Table 1: Pavement Construction Chart

Pavement Construction Type	Surface Course	Binder Course	Base Layer (Bituminous)	Base Layer (HBM)	Sub-base/Capping Layer (Foundation Class 2)
Access Road and Parking Bay PC1	25mm AC6 dense surf 160/220 to BS EN 13108-1 and BSI PD 6691 Annex B	60mm AC20 dense bin 100/150 to BS EN 13108-1 and BSI PD 6691 Annex B	80mm AC32 dense base 100/150 to BS EN13108-1 and BSI PD 6691 Annex B	--	150mm Type 1 sub base to DfT SHW Clause 803 and 300mm Capping Layer to SHW Clause 613
Permeable Paving PC2	80mm Concrete Block Paviours to Architect specification.	50mm Sand Layer Class II to BS7533 Part 3 2005+A1:2009 or similar approved	--	--	300mm Type 3 sub base (5 - 20 mm Stone) DfT SHW to Clause 805
Service Yard PC3	150mm thick slab grade PAV2 (air entrained to 5.5%) with brushed finish				150mm thick type 1 sub base well compacted, sub grade to be proof rolled

Notes:

1. Contractor to check insitu CBR at time of construction and adjust pavement foundation as per Table 3. Assumed 2% <= CBR < 5%

Table 2: Footway Construction Chart

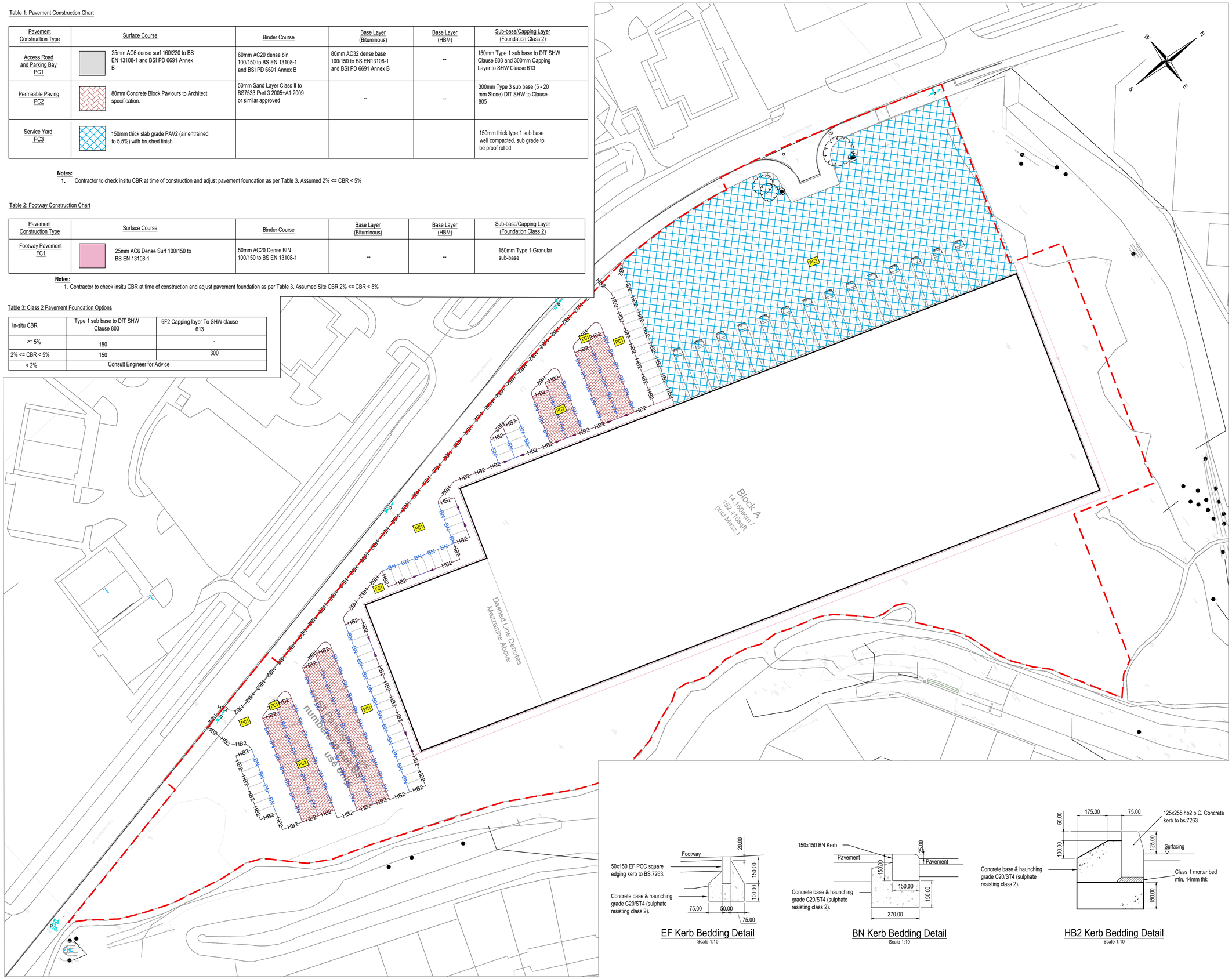
Pavement Construction Type	Surface Course	Binder Course	Base Layer (Bituminous)	Base Layer (HBM)	Sub-base/Capping Layer (Foundation Class 2)
Footway Pavement FC1	25mm AC6 Dense Surf 100/150 to BS EN 13108-1	50mm AC20 Dense BIN 100/150 to BS EN 13108-1	--	--	150mm Type 1 Granular sub-base

