Technical Note

Project: Cambridge North Development

Subject: Flood Risk Assessment Addendum

Client:	Brookgate Land Limited	**Version:**	D
Project No:	05425	**Author:**	JG
Date:	13/10/2022	**Approved:**	MC

1 Introduction

1.1.1 PJA has been commissioned by Brookgate Land Limited to prepare an addendum to the Cambridge North Development Flood Risk Assessment and Drainage Strategy (document ref. 05425-R-03-C-FRA) issued in June 2022 and submitted as part of the planning application for the mixed-use development at Land North of Cambridge North Station, Milton Avenue, Cambridge (planning ref. 22/02771/OUT).

1.1.2 This addendum addresses the comments received from Cambridgeshire County Council (CCC) in their role as the Lead Local Flood Authority (LLFA) and comments received from Cambridge City Council's Sustainable Drainage Engineer. Appendix A contains a copy of the LLFA comments letter (document ref. 201107945) and Appendix B contains a copy of the Cambridge City Council consultation response.

1.1.3 Further information regarding modifications to the drainage strategy and the opportunity to incorporate rainwater harvesting techniques at the development site are also set out in this addendum.

2 Climate Change Allowances

2.1.1 The first comment from the LLFA requires the surface water management scheme to incorporate climate change allowances for the 3.3% annual exceedance probability event (1 in 30 year event) in accordance with the recently updated climate change estimates.

2.1.2 As set out in the FRA and Drainage Strategy (paragraph 6.6.5) the climate change allowances applied to the 1% annual exceedance probability events are based on the expected lifetime of the development. A 20% climate change allowance was therefore used for the commercial, retail, and laboratory uses. For the residential area, further measures in the form of sunken areas

in the central courtyard were proposed to provide additional storage to accommodate the effects of a 40% climate change allowance.

2.1.3 The updated peak rainfall intensity climate change allowances vary by Management Catchment. The site lies within the Cam and Ely Ouse Management Catchment. For development with a lifetime of between 2061 and 2100, the central climate change allowances for the 2070s epoch should be used; this applies to the commercial, retail, and laboratory uses.

2.1.4 The central climate change allowances for the 2070s epoch in the Cam and Ely Ouse Management Catchment are as follows:

- 3.3% annual exceedance event: 20%
- 1% annual exceedance event: 25%

2.1.5 The MicroDrainage models for the commercial, retail, and laboratory development have therefore been updated to include a 20% climate change allowance for the 3.3% annual exceedance probability events (previously a 0% allowance was used) and a 25% climate change allowance for the 1% annual exceedance probability events (previously a 20% allowance was used). The updated MicroDrainage model outputs are included at Appendix C.

2.1.6 The updated climate change allowances require additional storage to be provided in some parts of the development. The updated Drainage Strategy is included at Appendix D.

2.1.7 For development with a lifetime beyond 2100 (i.e. the residential development) the updated guidance still recommends that a 40% climate change allowance is used. The design principals set out in the FRA and Drainage Strategy for this aspect of the drainage strategy are therefore still applicable and do not need to be developed further at this stage. The MicroDrainage model has been updated to include an assessment of the effects of a 35% climate change allowance during the 3.3% annual exceedance events (see Appendix C).

3 First Public Drain Overflow Diversion

3.1.1 The Cambridge City Council consultation response states that the proposed diversion of the First Public Drain Overflow introduces a number of 90 degree bends, noting that this will likely impact upon the culvert capacity and risk of blockages.

3.1.2 The route of the diversion has been revised to create an alignment with angles of change in direction similar to, and where possible less acute than, those on the existing culvert (approx. 130°). By adjusting the alignment of the diversion and introducing an additional chamber along

the route, the angles have been increased to approx. 120°, 130°, and 150°. The revised route is shown on the updated Drainage Strategy (Appendix D).

3.1.3 To reduce the impact of the bends, bespoke design manholes should be installed at each bend. Design measures for these chambers shall include using oversized manholes with deep catchpits (minimum 500mm depth), high specification concrete benching to prevent scour and increased access hatch sizes to facilitate silt/debris removal. These manhole chambers will be specified at the detailed design stage.

3.1.4 The First Public Drain Overflow Culvert has been checked under surcharge conditions (surcharge to culvert soffit level) to ensure that flow from the site can discharge to the culvert during storm conditions without flooding occurring on the site. This is possible because of the elevation difference between the culvert and the proposed surface water drainage network on the site.

4 First Public Drain Overflow Condition Survey

4.1.1 Comments from both the LLFA and Cambridge City Council related to the condition of the drainage network downstream of the proposed points of discharge on-site. The Drainage Strategy proposes to discharge surface water run-off into the First Public Drain overflow culvert, which crosses the site from west to east before continuing east beneath the railway line to outfall to the River Cam.

4.1.2 The consultees requested confirmation that the downstream network (between the proposed points of discharge and the River Cam outfall) is in suitable condition to convey the proposed flows. Verifying the condition of the downstream network will require off-site survey work to be undertaken; this will require approvals from Network Rail and other landowners for access to the drainage network.

4.1.3 A drainage survey has been specified, the extent of which covers the following lengths:

I. Box Culvert beneath Railway Lines, dimensions 1.4m width by 1.1m height. A previous survey dated 2015 has identified silt and sediment build-up therefore jetting will be undertaken prior to the new survey. Approx length 50m.

II. Open Channel from Railway Lines to Fen Road. Approx length 190m.

III. Culverted section beneath Fen Road. Approx length 40m, dimensions unknown.

IV. Open Channel from Fen Road to River Cam. Approx length 260m

Total length approximately 540m.

4.1.4 Further discussions have been held with the LLFA Drainage Officer and it has been agreed that the LLFA will request for the details of the survey to be added as a pre-commencement condition to any planning permission for this application. Appendix E includes the relevant correspondence.

4.1.5 The developer has agreed to the following statement which could be applied as a condition of planning:

> *Should the downstream condition survey of the culverted section of the First Public Drain overflow beneath the railway lines identify structural (or other defects) that require repair work then the developer agrees to address such defects, in liaison with the culvert owner. Defects identified as requiring repairs shall be defined in accordance with the Manual of Sewer Condition Classification 5th Edition (Sewer Rehabilitation Manual 5th edition scoring).*

5 Sustainable Drainage Systems

5.1.1 The Cambridge City Council consultation response notes that green roofs and permeable paving should be more widely used throughout the development. The Drainage Strategy drawing has been updated to show additional green roofs, rain gardens and areas of permeable paving/porous asphalt throughout the site, and further amendments have been made to the presentation of this information on the drawing in order to improve clarity.

5.1.2 The Cambridge City Council consultation response also requests that the CIRIA SuDS Manual Simple Index Method is applied to demonstrate that all discharges will meet the minimum water quality mitigation requirements.

5.1.3 Table 5-1 provides a summary of the land uses in each catchment and the associated pollution hazard levels and indices, as well the proposed surface water drainage features serving each catchment and their corresponding mitigation indices.

Table 5-1: Simple Index Method Assessment

Catchment	Land Use(s)	Pollution Hazard Level	Proposed Surface Water Drainage	Hazard/Mitigation Indices (C753 Tables 26.2 and 26.3)		
				TSS	Metals	Hydrocarbons
1	Residential, Commercial	Low	Pond	0.5	0.4	0.4
				0.7	0.7	0.5
2	Residential	Very Low	Bioretention (rain gardens)	Removal of gross solids and sediments only (C753 Table 4.3)		
				0.8	0.8	0.8
3	Commercial	Low	Swale	0.5	0.4	0.4
				0.5	0.6	0.6
4	Commercial, access roads, delivery areas	Medium	Bioretention (rain gardens)	0.7	0.6	0.7
				0.8	0.8	0.8
5	Commercial, access roads	Low	Pond	0.5	0.4	0.4
				0.7	0.7	0.5
6	Access roads	Low	Bioretention (rain gardens)	0.5	0.4	0.4
				0.8	0.8	0.8
7	Car park, access roads	Medium	Bioretention (rain gardens)	0.7	0.6	0.7
				0.8	0.8	0.8

5.1.4 The assessment above confirms that all discharges from the development meet the water quality mitigation requirements as set out in CIRIA C753 (The SuDS Manual).

6 Drainage Strategy Modifications

6.1.1 Following recent stakeholder consultation, it has been confirmed that the existing combined footway/cycleway running along the western side of the busway will be widened to improve the pedestrian and cyclist infrastructure in this area.

6.1.2 This reduces the space available for the proposed swale that was previously shown running parallel to the footway/cycleway. In the previous strategy the swale provided around 44% of the attenuation storage required for Catchment 1, with the remaining 56% provided in underground storage tanks beneath the busway.

6.1.3 The widening leaves only a limited area available between the proposed cycleway/footway and the wooded area to the west. To minimise the impact on tree roots in this area, and to retain as much of the existing Open Mosaic Habitat as possible, it is proposed that a swale will not be provided in this area. Attenuation storage for Catchment 1 will instead be provided entirely in underground tanks. The Drainage Strategy drawing has been updated to reflect this change (included at Appendix D).

6.1.4 The new tanks will be installed beneath the widened footway/cycleway. There is a 900mmØ oversized pipe associated with the surface water drainage system serving Cambridge North Station, One Cambridge Square and the busway that is located beneath the existing footway/cycleway. This pipe will be removed to accommodate the new tanks. The volume of the removed pipe will be reinstated as part of the total volume of the new tanks. The total tank volume is 740m³, comprising 660m³ for the Catchment 1 area and 80m³ to compensate for the volume in the 900mmØ pipe being removed.

6.1.5 The new footway/cycleway will be formed with a porous asphalt surface which will drain via an underlying granular layer directly into the tanks located underneath.

6.1.6 Surface water from the Catchment 1 drainage network will discharge to the existing surface water drainage system serving the Cambridge North Station, One Cambridge Square, and the busway.

7 Rainwater Harvesting

7.1.1 The FRA and Drainage Strategy noted the potential to incorporate rainwater harvesting and re-use measures, recommending further assessment at the detailed design stage.

7.1.2 This section provides an overview of one such potential rainwater harvesting system that could be incorporated into the proposed development. Refer to the Drainage Strategy in Appendix D for further information.

7.1.3 The rainwater harvesting system would be connected to the pond to the north of building S9. The inlet to the storage tank would be set at the design pond permanent water level and the outlet from the pond to the First Public Drain would be raised to ensure that incoming water fills the rainwater harvesting tank first before any discharge to the First Public Drain.

7.1.4 The rainwater harvesting tank could be installed in an area of open space near the pond, potentially beneath the temporary logistics area. Pumped outlets from the rainwater harvesting

tank would convey water across the site for irrigation of planted areas such as the Chesterton Gardens, Chesterton Square, and Swale Street (if required).

7.1.5 Utilising rainwater harvesting techniques can reduce the demand for potable water supply while also providing additional flood management benefits by reducing the volume of water discharged from the site.

