30/15 Summer				35.683	0.083	0.000	0.02
1.007	12	15 Winter	30	+0%	30/15 Summer				35.683	0.236	0.000	0.33
4.000	13	15 Winter	30	+0%	30/15 Summer				35.731	0.241	0.000	0.61
4.001	14	15 Winter	30	+0%	30/15 Summer				35.700	0.299	0.000	0.57
5.000	15	15 Winter	30	+0%	30/15 Winter				35.665	0.020	0.000	0.01
1.008	16	15 Winter	30	+0%	30/15 Summer				35.665	0.399	0.000	0.62
6.000	17	30 Winter	30	+0%	30/15 Summer				35.319	0.132	0.000	0.96
1.009	18	15 Winter	30	+0%	1/15 Summer				35.634	0.489	0.000	0.10
1.010	CWMH	60 Summer	30	+0%					34.711	-0.164	0.000	0.16

PN	US/MH Name	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1		4.7	SURCHARGED	
1.001	2		9.8	SURCHARGED	
1.002	3		12.9	SURCHARGED	
1.003	4		12.3	SURCHARGED	
1.004	5		17.5	SURCHARGED	
1.005	6		17.4	SURCHARGED	
2.000	7		10.5	SURCHARGED	
2.001	8		9.8	SURCHARGED	

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

PN	US/MH Name	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
2.002	9		9.0	SURCHARGED	
1.006	10		31.3	SURCHARGED	
3.000	11		0.2	SURCHARGED	
1.007	12		35.6	SURCHARGED	
4.000	13		9.5	SURCHARGED	
4.001	14		9.3	SURCHARGED	
5.000	15		0.2	SURCHARGED	
1.008	16		53.6	SURCHARGED	
6.000	17		12.2	SURCHARGED*	
1.009	18		13.3	SURCHARGED	
1.010	CWMH		13.3	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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.800	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.441	Cv (Winter) 0.840

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)	1, 30, 100
Climate Change (%)	0, 0, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	1	15 Winter	100	+20%	30/15 Winter				36.475	0.735	0.000	0.24
1.001	2	15 Winter	100	+20%	30/15 Summer				36.470	0.753	0.000	0.41
1.002	3	15 Winter	100	+20%	30/15 Summer				36.453	0.788	0.000	0.60
1.003	4	15 Winter	100	+20%	30/15 Summer				36.437	0.807	0.000	0.63
1.004	5	15 Winter	100	+20%	30/15 Summer				36.425	0.820	0.000	0.75
1.005	6	15 Winter	100	+20%	30/15 Summer				36.400	0.835	0.000	0.51
2.000	7	15 Winter	100	+20%	30/15 Winter				36.520	0.770	0.000	0.86
2.001	8	15 Winter	100	+20%	30/15 Summer				36.483	0.799	0.000	0.79
2.002	9	15 Winter	100	+20%	30/15 Summer				36.427	0.848	0.000	1.05
1.006	10	15 Winter	100	+20%	30/15 Summer				36.392	0.848	0.000	0.69
3.000	11	15 Winter	100	+20%	30/15 Summer				36.343	0.743	0.000	0.04
1.007	12	15 Winter	100	+20%	30/15 Summer				36.344	0.897	0.000	0.47
4.000	13	15 Winter	100	+20%	30/15 Summer				36.452	0.962	0.000	0.87
4.001	14	15 Winter	100	+20%	30/15 Summer				36.395	0.994	0.000	0.80
5.000	15	15 Winter	100	+20%	30/15 Winter				36.315	0.670	0.000	0.02
1.008	16	15 Winter	100	+20%	30/15 Summer				36.317	1.051	0.000	0.88
6.000	17	30 Winter	100	+20%	30/15 Summer				35.438	0.251	0.000	0.84
1.009	18	15 Winter	100	+20%	1/15 Summer				36.222	1.077	0.000	0.11
1.010	CWMH	15 Winter	100	+20%					34.713	-0.162	0.000	0.18

PN	US/MH Name	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1		6.2	FLOOD RISK	
1.001	2		12.1	FLOOD RISK	
1.002	3		16.7	FLOOD RISK	
1.003	4		16.5	FLOOD RISK	
1.004	5		21.1	FLOOD RISK	
1.005	6		24.2	FLOOD RISK	
2.000	7		12.9	FLOOD RISK	
2.001	8		12.5	FLOOD RISK	

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

PN	US/MH Name	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
2.002	9		12.4	FLOOD RISK	
1.006	10		44.6	FLOOD RISK	
3.000	11		0.4	FLOOD RISK	
1.007	12		50.1	FLOOD RISK	
4.000	13		13.6	FLOOD RISK	
4.001	14		13.1	FLOOD RISK	
5.000	15		0.4	FLOOD RISK	
1.008	16		76.6	FLOOD RISK	
6.000	17		10.7	SURCHARGED*	
1.009	18		14.1	FLOOD RISK	
1.010	CWMH		14.1	OK	