Notes:

1. Contractor to check insitu CBR at time of construction and adjust pavement foundation as per Table 3. Assumed Site CBR 2% <= CBR < 5%

Table 3: Class 2 Pavement Foundation Options

In-situ CBR	Type 1 sub base to DfT SHW Clause 803	6F2 Capping layer To SHW clause 613
>= 5%	150	-
2% <= CBR < 5%	150	300
< 2%	Consult Engineer for Advice	



EF Kerb Bedding Detail
Scale 1:10

BN Kerb Bedding Detail
Scale 1:10

HB2 Kerb Bedding Detail
Scale 1:10

Safety, Health & Environmental Information:

In addition to the hazards and risks normally associated with the types of work detailed on this drawing, please note the significant hazards identified by symbols below,

INDICATES A RESIDUAL RISK AS A WARNING

INDICATES A RESIDUAL RISK FOR INFORMATION

and described below:

Construction/Maintenance/Cleaning/Demolition

Refer to Drawing:

General Notes:

1. Do not scale from this drawing.
2. All dimensions are in millimetres (mm), all levels in metres (m) unless noted otherwise.
3. Discrepancies or omissions are to be reported to the Engineer prior to work commencing.
4. Materials and workmanship are to comply in all respects with current British Standard Specifications, Codes of Practice, and Building Regulations Approved Documents.
5. The copyright of this drawing is vested in the Engineer and must not be copied or reproduced without written consent.
6. The Contractor is to check and verify all building and site dimensions, levels and sewer invert levels at connection points before work commences.
7. This drawing is to be read in conjunction with all relevant specifications and drawings issued by the Engineer, Architect and other Specialists.

Key

—HB2—	Proposed HB2 Kerbs with 125mm upstand
–BN—BN–	Proposed BN Kerbs with 125mm upstand
–EF—EF–	Proposed EF Kerbs with 25mm upstand
► ◄	Proposed Dropped Kerbs
	Proposed Permeable Paving
	Proposed Asphalt Access Road
	Proposed Concrete Slab
	Proposed Asphalt Footpath
	Existing and Proposed Green Areas
	Proposed Building
	Site Boundary