Appendix A LLFA Consultation Response

My ref: FR/22-000248
Your ref: 22/02771/OUT
Date: 11/08/2022
Doc no: 201107945
Officer: **Harry Pickford**
E Mail: **harry.pickford@cambridgeshire.gov.uk**

Steve Cox: Executive Director
Place and Economy
Planning, Growth & Environment

New Shire Hall
Emery Crescent
Enterprise Campus
Alconbury Weald
PE28 4YE

Fiona Bradley
Greater Cambridge Shared Planning
South Cambridge Hall
Cambourne Business Park
CB23 6EA

Proposal: A hybrid planning application for: a) An outline application (all matters reserved apart from access and landscaping) for the construction of: three new residential blocks providing for up to 425 residential units and providing flexible Class E and Class F uses on the ground floor (excluding Class E (g) (iii)); and two commercial buildings for Use Classes E(g) i(offices), ii (research and development) providing flexible Class E and Class F uses on the ground floor (excluding Class E (g) (iii)),together with the construction of basements for parking and building services, car and cycle parking and infrastructure works. b) A full application for the construction of three commercial buildings for Use Classes E(g) i (offices) ii (research and development), providing flexible Class E and Class F uses on the ground floor (excluding Class E (g) (iii)) with associated car and cycle, the construction of a multi storey car and cycle park building, together with the construction of basements for parking and building services, car and cycle parking and associated landscaping, infrastructure works and demolition of existing structures

Land North Of Cambridge North Station Milton Avenue Cambridge Cambridgeshire

Comments from Lead Local Flood Authority (LLFA)

Dear Fiona,

Thank you for your consultation which we received on 24th July 2022.

At present we **object** to the grant of planning permission for the following reasons:

1. Climate Change Allowances
In accordance with the latest climate change peak rainfall intensity allowances, a climate change allowance should be incorporated into the surface water management scheme for the 3.3% annual exceedance probability rainfall event. The allowance used should be based on the lifetime of the development.

2. Downstream Network

The applicant proposes to discharge into the First Public Drain overflow culvert. It is not clear what the state of the downstream network is and whether this has capacity in the current state to receive these flows. Until it is clear that there is capacity in the downstream network to receive these flows, we are unable to support this application.

Informatives

Ordinary Watercourse Consent

Constructions or alterations within an ordinary watercourse (temporary or permanent) require consent from the Lead Local Flood Authority under the Land Drainage Act 1991. Ordinary watercourses include every river, drain, stream, ditch, dyke, sewer (other than public sewer) and passage through which water flows that do not form part of Main Rivers (Main Rivers are regulated by the Environment Agency). The applicant should refer to Cambridgeshire County Council's Culvert Policy for further guidance:

https://www.cambridgeshire.gov.uk/business/planning-and-development/water-minerals-and-waste/watercourse-management/

Please note the council does not regulate ordinary watercourses in Internal Drainage Board areas.

Pollution Control

Surface water and groundwater bodies are highly vulnerable to pollution and the impact of construction activities. It is essential that the risk of pollution (particularly during the construction phase) is considered and mitigated appropriately. It is important to remember that flow within the watercourse is likely to vary by season and it could be dry at certain times throughout the year. Dry watercourses should not be overlooked as these watercourses may flow or even flood following heavy rainfall.

Yours sincerely,

H Ellis

Hilary Ellis
Flood Risk Business Manager

If you have any queries regarding this application, please contact the Officer named at the top of this letter (contact details are above).

Please note: We are reliant on the accuracy and completeness of the reports in undertaking our review and can take no responsibility for incorrect data or interpretation made by the authors.

Appendix B Cambridge City Council Consultation Response

Planning Consultation Response
(Planning Applications)

Responding Officer:	**Rachel Veysey Sustainable Drainage Engineer**
Date:	**27/09/2022**
Planning Ref No:	**22/02771/OUT**
Description of Development:	**A hybrid planning application for: a) An outline application (all matters reserved apart from access and landscaping) for the construction of: three new residential blocks providing for up to 425 residential units and providing flexible Class E and Class F uses on the ground floor (excluding Class E (g) (iii)); and two commercial buildings for Use Classes E(g) i(offices), ii (research and development) providing flexible Class E and Class F uses on the ground floor (excluding Class E (g) (iii)),together with the construction of basements for parking and building services, car and cycle parking and infrastructure works. b) A full application for the construction of three commercial buildings for Use Classes E(g) i (offices) ii (research and development), providing flexible Class E and Class F uses on the ground floor (excluding Class E (g) (iii)) with associated car and cycle parking, the construction of a multi storey car and cycle park building, together with the construction of basements for parking and building services, car and cycle parking and associated landscaping, infrastructure works and demolition of existing structures. | Land North Of Cambridge North Station Milton Avenue Cambridge Cambridgeshire**

Cross one:

☐ The development proposed is **acceptable** subject to the imposition of the condition(s) outlined below.

☒ The development proposed is **unacceptable** and should be refused for the reason(s) set out below.

☐ It is not possible to comment on the proposed development and the additional information set out below will be required in order to provide comments.

Comments

The following documents have been reviewed in assessing this application:

Environmental Statement Volume 1 Main Report, Section 10 Flood Risk and Drainage (June 2022)

Appendix 10.1 Cambridge North Development Flood Risk Assessment and Drainage Strategy (June 2022)

1 Surface Water Drainage

Overall there are a number of deficiencies which need to be addressed by the applicant to ensure the development is policy compliant.

1.1 First Public Drain

Section 10.64 of the Environmental statement states that details of the First Public Drain Overflow downstream of the site were not available.

Previous investigations detailed that the culvert where it passes under the railway line would likely need some repairs. It must be shown at application stage that the discharge point is suitable by undertaking a condition survey of the downstream network or that there is an alternative viable discharge point.

There are proposals for a new alignment to part of the First Public Drain overflow where it passes under the development site. The alignment introduces a number of 90 degree bends. This is not satisfactory and has previously been raised in the pre applications stages as being unacceptable. It will likely impact on culvert capacity and increase the risk of blockage as well as likely speed up the rate of degradation to the existing culvert by introducing additional turbulence in the culvert under the railway line.

1.2 Climate change allowances

Reference is made to the use of a lower climate change allowance for some buildings. Whilst we recognise commercial buildings will be constructed with a shorter design life, following Eurocodes the design life will be at least 50 years, this means that it will be necessary to design for the building to still be in use up to year 2075. Commercial use buildings are now entering the 2070 climate change period (from 2061 onwards) and should use the relevant climate change allowances, there is not a scenario where it will be appropriate to use the lower 20% or 25% climate change allowance for modelling the 1% or 3.3% annual exceedance events. Additionally the 3.3% annual exceedance event must be incorporated into the surface water drainage scheme.

1.3 Discharge Rates

It is proposed that the majority of catchments discharge at 2l/s/ha with the exception of existing catchment area 5 which is set to 3.3l/s/ha This is acceptable and in line with current policy.

We would encourage the applicant to consider if any changes are proposed to catchment 5 that opportunities for betterment to the discharge rate must be provided.

1.4 SuDS

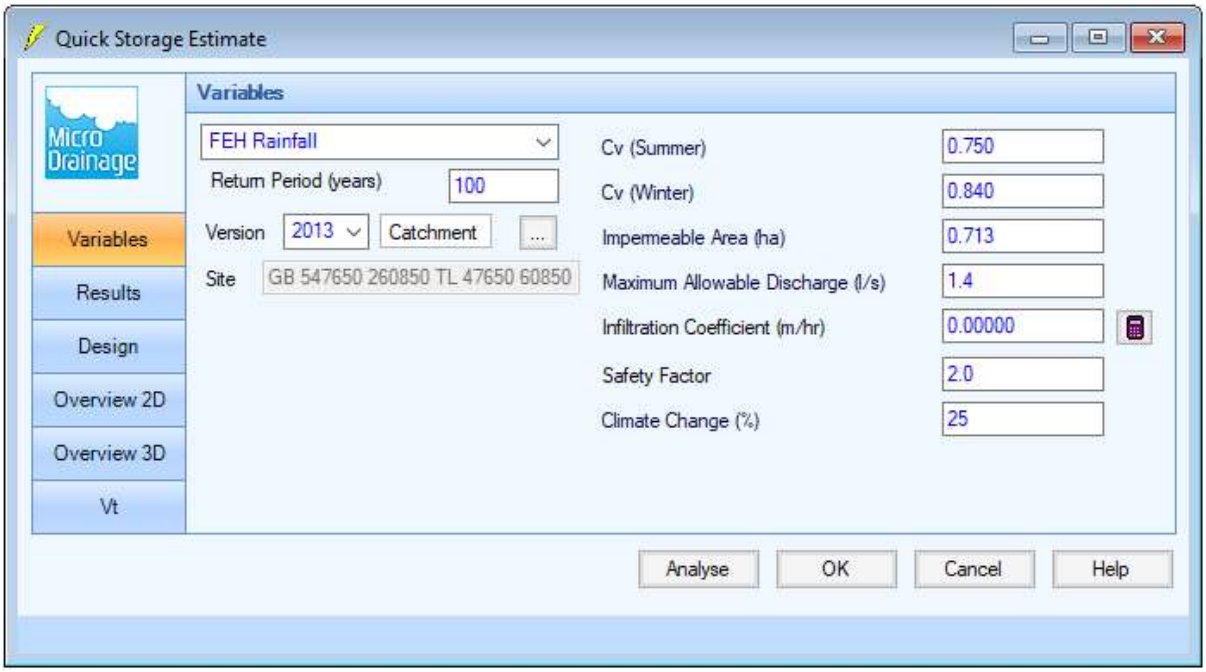
The design of the SuDS do not go far enough, this is a high density development therefore there should be a big emphasis on using interception storage wherever possible close to where rain falls. We see no reason why green roofs are not used more widely along with rain

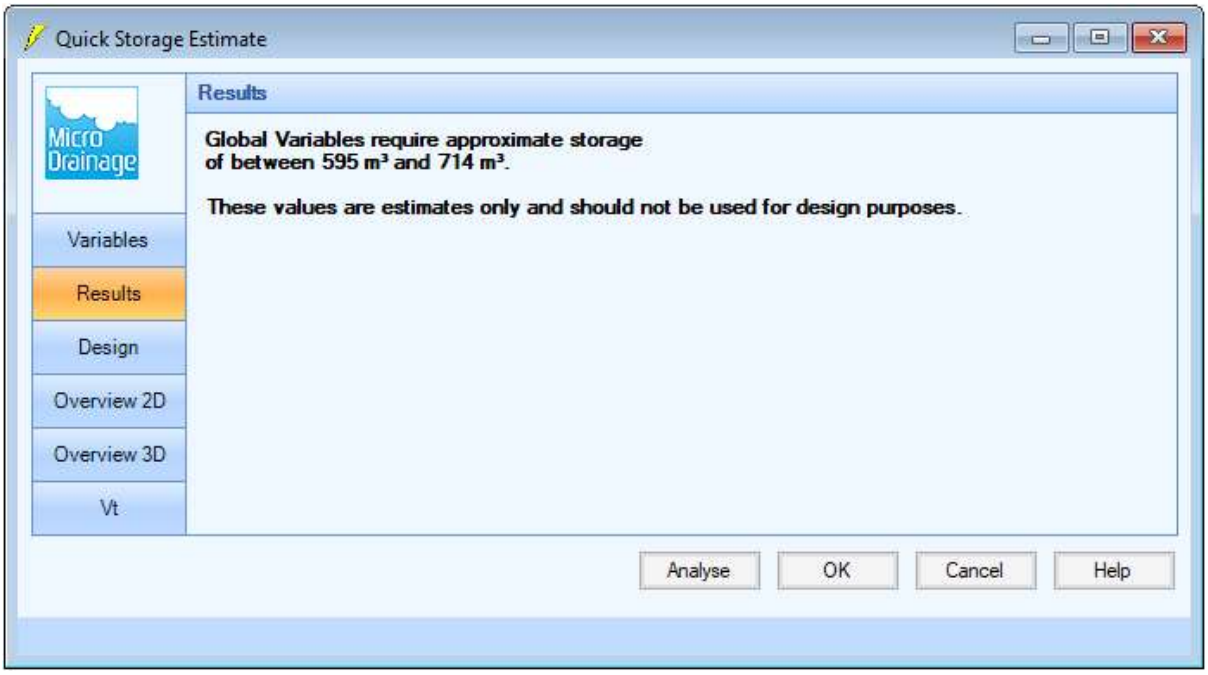
gardens and permeable paving which overall are lacking. There is still a large reliance of tanks, these appear very constrained and we are concerned with the deliverability of them without impacting on wider landscape proposals or SuDS measures. The need to use the site efficiently for sustainable drainage purposes should also be driving the building and landscape designs to some degree.