Rev	By / Chk'd	Date	Description
P01	DH/AM	15/09/21	Preliminary Issue

PRELIMINARY DRAWING
This drawing is not to be used for construction

Client

FI REAL ESTATE MANAGEMENT

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BarnsleyMarshall

Project

Site 5a, Wrexham

Drawing

Proposed External Surfaces

By MR/AM Date 00/00/0000

Drawing No. S5A-BML-XX-XX-DR-C-0700

Revision P01

BML Job No. 1000-02

Status -

Drawing Scale at A1: -

CAD Filename: C:\Users\DeanHolcroft\OneDrive\BM Server - Drawn\Projects\1000-02 Site 5a, Wrexham\Information - Working\DWG\S5A-BML-XX-XX-DR-C-0700 P01 - External Surfaces.dwg

Appendix E

Hydraulic Calculations

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	40
Ratio R	0.322	Minimum Backdrop Height (m)	4.000
Maximum Rainfall (mm/hr)	250	Maximum Backdrop Height (m)	4.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.112	4-8	0.794	8-12	0.249

Total Area Contributing (ha) = 1.154

Total Pipe Volume (m³) = 35.835

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	70.400	0.349	201.7	0.216	5.00	0.0	0.600	o	375	Pipe/Conduit	
S1.001	38.927	0.121	321.0	0.290	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.002	58.934	0.333	177.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	52.79	5.92	35.046	0.216	0.0	0.0	12.3	1.27	140.5	43.2
S1.001	50.51	6.57	34.697	0.506	0.0	0.0	27.7	1.01	111.1	96.9
S1.002	48.21	7.29	34.576	0.506	0.0	0.0	27.7	1.36	150.1	96.9

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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
S2.000	52.241	0.420	124.4	0.186	5.00	0.0	0.600	o	300	Pipe/Conduit	
S2.001	51.166	0.409	125.1	0.150	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	45.521	0.206	221.0	0.154	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.004	42.527	0.012	3543.9	0.080	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.005	12.267	0.025	490.7	0.078	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.000	53.96	5.62	35.147	0.186	0.0	0.0	10.9	1.41	99.6	38.1
S2.001	51.69	6.23	34.727	0.336	0.0	0.0	18.8	1.40	99.3	65.9
S1.003	46.42	7.91	34.243	0.996	0.0	0.0	50.1	1.21	134.2«	175.3
S1.004	40.79	10.32	34.037	1.076	0.0	0.0	50.1	0.29	32.6«	175.3
S1.005	39.89	10.77	34.025	1.154	0.0	0.0	50.1	0.45	7.9«	175.3

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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)
S1	36.520	1.474	Open Manhole	1500	S1.000	35.046	375				
S2	36.290	1.593	Open Manhole	1500	S1.001	34.697	375	S1.000	34.697	375	
S3	36.083	1.507	Open Manhole	1500	S1.002	34.576	375	S1.001	34.576	375	
S4	36.647	1.500	Open Manhole	1200	S2.000	35.147	300				
S5	36.227	1.500	Open Manhole	1200	S2.001	34.727	300	S2.000	34.727	300	
S6	35.916	1.673	Open Manhole	1500	S1.003	34.243	375	S1.002	34.243	375	
								S2.001	34.318	300	
S7	35.700	1.663	Open Manhole	1500	S1.004	34.037	375	S1.003	34.037	375	
S8	35.525	1.500	Open Manhole	1500	S1.005	34.025	150	S1.004	34.025	375	
SHWtoDitch	35.100	1.100	Open Manhole	0		OUTFALL		S1.005	34.000	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	337056.102	349090.770	337056.102	349090.770	Required	
S2	337036.056	349023.285	337036.056	349023.285	Required	
S3	337045.298	348985.471	337045.298	348985.471	Required	
S4	337124.187	349068.873	337124.187	349068.873	Required	
S5	337109.417	349018.763	337109.417	349018.763	Required	
S6	337101.642	348968.191	337101.642	348968.191	Required	
S7	337087.679	348924.864	337087.679	348924.864	Required	
S8	337071.553	348885.513	337071.553	348885.513	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SHWtoDitch	337080.213	348876.824			No Entry	