The approach to SuDS should seek to improve water quality before it goes into the First Public Drain which ultimately outfalls into the River Cam. The application will need to demonstrate using the CIRIA SuDS Manual Simple Index Assessment Method for water quality that all discharges will meet the minimum water quality mitigation requirements.

Appendix C MicroDrainage Output Reports

Catchment 1


Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Variables
FEH Rainfall
Return Period (years) 100
Version 2013
Catchment
...
Site GB 547650 260850 TL 47650 60850
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 0.713
Maximum Allowable Discharge (l/s) 1.4
Infiltration Coefficient (m/hr) 0.00000
Safety Factor 2.0
Climate Change (%) 25
Analyse
OK
Cancel
Help


Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Results
Global Variables require approximate storage
of between 595 m³ and 714 m³.
These values are estimates only and should not be used for design purposes.
Analyse
OK
Cancel
Help

Existing Network Details for Catchment 2

- Indicates pipe length does not match coordinates

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
1.000	55.000#	0.225	244.4	0.255	5.00	0.0	0.600	o	375	Pipe/Conduit
1.001	37.026	0.200	185.1	0.900	0.00	0.0	0.600	o	375	Pipe/Conduit
2.000	37.213	0.300	124.0	0.130	5.00	0.0	0.600	o	300	Pipe/Conduit
2.001	45.168	0.325	139.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit
1.002	121.860	0.160	761.6	0.340	0.00	0.0	0.600	o	375	Pipe/Conduit
1.003	22.445	0.220	102.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit

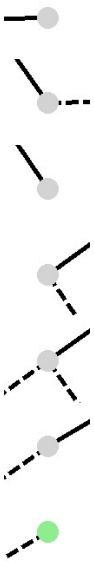
Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
1.000	5.725	0.255	0.0	1.15	127.5
1.001	5.500	1.155	0.0	1.33	146.7
2.000	6.000	0.130	0.0	1.41	99.7
2.001	5.700	0.130	0.0	1.33	94.1
1.002	5.300	1.625	0.0	0.65	71.7
1.003	5.140	1.625	0.0	0.99	17.6

Manhole Schedules for Catchment 2

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)
S101	6.500	0.775	Open Manhole	1200	1.000	5.725	375				
S102	6.500	1.000	Open Manhole	1200	1.001	5.500	375	1.000	5.500	375	
S103	7.200	1.200	Open Manhole	1200	2.000	6.000	300				
S104	7.200	1.500	Open Manhole	1200	2.001	5.700	300	2.000	5.700	300	
S105	6.500	1.200	Open Manhole	1200	1.002	5.300	375	1.001	5.300	375	
								2.001	5.375	300	
S106	6.500	1.360	Open Manhole	1200	1.003	5.140	150	1.002	5.140	375	
FPD	7.000	2.080	Open Manhole	0		OUTFALL		1.003	4.920	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S101	547445.102	260890.102	547445.102	260890.102	Required	
S102	547355.822	260888.402	547355.822	260888.402	Required	
S103	547318.715	260861.371	547318.715	260861.371	Required	
S104	547297.728	260892.101	547297.728	260892.101	Required	
S105	547334.337	260918.557	547334.337	260918.557	Required	
S106	547433.423	260989.493	547433.423	260989.493	Required	
FPD	547452.676	261001.029			No Entry	



PIPELINE SCHEDULES for Catchment 2

Upstream Manhole

- Indicates pipe length does not match coordinates

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	375	S101	6.500	5.725	0.400	Open Manhole	1200
1.001	o	375	S102	6.500	5.500	0.625	Open Manhole	1200
2.000	o	300	S103	7.200	6.000	0.900	Open Manhole	1200
2.001	o	300	S104	7.200	5.700	1.200	Open Manhole	1200
1.002	o	375	S105	6.500	5.300	0.825	Open Manhole	1200
1.003	o	150	S106	6.500	5.140	1.210	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)
1.000	55.000#	244.4	S102	6.500	5.500	0.625	Open Manhole	1200
1.001	37.026	185.1	S105	6.500	5.300	0.825	Open Manhole	1200
2.000	37.213	124.0	S104	7.200	5.700	1.200	Open Manhole	1200
2.001	45.168	139.0	S105	6.500	5.375	0.825	Open Manhole	1200
1.002	121.860	761.6	S106	6.500	5.140	0.985	Open Manhole	1200
1.003	22.445	102.0	FPD	7.000	4.920	1.930	Open Manhole	0

Surcharged Outfall Details for Catchment 2

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.003	FPD	7.000	4.920	4.500	0	0

Datum (m) 0.000 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1	5.482	19	5.482	37	5.482	55	5.482	73	5.482	91	5.482	109	5.482	127	5.482
2	5.482	20	5.482	38	5.482	56	5.482	74	5.482	92	5.482	110	5.482	128	5.482
3	5.482	21	5.482	39	5.482	57	5.482	75	5.482	93	5.482	111	5.482	129	5.482
4	5.482	22	5.482	40	5.482	58	5.482	76	5.482	94	5.482	112	5.482	130	5.482
5	5.482	23	5.482	41	5.482	59	5.482	77	5.482	95	5.482	113	5.482	131	5.482
6	5.482	24	5.482	42	5.482	60	5.482	78	5.482	96	5.482	114	5.482	132	5.482
7	5.482	25	5.482	43	5.482	61	5.482	79	5.482	97	5.482	115	5.482	133	5.482
8	5.482	26	5.482	44	5.482	62	5.482	80	5.482	98	5.482	116	5.482	134	5.482
9	5.482	27	5.482	45	5.482	63	5.482	81	5.482	99	5.482	117	5.482	135	5.482
10	5.482	28	5.482	46	5.482	64	5.482	82	5.482	100	5.482	118	5.482	136	5.482
11	5.482	29	5.482	47	5.482	65	5.482	83	5.482	101	5.482	119	5.482	137	5.482
12	5.482	30	5.482	48	5.482	66	5.482	84	5.482	102	5.482	120	5.482	138	5.482
13	5.482	31	5.482	49	5.482	67	5.482	85	5.482	103	5.482	121	5.482	139	5.482
14	5.482	32	5.482	50	5.482	68	5.482	86	5.482	104	5.482	122	5.482	140	5.482
15	5.482	33	5.482	51	5.482	69	5.482	87	5.482	105	5.482	123	5.482	141	5.482
16	5.482	34	5.482	52	5.482	70	5.482	88	5.482	106	5.482	124	5.482	142	5.482
17	5.482	35	5.482	53	5.482	71	5.482	89	5.482	107	5.482	125	5.482	143	5.482
18	5.482	36	5.482	54	5.482	72	5.482	90	5.482	108	5.482	126	5.482	144	5.482

Surcharged Outfall Details for Catchment 2

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
145	5.482	157	5.482	169	5.482	181	5.482	193	5.482	205	5.482	217	5.482	229	5.482
146	5.482	158	5.482	170	5.482	182	5.482	194	5.482	206	5.482	218	5.482	230	5.482
147	5.482	159	5.482	171	5.482	183	5.482	195	5.482	207	5.482	219	5.482	231	5.482
148	5.482	160	5.482	172	5.482	184	5.482	196	5.482	208	5.482	220	5.482	232	5.482
149	5.482	161	5.482	173	5.482	185	5.482	197	5.482	209	5.482	221	5.482	233	5.482
150	5.482	162	5.482	174	5.482	186	5.482	198	5.482	210	5.482	222	5.482	234	5.482
151	5.482	163	5.482	175	5.482	187	5.482	199	5.482	211	5.482	223	5.482	235	5.482
152	5.482	164	5.482	176	5.482	188	5.482	200	5.482	212	5.482	224	5.482	236	5.482
153	5.482	165	5.482	177	5.482	189	5.482	201	5.482	213	5.482	225	5.482	237	5.482
154	5.482	166	5.482	178	5.482	190	5.482	202	5.482	214	5.482	226	5.482	238	5.482
155	5.482	167	5.482	179	5.482	191	5.482	203	5.482	215	5.482	227	5.482	239	5.482
156	5.482	168	5.482	180	5.482	192	5.482	204	5.482	216	5.482	228	5.482	240	5.482

Simulation Criteria for Catchment 2

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Summer Storms	Yes
Return Period (years)	30	Winter Storms	No
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 547650 260850 TL 47650 60850	Cv (Winter)	0.840
Data Type	Catchment	Storm Duration (mins)	30

Online Controls for Catchment 2

Hydro-Brake® Optimum Manhole: S106, DS/PN: 1.003, Volume (m³): 14.9

Unit Reference	MD-SHE-0080-3200-1360-3200
Design Head (m)	1.360
Design Flow (l/s)	3.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	80
Invert Level (m)	5.140
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.360	3.2	Kick-Flo®	0.711	2.4
Flush-Flo™	0.350	3.0	Mean Flow over Head Range	-	2.7

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	2.3	0.800	2.5	2.000	3.8	4.000	5.3	7.000	6.9
0.200	2.8	1.000	2.8	2.200	4.0	4.500	5.6	7.500	7.1
0.300	2.9	1.200	3.0	2.400	4.2	5.000	5.9	8.000	7.3
0.400	2.9	1.400	3.2	2.600	4.3	5.500	6.1	8.500	7.5
0.500	2.9	1.600	3.4	3.000	4.6	6.000	6.4	9.000	7.7
0.600	2.7	1.800	3.6	3.500	5.0	6.500	6.6	9.500	7.9

Storage Structures for Catchment 2

Cellular Storage Manhole: S102, DS/PN: 1.001

Invert Level (m) 5.500 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)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	970.0	0.0	0.600	970.0	0.0	0.601	0.0	0.0

Cellular Storage Manhole: S106, DS/PN: 1.003

Invert Level (m) 5.200 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)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1140.0	0.0	0.800	1140.0	0.0	0.801	0.0	0.0

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Catchment
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 547650 260850 TL 47650 60850	Cv (Winter)	0.840

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
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 35, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	S101	15 minute 2 year Winter I+0%	6.500	5.882	-0.218	0.000	0.36		42.6	OK
1.001	S102	120 minute 2 year Winter I+0%	6.500	5.621	-0.254	0.000	0.23		30.4	OK
2.000	S103	15 minute 2 year Winter I+0%	7.200	6.099	-0.201	0.000	0.23		21.5	OK
2.001	S104	15 minute 2 year Winter I+0%	7.200	5.801	-0.199	0.000	0.24		21.3	OK
1.002	S105	15 minute 2 year Winter I+0%	6.500	5.583	-0.092	0.000	0.79		55.0	OK
1.003	S106	480 minute 2 year Winter I+0%	6.500	5.479	0.189	0.000	0.18		2.9	SURCHARGED

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Catchment
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 547650 260850 TL 47650 60850	Cv (Winter)	0.840

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
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 35, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	S101	15 minute 30 year Winter I+35%	6.500	6.151	0.051	0.000	1.09		129.3	SURCHARGED
1.001	S102	120 minute 30 year Winter I+35%	6.500	5.914	0.039	0.000	0.51		67.5	SURCHARGED
2.000	S103	15 minute 30 year Winter I+35%	7.200	6.357	0.057	0.000	0.73		67.4	SURCHARGED
2.001	S104	15 minute 30 year Winter I+35%	7.200	6.198	0.198	0.000	0.80		70.1	SURCHARGED
1.002	S105	15 minute 30 year Winter I+35%	6.500	6.032	0.357	0.000	1.57		108.6	SURCHARGED
1.003	S106	960 minute 30 year Winter I+35%	6.500	5.860	0.570	0.000	0.18		2.9	SURCHARGED

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Catchment
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 547650 260850 TL 47650 60850	Cv (Winter)	0.840

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
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 35, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	S101	15 minute 100 year Winter I+20%	6.500	6.261	0.161	0.000	1.28		151.8	FLOOD RISK
1.001	S102	120 minute 100 year Winter I+20%	6.500	6.016	0.141	0.000	0.58		77.4	SURCHARGED
2.000	S103	15 minute 100 year Winter I+20%	7.200	6.576	0.276	0.000	0.86		79.0	SURCHARGED
2.001	S104	15 minute 100 year Winter I+20%	7.200	6.358	0.358	0.000	0.92		81.3	SURCHARGED
1.002	S105	15 minute 100 year Winter I+20%	6.500	6.123	0.448	0.000	1.67		115.9	SURCHARGED
1.003	S106	960 minute 100 year Winter I+20%	6.500	5.992	0.702	0.000	0.18		2.9	SURCHARGED

Existing Network Details for C3, C4, C7

- Indicates pipe length does not match coordinates

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type
1.000	11.189	0.050	223.8	0.584	5.00	0.0	0.600		o	375	Pipe/Conduit
1.001	108.847	0.025	4353.9	0.000	0.00	0.0		0.035	\/	-1	Pipe/Conduit
1.002	39.925	0.075	532.3	0.000	0.00	0.0		0.035	\/	-1	Pipe/Conduit
2.000	36.091	0.150	240.6	1.154	5.00	0.0	0.600		o	375	Pipe/Conduit
1.003	61.223	0.025	2448.9	0.000	0.00	0.0		0.035	\/	-1	Pipe/Conduit
1.004	15.766	0.025	630.6	0.000	0.00	0.0	0.600		o	375	Pipe/Conduit
1.005	37.018	0.250	148.1	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit
1.006	3.845	0.025	153.8	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit
1.007	57.619#	0.105	548.8	0.000	0.00	0.0	0.600		o	900	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
1.000	5.100	0.584	0.0	1.21	133.3
1.001	5.050	0.584	0.0	0.34	1470.1
1.002	5.025	0.584	0.0	0.97	4204.3
2.000	5.100	1.154	0.0	1.16	128.5
1.003	4.950	1.738	0.0	0.45	1960.2
1.004	4.925	1.738	0.0	0.71	78.9
1.005	4.900	1.738	0.0	0.82	14.6
1.006	4.650	1.738	0.0	0.81	14.3
1.007	4.425	1.738	0.0	1.33	846.4

Manhole Schedules for C3, C4, C7

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)
S5	6.500	1.400	Open Manhole	1200	1.000	5.100	375				
SwaleA	6.250	1.200	Open Manhole	1	1.001	5.050	-1	1.000	5.050	375	
SwaleB	6.200	1.175	Open Manhole	1	1.002	5.025	-1	1.001	5.025	-1	
S8S9S10	6.500	1.400	Open Manhole	1200	2.000	5.100	375				
SwaleC	6.150	1.200	Open Manhole	1	1.003	4.950	-1	1.002	4.950	-1	
								2.000	4.950	375	
SwaleEnd	6.125	1.200	Open Manhole	1	1.004	4.925	375	1.003	4.925	-1	
FlowControl1	6.500	1.600	Open Manhole	1200	1.005	4.900	150	1.004	4.900	375	
Outfall	6.500	1.850	Open Manhole	1200	1.006	4.650	150	1.005	4.650	150	
FPDDiv1	6.500	2.075	Open Manhole	1800	1.007	4.425	900	1.006	4.625	150	
FPD	7.000	2.680	Open Manhole	0		OUTFALL		1.007	4.320	900	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S5	547488.260	260746.143	547488.260	260746.143	Required	
SwaleA	547478.608	260751.803	547478.608	260751.803	Required	
SwaleB	547519.471	260852.688	547519.471	260852.688	Required	
S8S9S10	547496.771	260894.067	547496.771	260894.067	Required	
SwaleC	547532.672	260890.367	547532.672	260890.367	Required	
SwaleEnd	547555.721	260947.086	547555.721	260947.086	Required	
FlowControl1	547571.045	260950.791	547571.045	260950.791	Required	
Outfall	547605.029	260936.114	547605.029	260936.114	Required	
FPDDiv1	547607.800	260938.779	547607.800	260938.779	Required	
FPD	547630.987	260868.930			No Entry	

PIPELINE SCHEDULES for C3, C4, C7

Upstream Manhole

- Indicates pipe length does not match coordinates

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	375	S5	6.500	5.100	1.025	Open Manhole	1200
1.001	\/	-1	SwaleA	6.250	5.050	0.000	Open Manhole	1
1.002	\/	-1	SwaleB	6.200	5.025	-0.025	Open Manhole	1
2.000	o	375	S8S9S10	6.500	5.100	1.025	Open Manhole	1200
1.003	\/	-1	SwaleC	6.150	4.950	0.000	Open Manhole	1
1.004	o	375	SwaleEnd	6.125	4.925	0.825	Open Manhole	1
1.005	o	150	FlowControl1	6.500	4.900	1.450	Open Manhole	1200
1.006	o	150	Outfall	6.500	4.650	1.700	Open Manhole	1200
1.007	o	900	FPDDiv1	6.500	4.425	1.175	Open Manhole	1800

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	11.189	223.8	SwaleA	6.250	5.050	0.825	Open Manhole	1
1.001	108.847	4353.9	SwaleB	6.200	5.025	-0.025	Open Manhole	1
1.002	39.925	532.3	SwaleC	6.150	4.950	0.000	Open Manhole	1
2.000	36.091	240.6	SwaleC	6.150	4.950	0.825	Open Manhole	1
1.003	61.223	2448.9	SwaleEnd	6.125	4.925	0.000	Open Manhole	1
1.004	15.766	630.6	FlowControl1	6.500	4.900	1.225	Open Manhole	1200
1.005	37.018	148.1	Outfall	6.500	4.650	1.700	Open Manhole	1200
1.006	3.845	153.8	FPDDiv1	6.500	4.625	1.725	Open Manhole	1800
1.007	57.619#	548.8	FPD	7.000	4.320	1.780	Open Manhole	0

Surcharged Outfall Details for C3, C4, C7

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.007	FPD	7.000	4.320	0.000	0	0

Datum (m) 0.000 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1	5.240	13	5.240	25	5.240	37	5.240	49	5.240	61	5.240	73	5.240	85	5.240
2	5.240	14	5.240	26	5.240	38	5.240	50	5.240	62	5.240	74	5.240	86	5.240
3	5.240	15	5.240	27	5.240	39	5.240	51	5.240	63	5.240	75	5.240	87	5.240
4	5.240	16	5.240	28	5.240	40	5.240	52	5.240	64	5.240	76	5.240	88	5.240
5	5.240	17	5.240	29	5.240	41	5.240	53	5.240	65	5.240	77	5.240	89	5.240
6	5.240	18	5.240	30	5.240	42	5.240	54	5.240	66	5.240	78	5.240	90	5.240
7	5.240	19	5.240	31	5.240	43	5.240	55	5.240	67	5.240	79	5.240	91	5.240
8	5.240	20	5.240	32	5.240	44	5.240	56	5.240	68	5.240	80	5.240	92	5.240
9	5.240	21	5.240	33	5.240	45	5.240	57	5.240	69	5.240	81	5.240	93	5.240
10	5.240	22	5.240	34	5.240	46	5.240	58	5.240	70	5.240	82	5.240	94	5.240
11	5.240	23	5.240	35	5.240	47	5.240	59	5.240	71	5.240	83	5.240	95	5.240
12	5.240	24	5.240	36	5.240	48	5.240	60	5.240	72	5.240	84	5.240	96	5.240

Surcharged Outfall Details for C3, C4, C7

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
97	5.240	115	5.240	133	5.240	151	5.240	169	5.240	187	5.240	205	5.240	223	5.240
98	5.240	116	5.240	134	5.240	152	5.240	170	5.240	188	5.240	206	5.240	224	5.240
99	5.240	117	5.240	135	5.240	153	5.240	171	5.240	189	5.240	207	5.240	225	5.240
100	5.240	118	5.240	136	5.240	154	5.240	172	5.240	190	5.240	208	5.240	226	5.240
101	5.240	119	5.240	137	5.240	155	5.240	173	5.240	191	5.240	209	5.240	227	5.240
102	5.240	120	5.240	138	5.240	156	5.240	174	5.240	192	5.240	210	5.240	228	5.240
103	5.240	121	5.240	139	5.240	157	5.240	175	5.240	193	5.240	211	5.240	229	5.240
104	5.240	122	5.240	140	5.240	158	5.240	176	5.240	194	5.240	212	5.240	230	5.240
105	5.240	123	5.240	141	5.240	159	5.240	177	5.240	195	5.240	213	5.240	231	5.240
106	5.240	124	5.240	142	5.240	160	5.240	178	5.240	196	5.240	214	5.240	232	5.240
107	5.240	125	5.240	143	5.240	161	5.240	179	5.240	197	5.240	215	5.240	233	5.240
108	5.240	126	5.240	144	5.240	162	5.240	180	5.240	198	5.240	216	5.240	234	5.240
109	5.240	127	5.240	145	5.240	163	5.240	181	5.240	199	5.240	217	5.240	235	5.240
110	5.240	128	5.240	146	5.240	164	5.240	182	5.240	200	5.240	218	5.240	236	5.240
111	5.240	129	5.240	147	5.240	165	5.240	183	5.240	201	5.240	219	5.240	237	5.240
112	5.240	130	5.240	148	5.240	166	5.240	184	5.240	202	5.240	220	5.240	238	5.240
113	5.240	131	5.240	149	5.240	167	5.240	185	5.240	203	5.240	221	5.240	239	5.240
114	5.240	132	5.240	150	5.240	168	5.240	186	5.240	204	5.240	222	5.240	240	5.240

Simulation Criteria for C3, C4, C7

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 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Summer Storms	Yes
Return Period (years)	30	Winter Storms	No
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 547650 260850 TL 47650 60850	Cv (Winter)	0.840
Data Type	Catchment	Storm Duration (mins)	30

Online Controls for C3, C4, C7

Hydro-Brake® Optimum Manhole: FlowControl1, DS/PN: 1.005, Volume (m³): 3.5

Unit Reference	MD-SHE-0084-3400-1225-3400
Design Head (m)	1.225
Design Flow (l/s)	3.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	84
Invert Level (m)	4.900
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.225	3.4	Kick-Flo®	0.753	2.7
Flush-Flo™	0.370	3.4	Mean Flow over Head Range	-	3.0

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	2.5	0.800	2.8	2.000	4.3	4.000	5.9	7.000	7.7
0.200	3.2	1.000	3.1	2.200	4.5	4.500	6.2	7.500	7.9
0.300	3.4	1.200	3.4	2.400	4.6	5.000	6.5	8.000	8.2
0.400	3.4	1.400	3.6	2.600	4.8	5.500	6.8	8.500	8.4
0.500	3.3	1.600	3.8	3.000	5.1	6.000	7.1	9.000	8.7
0.600	3.2	1.800	4.1	3.500	5.5	6.500	7.4	9.500	8.9

Storage Structures for C3, C4, C7

Cellular Storage Manhole: S8S9S10, DS/PN: 2.000

Invert Level (m) 5.100 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)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	330.0	0.0	0.800	330.0	0.0	0.801	0.0	0.0

Cellular Storage Manhole: FlowControl1, DS/PN: 1.005

Invert Level (m) 4.900 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)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	410.0	0.0	1.200	410.0	0.0	1.201	0.0	0.0

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C3, C4, C7

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Catchment
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location GB 547650 260850 TL 47650 60850		Cv (Winter)	0.840

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
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 20, 25

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.000	S5	15 minute 2 year Winter I+0%	6.500	5.398	-0.077	0.000	0.96		97.1
1.001	SwaleA	480 minute 2 year Winter I+0%	6.250	5.357	-0.893	0.000	0.00		12.2
1.002	SwaleB	480 minute 2 year Winter I+0%	6.200	5.357	-0.868	0.000	0.00		8.0
2.000	S8S9S10	480 minute 2 year Winter I+0%	6.500	5.358	-0.117	0.000	0.16		18.2
1.003	SwaleC	480 minute 2 year Winter I+0%	6.150	5.357	-0.793	0.000	0.01		22.7
1.004	SwaleEnd	480 minute 2 year Winter I+0%	6.125	5.356	0.056	0.000	0.41		18.5
1.005	FlowControl1	480 minute 2 year Winter I+0%	6.500	5.355	0.305	0.000	0.24		3.4
1.006	Outfall	240 minute 2 year Winter I+0%	6.500	5.245	0.445	0.000	1.68		18.2
1.007	FPDDiv1	240 minute 2 year Winter I+0%	6.500	5.241	-0.084	0.000	0.04		26.7

PN	US/MH Name	Status
1.000	S5	OK
1.001	SwaleA	OK
1.002	SwaleB	OK
2.000	S8S9S10	OK
1.003	SwaleC	OK
1.004	SwaleEnd	SURCHARGED
1.005	FlowControl1	SURCHARGED
1.006	Outfall	SURCHARGED
1.007	FPDDiv1	OK

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C3, C4, C7

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FEH Data Type	Catchment
FEH Rainfall Version		2013 Cv (Summer)	0.750
Site Location	GB 547650 260850 TL 47650 60850	Cv (Winter)	0.840

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
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 20, 25

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.000	S5	15 minute 30 year Winter I+20%	6.500	5.937	0.462	0.000	2.73		274.3
1.001	SwaleA	480 minute 30 year Winter I+20%	6.250	5.783	-0.467	0.000	0.01		29.8
1.002	SwaleB	480 minute 30 year Winter I+20%	6.200	5.783	-0.442	0.000	0.00		17.6
2.000	S8S9S10	480 minute 30 year Winter I+20%	6.500	5.786	0.311	0.000	0.42		48.9
1.003	SwaleC	480 minute 30 year Winter I+20%	6.150	5.783	-0.367	0.000	0.02		46.3
1.004	SwaleEnd	480 minute 30 year Winter I+20%	6.125	5.782	0.482	0.000	0.73		33.0
1.005	FlowControl1	480 minute 30 year Winter I+20%	6.500	5.781	0.731	0.000	0.22		3.2
1.006	Outfall	240 minute 30 year Winter I+20%	6.500	5.249	0.449	0.000	1.74		18.9
1.007	FPDDiv1	240 minute 30 year Winter I+20%	6.500	5.243	-0.082	0.000	0.04		27.8

PN	US/MH Name	Status
1.000	S5	SURCHARGED
1.001	SwaleA	OK
1.002	SwaleB	OK
2.000	S8S9S10	SURCHARGED
1.003	SwaleC	OK
1.004	SwaleEnd	SURCHARGED
1.005	FlowControl1	SURCHARGED
1.006	Outfall	SURCHARGED
1.007	FPDDiv1	OK

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C3, C4, C7

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FEH Data Type	Catchment
FEH Rainfall Version		2013 Cv (Summer)	0.750
Site Location	GB 547650 260850 TL 47650 60850	Cv (Winter)	0.840

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
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 20, 25

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.000	S5	15 minute 100 year Winter I+25%	6.500	6.402	0.927	0.000	3.70		372.3
1.001	SwaleA	480 minute 100 year Winter I+25%	6.250	6.105	-0.145	0.000	0.01		43.4
1.002	SwaleB	480 minute 100 year Winter I+25%	6.200	6.103	-0.122	0.000	0.01		18.4
2.000	S8S9S10	30 minute 100 year Winter I+25%	6.500	6.145	0.670	0.000	2.01		232.2
1.003	SwaleC	480 minute 100 year Winter I+25%	6.150	6.102	-0.048	0.000	0.02		56.4
1.004	SwaleEnd	480 minute 100 year Winter I+25%	6.125	6.086	0.786	0.000	0.83		37.4
1.005	FlowControl1	480 minute 100 year Winter I+25%	6.500	6.084	1.034	0.000	0.24		3.3
1.006	Outfall	120 minute 100 year Summer I+25%	6.500	5.249	0.449	0.000	0.31		3.4
1.007	FPDDiv1	120 minute 100 year Summer I+25%	6.500	5.243	-0.082	0.000	0.00		3.4

PN	US/MH Name	Status
1.000	S5	FLOOD RISK
1.001	SwaleA	FLOOD RISK
1.002	SwaleB	FLOOD RISK
2.000	S8S9S10	SURCHARGED
1.003	SwaleC	FLOOD RISK
1.004	SwaleEnd	FLOOD RISK
1.005	FlowControl1	SURCHARGED
1.006	Outfall	SURCHARGED
1.007	FPDDiv1	OK

Existing Network Details for C3, C4, C7

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type
1.000	11.189	0.050	223.8	0.584	5.00	0.0	0.600		o	375	Pipe/Conduit
1.001	108.847	0.025	4353.9	0.000	0.00	0.0		0.035	\/	-1	Pipe/Conduit
1.002	39.925	0.075	532.3	0.000	0.00	0.0		0.035	\/	-1	Pipe/Conduit
2.000	36.091	0.150	240.6	1.154	5.00	0.0	0.600		o	375	Pipe/Conduit
1.003	61.223	0.025	2448.9	0.000	0.00	0.0		0.035	\/	-1	Pipe/Conduit
1.004	15.766	0.025	630.6	0.000	0.00	0.0	0.600		o	375	Pipe/Conduit
1.005	37.018	0.250	148.1	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit
1.006	3.845	0.025	153.8	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit
1.007	11.921	0.025	476.8	0.000	0.00	0.0	0.600		o	900	Pipe/Conduit
1.008	45.698	0.080	571.2	0.000	0.00	0.0	0.600		o	900	Pipe/Conduit
3.000	45.110	0.050	902.2	0.817	5.00	0.0	0.600		o	450	Pipe/Conduit
3.001	5.364	0.041	130.8	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit
1.009	31.680	0.059	536.9	0.000	0.00	0.0	0.600		[]	-2	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
1.000	5.100	0.584	0.0	1.21	133.3
1.001	5.050	0.584	0.0	0.34	1470.1
1.002	5.025	0.584	0.0	0.97	4204.3
2.000	5.100	1.154	0.0	1.16	128.5
1.003	4.950	1.738	0.0	0.45	1960.2
1.004	4.925	1.738	0.0	0.71	78.9
1.005	4.900	1.738	0.0	0.82	14.6
1.006	4.650	1.738	0.0	0.81	14.3
1.007	4.425	1.738	0.0	1.43	908.5
1.008	4.400	1.738	0.0	1.30	829.4
3.000	4.650	0.817	0.0	0.67	106.4
3.001	4.350	0.817	0.0	0.88	15.5
1.009	4.309	2.555	0.0	1.63	2516.0

Manhole Schedules for C3, C4, C7

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)
S5	6.500	1.400	Open Manhole	1200	1.000	5.100	375				
SwaleA	6.250	1.200	Open Manhole	1	1.001	5.050	-1	1.000	5.050	375	
SwaleB	6.200	1.175	Open Manhole	1	1.002	5.025	-1	1.001	5.025	-1	
S8S9S10	6.500	1.400	Open Manhole	1200	2.000	5.100	375				
SwaleC	6.150	1.200	Open Manhole	1	1.003	4.950	-1	1.002	4.950	-1	
								2.000	4.950	375	
SwaleEnd	6.125	1.200	Open Manhole	1	1.004	4.925	375	1.003	4.925	-1	
FlowControl1	6.500	1.600	Open Manhole	1200	1.005	4.900	150	1.004	4.900	375	
Outfall	6.500	1.850	Open Manhole	1200	1.006	4.650	150	1.005	4.650	150	
FPDDiv1	6.500	2.075	Open Manhole	1800	1.007	4.425	900	1.006	4.625	150	
FPDDiv2	6.500	2.100	Open Manhole	1800	1.008	4.400	900	1.007	4.400	900	
S6S7	6.500	1.850	Open Manhole	1200	3.000	4.650	450				
FlowControl2	6.500	2.150	Open Manhole	1200	3.001	4.350	150	3.000	4.600	450	550
FPD	6.500	2.191	Open Manhole	1	1.009	4.309	-2	1.008	4.320	900	
								3.001	4.309	150	
FPD	7.000	2.750	Open Manhole	0		OUTFALL		1.009	4.250	-2	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S5	547488.260	260746.143	547488.260	260746.143	Required	
SwaleA	547478.608	260751.803	547478.608	260751.803	Required	
SwaleB	547519.471	260852.688	547519.471	260852.688	Required	
S8S9S10	547496.771	260894.067	547496.771	260894.067	Required	
SwaleC	547532.672	260890.367	547532.672	260890.367	Required	
SwaleEnd	547555.721	260947.086	547555.721	260947.086	Required	
FlowControl1	547571.045	260950.791	547571.045	260950.791	Required	
Outfall	547605.029	260936.114	547605.029	260936.114	Required	
FPDDiv1	547607.800	260938.779	547607.800	260938.779	Required	
FPDDiv2	547618.466	260933.454	547618.466	260933.454	Required	

Manhole Schedules for C3, C4, C7

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S6S7	547586.587	260843.244	547586.587	260843.244	Required	
FlowControl2	547603.396	260885.080	547603.396	260885.080	Required	
FPD	547606.718	260889.292	547606.718	260889.292	Required	
FPD	547630.987	260868.930			No Entry	

PIPELINE SCHEDULES for C3, C4, C7

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	375	S5	6.500	5.100	1.025	Open Manhole	1200
1.001	\/	-1	SwaleA	6.250	5.050	0.000	Open Manhole	1
1.002	\/	-1	SwaleB	6.200	5.025	-0.025	Open Manhole	1
2.000	o	375	S8S9S10	6.500	5.100	1.025	Open Manhole	1200
1.003	\/	-1	SwaleC	6.150	4.950	0.000	Open Manhole	1
1.004	o	375	SwaleEnd	6.125	4.925	0.825	Open Manhole	1
1.005	o	150	FlowControl1	6.500	4.900	1.450	Open Manhole	1200
1.006	o	150	Outfall	6.500	4.650	1.700	Open Manhole	1200
1.007	o	900	FPDDiv1	6.500	4.425	1.175	Open Manhole	1800
1.008	o	900	FPDDiv2	6.500	4.400	1.200	Open Manhole	1800
3.000	o	450	S6S7	6.500	4.650	1.400	Open Manhole	1200
3.001	o	150	FlowControl2	6.500	4.350	2.000	Open Manhole	1200
1.009	[]	-2	FPD	6.500	4.309	1.091	Open Manhole	1

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	11.189	223.8	SwaleA	6.250	5.050	0.825	Open Manhole	1
1.001	108.847	4353.9	SwaleB	6.200	5.025	-0.025	Open Manhole	1
1.002	39.925	532.3	SwaleC	6.150	4.950	0.000	Open Manhole	1
2.000	36.091	240.6	SwaleC	6.150	4.950	0.825	Open Manhole	1
1.003	61.223	2448.9	SwaleEnd	6.125	4.925	0.000	Open Manhole	1
1.004	15.766	630.6	FlowControl1	6.500	4.900	1.225	Open Manhole	1200
1.005	37.018	148.1	Outfall	6.500	4.650	1.700	Open Manhole	1200
1.006	3.845	153.8	FPDDiv1	6.500	4.625	1.725	Open Manhole	1800
1.007	11.921	476.8	FPDDiv2	6.500	4.400	1.200	Open Manhole	1800
1.008	45.698	571.2	FPD	6.500	4.320	1.280	Open Manhole	1
3.000	45.110	902.2	FlowControl2	6.500	4.600	1.450	Open Manhole	1200
3.001	5.364	130.8	FPD	6.500	4.309	2.041	Open Manhole	1
1.009	31.680	536.9	FPD	7.000	4.250	1.650	Open Manhole	0

Surcharged Outfall Details for C3, C4, C7

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.009	FPD	7.000	4.250	4.500	0	0

Datum (m) 0.000 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1	5.612	4	5.612	7	5.612	10	5.612	13	5.612	16	5.612	19	5.612	22	5.612
2	5.612	5	5.612	8	5.612	11	5.612	14	5.612	17	5.612	20	5.612	23	5.612
3	5.612	6	5.612	9	5.612	12	5.612	15	5.612	18	5.612	21	5.612	24	5.612

Surcharged Outfall Details for C3, C4, C7

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
25	5.612	52	5.612	79	5.612	106	5.612	133	5.612	160	5.612	187	5.612	214	5.612
26	5.612	53	5.612	80	5.612	107	5.612	134	5.612	161	5.612	188	5.612	215	5.612
27	5.612	54	5.612	81	5.612	108	5.612	135	5.612	162	5.612	189	5.612	216	5.612
28	5.612	55	5.612	82	5.612	109	5.612	136	5.612	163	5.612	190	5.612	217	5.612
29	5.612	56	5.612	83	5.612	110	5.612	137	5.612	164	5.612	191	5.612	218	5.612
30	5.612	57	5.612	84	5.612	111	5.612	138	5.612	165	5.612	192	5.612	219	5.612
31	5.612	58	5.612	85	5.612	112	5.612	139	5.612	166	5.612	193	5.612	220	5.612
32	5.612	59	5.612	86	5.612	113	5.612	140	5.612	167	5.612	194	5.612	221	5.612
33	5.612	60	5.612	87	5.612	114	5.612	141	5.612	168	5.612	195	5.612	222	5.612
34	5.612	61	5.612	88	5.612	115	5.612	142	5.612	169	5.612	196	5.612	223	5.612
35	5.612	62	5.612	89	5.612	116	5.612	143	5.612	170	5.612	197	5.612	224	5.612
36	5.612	63	5.612	90	5.612	117	5.612	144	5.612	171	5.612	198	5.612	225	5.612
37	5.612	64	5.612	91	5.612	118	5.612	145	5.612	172	5.612	199	5.612	226	5.612
38	5.612	65	5.612	92	5.612	119	5.612	146	5.612	173	5.612	200	5.612	227	5.612
39	5.612	66	5.612	93	5.612	120	5.612	147	5.612	174	5.612	201	5.612	228	5.612
40	5.612	67	5.612	94	5.612	121	5.612	148	5.612	175	5.612	202	5.612	229	5.612
41	5.612	68	5.612	95	5.612	122	5.612	149	5.612	176	5.612	203	5.612	230	5.612
42	5.612	69	5.612	96	5.612	123	5.612	150	5.612	177	5.612	204	5.612	231	5.612
43	5.612	70	5.612	97	5.612	124	5.612	151	5.612	178	5.612	205	5.612	232	5.612
44	5.612	71	5.612	98	5.612	125	5.612	152	5.612	179	5.612	206	5.612	233	5.612
45	5.612	72	5.612	99	5.612	126	5.612	153	5.612	180	5.612	207	5.612	234	5.612
46	5.612	73	5.612	100	5.612	127	5.612	154	5.612	181	5.612	208	5.612	235	5.612
47	5.612	74	5.612	101	5.612	128	5.612	155	5.612	182	5.612	209	5.612	236	5.612
48	5.612	75	5.612	102	5.612	129	5.612	156	5.612	183	5.612	210	5.612	237	5.612
49	5.612	76	5.612	103	5.612	130	5.612	157	5.612	184	5.612	211	5.612	238	5.612
50	5.612	77	5.612	104	5.612	131	5.612	158	5.612	185	5.612	212	5.612	239	5.612
51	5.612	78	5.612	105	5.612	132	5.612	159	5.612	186	5.612	213	5.612	240	5.612

Simulation Criteria for C3, C4, C7

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 4	Number of Storage Structures 3	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Summer Storms	Yes
Return Period (years)	30	Winter Storms	No
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 547650 260850 TL 47650 60850	Cv (Winter)	0.840
Data Type	Catchment	Storm Duration (mins)	30

Online Controls for C3, C4, C7

Hydro-Brake® Optimum Manhole: FlowControl1, DS/PN: 1.005, Volume (m³): 3.5

Unit Reference	MD-SHE-0084-3400-1225-3400
Design Head (m)	1.225
Design Flow (l/s)	3.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	84
Invert Level (m)	4.900
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.225	3.4	Kick-Flo®	0.753	2.7
Flush-Flo™	0.370	3.4	Mean Flow over Head Range	-	3.0

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	2.5	0.800	2.8	2.000	4.3	4.000	5.9	7.000	7.7
0.200	3.2	1.000	3.1	2.200	4.5	4.500	6.2	7.500	7.9
0.300	3.4	1.200	3.4	2.400	4.6	5.000	6.5	8.000	8.2
0.400	3.4	1.400	3.6	2.600	4.8	5.500	6.8	8.500	8.4
0.500	3.3	1.600	3.8	3.000	5.1	6.000	7.1	9.000	8.7
0.600	3.2	1.800	4.1	3.500	5.5	6.500	7.4	9.500	8.9

Non Return Valve Manhole: FPDDiv1, DS/PN: 1.007, Volume (m³): 5.3

Hydro-Brake® Optimum Manhole: FlowControl2, DS/PN: 3.001, Volume (m³): 9.4

Unit Reference	MD-SHE-0058-2000-1850-2000
Design Head (m)	1.850
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	58
Invert Level (m)	4.350
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.850	2.0	Kick-Flo®	0.519	1.1
Flush-Flo™	0.255	1.4	Mean Flow over Head Range	-	1.5

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	1.2	0.300	1.4	0.500	1.2	0.800	1.4	1.200	1.6
0.200	1.4	0.400	1.3	0.600	1.2	1.000	1.5	1.400	1.8

Hydro-Brake® Optimum Manhole: FlowControl2, DS/PN: 3.001, Volume (m³): 9.4

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)
1.600	1.9	2.400	2.3	4.000	2.8	6.000	3.4	8.000	3.9
1.800	2.0	2.600	2.3	4.500	3.0	6.500	3.6	8.500	4.1
2.000	2.1	3.000	2.5	5.000	3.2	7.000	3.7	9.000	4.2
2.200	2.2	3.500	2.7	5.500	3.3	7.500	3.8	9.500	4.3

Non Return Valve Manhole: FPD, DS/PN: 1.009, Volume (m³): 28.6

Storage Structures for C3, C4, C7

Cellular Storage Manhole: S8S9S10, DS/PN: 2.000

Invert Level (m) 5.100 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)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	330.0	0.0	0.800	330.0	0.0	0.801	0.0	0.0

Cellular Storage Manhole: FlowControl1, DS/PN: 1.005

Invert Level (m) 4.900 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)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	410.0	0.0	1.200	410.0	0.0	1.201	0.0	0.0

Cellular Storage Manhole: FlowControl2, DS/PN: 3.001

Invert Level (m) 4.600 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)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	595.0	0.0	1.200	595.0	0.0	1.201	0.0	0.0

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C3, C4, C7

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 4 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Catchment
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 547650 260850 TL 47650 60850	Cv (Winter)	0.840

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, 2880
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 20, 25

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.000	S5	15 minute 2 year Winter I+0%	6.500	5.398	-0.077	0.000	0.96		97.1
1.001	SwaleA	480 minute 2 year Winter I+0%	6.250	5.343	-0.907	0.000	0.00		12.3
1.002	SwaleB	480 minute 2 year Winter I+0%	6.200	5.343	-0.882	0.000	0.00		8.6
2.000	S8S9S10	480 minute 2 year Winter I+0%	6.500	5.345	-0.130	0.000	0.17		19.5
1.003	SwaleC	480 minute 2 year Winter I+0%	6.150	5.343	-0.807	0.000	0.01		25.0
1.004	SwaleEnd	480 minute 2 year Winter I+0%	6.125	5.343	0.043	0.000	0.46		20.7
1.005	FlowControl1	480 minute 2 year Winter I+0%	6.500	5.341	0.291	0.000	0.24		3.4
1.006	Outfall	120 minute 2 year Winter I+0%	6.500	5.118	0.318	0.000	0.30		3.3
1.007	FPDDiv1	120 minute 2 year Winter I+0%	6.500	5.113	-0.212	0.000	0.01		3.2
1.008	FPDDiv2	120 minute 2 year Winter I+0%	6.500	5.113	-0.187	0.000	0.00		2.7
3.000	S6S7	15 minute 2 year Winter I+0%	6.500	5.134	0.034	0.000	1.42		136.2
3.001	FlowControl2	480 minute 2 year Winter I+0%	6.500	4.910	0.410	0.000	0.11		1.4
1.009	FPD	120 minute 2 year Winter I+0%	6.500	5.113	-0.296	0.000	0.00		0.0

PN	US/MH Name	Status
1.000	S5	OK
1.001	SwaleA	OK
1.002	SwaleB	OK
2.000	S8S9S10	OK
1.003	SwaleC	OK
1.004	SwaleEnd	SURCHARGED
1.005	FlowControl1	SURCHARGED
1.006	Outfall	SURCHARGED
1.007	FPDDiv1	OK
1.008	FPDDiv2	OK
3.000	S6S7	SURCHARGED
3.001	FlowControl2	SURCHARGED
1.009	FPD	OK

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C3, C4, C7

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 4 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Catchment
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 547650 260850 TL 47650 60850	Cv (Winter)	0.840

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, 2880
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 20, 25

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.000	S5	15 minute 30 year Winter I+20%	6.500	5.937	0.462	0.000	2.73		274.3
1.001	SwaleA	960 minute 30 year Winter I+20%	6.250	5.789	-0.461	0.000	0.01		16.9
1.002	SwaleB	960 minute 30 year Winter I+20%	6.200	5.789	-0.436	0.000	0.00		10.5
2.000	S8S9S10	960 minute 30 year Winter I+20%	6.500	5.790	0.315	0.000	0.23		27.0
1.003	SwaleC	960 minute 30 year Winter I+20%	6.150	5.789	-0.361	0.000	0.01		26.5
1.004	SwaleEnd	960 minute 30 year Winter I+20%	6.125	5.788	0.488	0.000	0.49		22.0
1.005	FlowControl1	960 minute 30 year Winter I+20%	6.500	5.786	0.736	0.000	0.24		3.4
1.006	Outfall	240 minute 30 year Winter I+20%	6.500	5.569	0.769	0.000	1.53		16.6
1.007	FPDDiv1	240 minute 30 year Winter I+20%	6.500	5.568	0.243	0.000	0.09		35.4
1.008	FPDDiv2	240 minute 30 year Winter I+20%	6.500	5.601	0.301	0.000	0.16		103.9
3.000	S6S7	15 minute 30 year Winter I+20%	6.500	5.833	0.733	0.000	3.81		365.2
3.001	FlowControl2	960 minute 30 year Winter I+20%	6.500	5.418	0.918	0.000	0.12		1.5
1.009	FPD	240 minute 30 year Winter I+20%	6.500	5.613	0.204	0.000	0.16		275.3

PN	US/MH Name	Status
1.000	S5	SURCHARGED
1.001	SwaleA	OK
1.002	SwaleB	OK
2.000	S8S9S10	SURCHARGED
1.003	SwaleC	OK
1.004	SwaleEnd	SURCHARGED
1.005	FlowControl1	SURCHARGED
1.006	Outfall	SURCHARGED
1.007	FPDDiv1	SURCHARGED
1.008	FPDDiv2	SURCHARGED
3.000	S6S7	SURCHARGED
3.001	FlowControl2	SURCHARGED
1.009	FPD	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C3, C4, C7

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 4 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Catchment
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 547650 260850 TL 47650 60850	Cv (Winter)	0.840

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, 2880
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 20, 25

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.000	S5	15 minute 100 year Winter I+25%	6.500	6.402	0.927	0.000	3.70		372.3
1.001	SwaleA	960 minute 100 year Winter I+25%	6.250	6.127	-0.123	0.000	0.01		23.8
1.002	SwaleB	960 minute 100 year Winter I+25%	6.200	6.127	-0.098	0.000	0.00		10.7
2.000	S8S9S10	30 minute 100 year Winter I+25%	6.500	6.145	0.670	0.000	2.01		232.2
1.003	SwaleC	960 minute 100 year Winter I+25%	6.150	6.126	-0.024	0.000	0.01		32.5
1.004	SwaleEnd	960 minute 100 year Winter I+25%	6.125	6.119	0.819	0.000	0.50		22.5
1.005	FlowControl1	960 minute 100 year Winter I+25%	6.500	6.268	1.218	0.000	0.24		3.4
1.006	Outfall	240 minute 100 year Summer I+25%	6.500	5.618	0.818	0.000	1.56		16.9
1.007	FPDDiv1	240 minute 100 year Summer I+25%	6.500	5.613	0.288	0.000	0.09		36.6
1.008	FPDDiv2	120 minute 100 year Winter I+25%	6.500	5.613	0.313	0.000	0.00		3.1
3.000	S6S7	15 minute 100 year Winter I+25%	6.500	6.483	1.383	0.000	5.20		497.8
3.001	FlowControl2	960 minute 100 year Winter I+25%	6.500	6.373	1.873	0.000	0.16		2.1
1.009	FPD	360 minute 100 year Summer I+25%	6.500	5.613	0.204	0.000	0.16		275.1

PN	US/MH Name	Status
1.000	S5	FLOOD RISK
1.001	SwaleA	FLOOD RISK
1.002	SwaleB	FLOOD RISK
2.000	S8S9S10	SURCHARGED
1.003	SwaleC	FLOOD RISK
1.004	SwaleEnd	FLOOD RISK
1.005	FlowControl1	FLOOD RISK
1.006	Outfall	SURCHARGED
1.007	FPDDiv1	SURCHARGED
1.008	FPDDiv2	SURCHARGED
3.000	S6S7	FLOOD RISK
3.001	FlowControl2	FLOOD RISK
1.009	FPD	SURCHARGED

Summary of Results for 100 year Return Period (+25%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	5.288	0.588	11.6	967.4	O K
30 min Summer	5.438	0.738	11.6	1246.3	O K
60 min Summer	5.575	0.875	11.6	1514.4	O K
120 min Summer	5.759	1.059	11.6	1890.5	O K
180 min Summer	5.862	1.162	11.6	2111.2	O K
240 min Summer	5.927	1.227	11.6	2253.9	Flood Risk
360 min Summer	5.999	1.299	11.6	2412.7	Flood Risk
480 min Summer	6.030	1.330	11.6	2484.8	Flood Risk
600 min Summer	6.042	1.342	11.6	2512.7	Flood Risk
720 min Summer	6.044	1.344	11.6	2515.6	Flood Risk
960 min Summer	6.027	1.327	11.6	2478.3	Flood Risk
1440 min Summer	5.966	1.266	11.6	2339.4	Flood Risk
2160 min Summer	5.867	1.167	11.6	2121.9	O K
2880 min Summer	5.791	1.091	11.6	1957.1	O K
4320 min Summer	5.677	0.977	11.6	1720.0	O K
5760 min Summer	5.579	0.879	11.6	1521.5	O K
7200 min Summer	5.506	0.806	11.6	1377.7	O K
8640 min Summer	5.449	0.749	11.6	1268.9	O K
10080 min Summer	5.405	0.705	11.6	1185.4	O K
15 min Winter	5.351	0.651	11.6	1084.6	O K
30 min Winter	5.516	0.816	11.6	1397.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	147.000	0.0	863.5	23
30 min Summer	95.000	0.0	972.8	38
60 min Summer	58.125	0.0	1492.0	68
120 min Summer	36.688	0.0	1800.2	128
180 min Summer	27.629	0.0	1824.0	186
240 min Summer	22.375	0.0	1805.3	246
360 min Summer	16.333	0.0	1776.9	366
480 min Summer	12.905	0.0	1757.7	486
600 min Summer	10.679	0.0	1742.0	604
720 min Summer	9.115	0.0	1727.3	724
960 min Summer	7.053	0.0	1698.5	962
1440 min Summer	4.875	0.0	1639.4	1440
2160 min Summer	3.359	0.0	3149.9	1816
2880 min Summer	2.586	0.0	3195.8	2164
4320 min Summer	1.815	0.0	3046.2	2984
5760 min Summer	1.430	0.0	3641.6	3744
7200 min Summer	1.205	0.0	3834.0	4536
8640 min Summer	1.058	0.0	4037.1	5280
10080 min Summer	0.956	0.0	4246.2	6056
15 min Winter	147.000	0.0	934.3	23
30 min Winter	95.000	0.0	972.3	37

Summary of Results for 100 year Return Period (+25%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	5.667	0.967	11.6	1700.3	O K
120 min Winter	5.868	1.168	11.6	2123.4	O K
180 min Winter	5.981	1.281	11.6	2373.7	Flood Risk
240 min Winter	6.053	1.353	11.6	2536.6	Flood Risk
360 min Winter	6.133	1.433	11.6	2721.5	Flood Risk
480 min Winter	6.170	1.470	11.6	2809.2	Flood Risk
600 min Winter	6.186	1.486	11.6	2847.1	Flood Risk
720 min Winter	6.190	1.490	11.6	2856.8	Flood Risk
960 min Winter	6.178	1.478	11.6	2828.1	Flood Risk
1440 min Winter	6.122	1.422	11.6	2697.8	Flood Risk
2160 min Winter	6.019	1.319	11.6	2459.7	Flood Risk
2880 min Winter	5.927	1.227	11.6	2253.7	Flood Risk
4320 min Winter	5.788	1.088	11.6	1952.1	O K
5760 min Winter	5.665	0.965	11.6	1694.9	O K
7200 min Winter	5.543	0.843	11.6	1450.4	O K
8640 min Winter	5.447	0.747	11.6	1263.8	O K
10080 min Winter	5.370	0.670	11.6	1118.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	58.125	0.0	1653.5	66
120 min Winter	36.688	0.0	1832.3	126
180 min Winter	27.629	0.0	1807.5	184
240 min Winter	22.375	0.0	1791.1	242
360 min Winter	16.333	0.0	1776.5	360
480 min Winter	12.905	0.0	1769.7	478
600 min Winter	10.679	0.0	1764.6	594
720 min Winter	9.115	0.0	1759.8	710
960 min Winter	7.053	0.0	1748.3	942
1440 min Winter	4.875	0.0	1714.0	1388
2160 min Winter	3.359	0.0	3449.5	2016
2880 min Winter	2.586	0.0	3381.2	2280
4320 min Winter	1.815	0.0	3110.2	3200
5760 min Winter	1.430	0.0	4078.4	4144
7200 min Winter	1.205	0.0	4294.2	4904
8640 min Winter	1.058	0.0	4522.6	5704
10080 min Winter	0.956	0.0	4760.3	6456

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 547650 260850 TL 47650 60850
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+25

Time Area Diagram

Total Area (ha) 3.548

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	1.774	4	8	1.774

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 6.200

Tank or Pond Structure

Invert Level (m) 4.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1484.0	1.500	2394.0

Hydro-Brake® Optimum Outflow Control

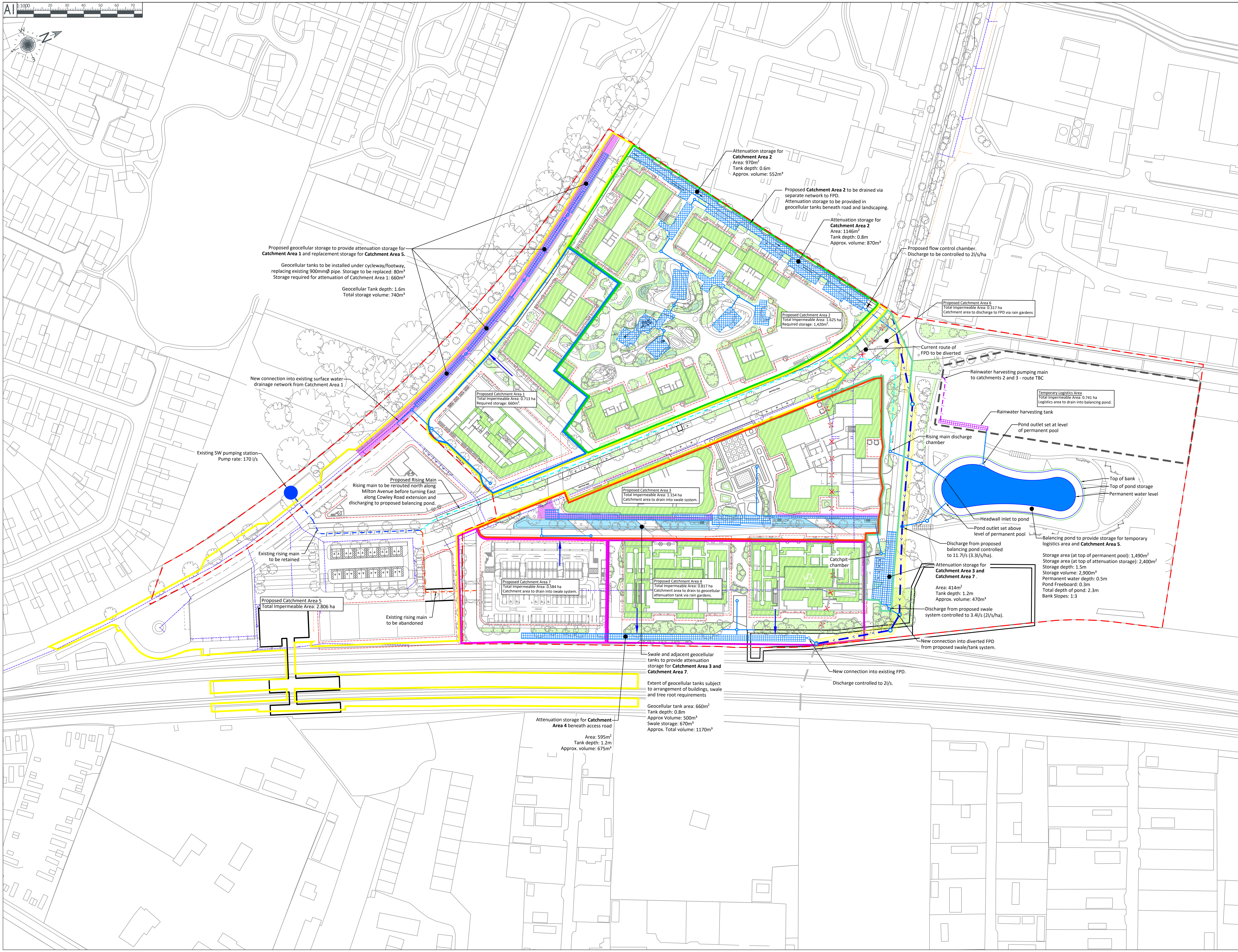
Unit Reference	MD-SHE-0149-1170-1500-1170
Design Head (m)	1.500
Design Flow (l/s)	11.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	149
Invert Level (m)	4.700
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	11.7
Flush-Flo™	0.440	11.6
Kick-Flo®	0.937	9.4
Mean Flow over Head Range	-	10.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.4	1.200	10.5	3.000	16.2	7.000	24.3
0.200	10.5	1.400	11.3	3.500	17.5	7.500	25.2
0.300	11.3	1.600	12.0	4.000	18.6	8.000	26.0
0.400	11.6	1.800	12.7	4.500	19.7	8.500	26.7
0.500	11.6	2.000	13.4	5.000	20.7	9.000	27.5
0.600	11.4	2.200	14.0	5.500	21.7	9.500	28.2
0.800	10.7	2.400	14.6	6.000	22.6		
1.000	9.6	2.600	15.2	6.500	23.5		

Appendix D Drainage Strategy Drawing


A1 1:1000
Attenuation storage for Catchment Area 2
Area: 970m²
Tank depth: 0.6m
Approx. volume: 552m³
Proposed Catchment Area 2 to be drained via separate network to FPD.
Attenuation storage to be provided in geocellular tanks beneath road and landscaping.
Attenuation storage for Catchment Area 2
Area: 1146m²
Tank depth: 0.8m
Approx. volume: 870m³
Proposed flow control chamber.
Discharge to be controlled to 2l/s/ha
Proposed geocellular storage to provide attenuation storage for Catchment Area 1 and replacement storage for Catchment Area 5.
Geocellular tanks to be installed under cycleway/footway, replacing existing 900mmØ pipe. Storage to be replaced: 80m³
Storage required for attenuation of Catchment Area 1: 660m³
Geocellular Tank depth: 1.6m
Total storage volume: 740m³
Proposed Catchment Area 2
Total Impermeable Area: 1.625 ha
Required storage: 1,420m³.
Proposed Catchment Area 6
Total Impermeable Area: 0.317 ha
Catchment area to discharge to FPD via rain gardens
Current route of FPD to be diverted
Rainwater harvesting pumping main to catchments 2 and 3 - route TBC
New connection into existing surface water drainage network from Catchment Area 1
Proposed Catchment Area 1
Total Impermeable Area: 0.713 ha
Required storage: 660m³.
Temporary Logistics Area
Total Impermeable Area: 0.741 ha
Logistics area to drain into balancing pond.
Rainwater harvesting tank
Pond outlet set at level of permanent pool
Rising main discharge chamber
Existing SW pumping station
Pump rate: 170 l/s
Proposed Rising Main
Rising main to be rerouted north along Milton Avenue before turning East along Cowley Road extension and discharging to proposed balancing pond.
Proposed Catchment Area 3
Total Impermeable Area: 1.154 ha
Catchment area to drain into swale system.
Top of bank
Top of pond storage
Permanent water level
Headwall inlet to pond
Pond outlet set above level of permanent pool
Balancing pond to provide storage for temporary logistics area and Catchment Area 5.
Storage area (at top of permanent pool): 1,490m²
Storage area (at top of attenuation storage): 2,400m²
Storage depth: 1.5m
Storage volume: 2,900m³
Permanent water depth: 0.5m
Pond Freeboard: 0.3m
Total depth of pond: 2.3m
Bank Slopes: 1:3
Discharge from proposed balancing pond controlled to 11.7l/s (3.3l/s/ha).
Existing rising main to be retained
Catchpit chamber
Attenuation storage for Catchment Area 3 and Catchment Area 7.
Area: 414m²
Tank depth: 1.2m
Approx. volume: 470m³
Proposed Catchment Area 7
Total Impermeable Area: 0.584 ha
Catchment area to drain into swale system.
Proposed Catchment Area 4
Total Impermeable Area: 0.817 ha
Catchment area to drain to geocellular attenuation tank via rain gardens.
Proposed Catchment Area 5
Total Impermeable Area: 2.806 ha
Existing rising main to be abandoned
Discharge from proposed swale system controlled to 3.4l/s (2l/s/ha).
New connection into diverted FPD from proposed swale/tank system.
Swale and adjacent geocellular tanks to provide attenuation storage for Catchment Area 3 and Catchment Area 7.
Extent of geocellular tanks subject to arrangement of buildings, swale and tree root requirements
Geocellular tank area: 660m²
Tank depth: 0.8m
Approx Volume: 500m³
Swale storage: 670m³
Approx. Total volume: 1170m³
New connection into existing FPD.
Discharge controlled to 2l/s.
Attenuation storage for Catchment Area 4 beneath access road
Area: 595m²
Tank depth: 1.2m
Approx. volume: 675m³

NOTES

These drawings have been produced with reference to the CDM Regulations 2015. Please note that these are pre-construction phase drawings and should be subject to further design risk management as required in accordance with Regulation 9

NOTES

1. Site layout provided by ACME (drawing ref. 239-ACME-PLA-S00-0013 ILLUSTRATIVE MASTERPLAN - GROUND FLOOR) received 23/05/2022.
2. The First Public Drain overflow culvert is under riparian ownership.
3. Ordinary watercourse consent from Cambridgeshire County Council will be required for the First Public Drain overflow culvert diversion.
4. Balancing pond is sized to attenuate runoff from the adjacent temporary logistics area North of Cowley Road in addition to the pumped flow from Catchment Area 1 and 5.
5. Green / brown roofs to be provided on structures S4, S6, S7, S8 and S9/S10.
6. Existing rain gardens for highway drainage adjacent to Cowley Road to be retained.
7. Tree pits to be provided with 'Arborcell' water attenuation within the sub-base.

KEY

- Catchment Area 1
- Catchment Area 2
- Catchment Area 3
- Catchment Area 4
- Catchment Area 5
- Catchment Area 6
- Catchment Area 7
- Proposed Surface Water Drainage
- Proposed Attenuation Tank
- Proposed FPD Diversion
- FPD 5m Easement
- Proposed Attenuation Pond
- Proposed Swale
- Proposed Surface Water Rising Main
- Existing Surface Water Rising Main to be Abandoned
- Existing Surface Water Rising Main to be Retained
- Proposed Green / Brown Roof Area
- Proposed Rain Gardens
- Proposed Permeable Paving
- Proposed Rainwater Harvesting Tank
- Proposed Rainwater Harvesting Pumped Outlet
- Red Line Boundary

REV	DATE	REVISION NOTE	BY
P7	11/10/22	FPD diversion amended. Green roofs, rain gardens and permeable paving updated.	JG
P6	15/09/22	Catchment 1 attenuation storage updated	JG
P5	01/09/22	Updated according to LLFA comments. Indicative rainwater harvesting system shown.	JG
P4	27/05/22	Updated to suit revised site layout	JG
P3	30/03/22	Attenuation basin, residential attenuation tanks and rain gardens updated	DS
P2	15/02/22	Updated to suit revised masterplan	JG
P1	28/01/22	Drainage layout amended following masterplan update, attenuation basin revised, FPD easement added, Chesterton Square attenuation tank revised and green / brown roof area added	DS
P0	07/12/21	First Issue	DS

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CLIENT
Brookgate Ltd

PROJECT
Cambridge North

DRAWING TITLE
Proposed Drainage Strategy - Basin

DRAWING ISSUE STATUS
INFORMATION

PJA JOB No. SUB-CODE
05425 - C - 1003 - P7

Revision Letter : P - Prelim / A - Approval / T - Tender / C - Construction

BIM DRAWING REFERENCE

SCALE	DRAWN	REVIEWED	DATE
A1@1:1000	DS	MC	07/12/2021

Appendix E LLFA Correspondence

Joe Garlick

From: Harry Pickford <Harry.Pickford@cambridgeshire.gov.uk>
Sent: 17 August 2022 17:00
To: Malcolm Crowther
Subject: RE: [PJA: 05425-C] Cambridge North Phase Two

Categories: Scanned by Gekko

Good afternoon Malcolm,

Thanks for the email. As discussed yesterday, the LLFA could request a condition for the details for the survey to be put on any permission for this application by the LPA. This would be a pre-commencement condition.

Kind regards

Harry Pickford
Principal Sustainable Drainage Officer
T: 01223 715952 | M: 07469 377536
Flood Risk Team

Upcoming annual leave:

Cambridgeshire County Council

From: Malcolm Crowther <malcolm.crowther@pja.co.uk>
Sent: 16 August 2022 11:55
To: Harry Pickford <Harry.Pickford@cambridgeshire.gov.uk>
Subject: RE:[PJA: 05425-C] Cambridge North Phase Two

Hi Harry

Following our discussion regarding the downstream capacity of the overflow culvert to the First Public Drain yesterday, the client has requested if you could confirm in writing that this investigation can be deferred to a pre-commencement condition. As you can appreciate procuring a survey and arranging the access onto third party land (including network rail permissions) can take some time to arrange.

Kind Regards
Malcolm

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