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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)
S1.000	o	375	S1	36.520	35.046	1.099	Open Manhole	1500
S1.001	o	375	S2	36.290	34.697	1.218	Open Manhole	1500
S1.002	o	375	S3	36.083	34.576	1.132	Open Manhole	1500
S2.000	o	300	S4	36.647	35.147	1.200	Open Manhole	1200
S2.001	o	300	S5	36.227	34.727	1.200	Open Manhole	1200
S1.003	o	375	S6	35.916	34.243	1.298	Open Manhole	1500
S1.004	o	375	S7	35.700	34.037	1.288	Open Manhole	1500
S1.005	o	150	S8	35.525	34.025	1.350	Open Manhole	1500

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)
S1.000	70.400	201.7	S2	36.290	34.697	1.218	Open Manhole	1500
S1.001	38.927	321.0	S3	36.083	34.576	1.132	Open Manhole	1500
S1.002	58.934	177.0	S6	35.916	34.243	1.298	Open Manhole	1500
S2.000	52.241	124.4	S5	36.227	34.727	1.200	Open Manhole	1200
S2.001	51.166	125.1	S6	35.916	34.318	1.298	Open Manhole	1500
S1.003	45.521	221.0	S7	35.700	34.037	1.288	Open Manhole	1500
S1.004	42.527	3543.9	S8	35.525	34.025	1.125	Open Manhole	1500
S1.005	12.267	490.7	SHWtoDitch	35.100	34.000	0.950	Open Manhole	0

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Setting Out Information - True Coordinates (Storm)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Layout (North)
S1.000	S1	1500		337056.102	349090.770	337056.102	349090.770	
S1.001	S2	1500		337036.056	349023.285	337036.056	349023.285	
S1.002	S3	1500		337045.298	348985.471	337045.298	348985.471	
S2.000	S4	1200		337124.187	349068.873	337124.187	349068.873	
S2.001	S5	1200		337109.417	349018.763	337109.417	349018.763	
S1.003	S6	1500		337101.642	348968.191	337101.642	348968.191	
S1.004	S7	1500		337087.679	348924.864	337087.679	348924.864	
S1.005	S8	1500		337071.553	348885.513	337071.553	348885.513	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
S1.005	SHWtoDitch	0		337080.213	348876.824	

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.216	0.216	0.216
1.001	User	-	100	0.147	0.147	0.147
	User	-	100	0.143	0.143	0.290
1.002	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.186	0.186	0.186
2.001	User	-	100	0.150	0.150	0.150
1.003	User	-	100	0.154	0.154	0.154
1.004	User	-	100	0.080	0.080	0.080
1.005	User	-	100	0.078	0.078	0.078
				Total	Total	Total
				1.154	1.154	1.154

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.005	SHWtoDitch	35.100	34.000	34.000	0	0

Simulation Criteria for Storm

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

Number of Input Hydrographs	0	Number of 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	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.322		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S8, DS/PN: S1.005, Volume (m³): 7.2

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	34.025
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	Mean Flow over Head Range	-	4.4

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	3.4	1.200	5.0	3.000	7.7	7.000	11.5
0.200	4.7	1.400	5.4	3.500	8.3	7.500	11.8
0.300	5.0	1.600	5.7	4.000	8.8	8.000	12.2
0.400	5.0	1.800	6.0	4.500	9.3	8.500	12.6
0.500	4.9	2.000	6.3	5.000	9.8	9.000	12.9
0.600	4.7	2.200	6.6	5.500	10.2	9.500	13.3
0.800	4.1	2.400	6.9	6.000	10.7		
1.000	4.6	2.600	7.2	6.500	11.1		

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Storage Structures for Storm

Cellular Storage Manhole: S6, DS/PN: S1.003

Invert Level (m) 34.243 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	921.0	0.0	0.401	0.0	0.0
0.400	921.0	0.0			

Tank or Pond Manhole: S8, DS/PN: S1.005

Invert Level (m) 34.025

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	294.0	1.200	553.5	1.500	631.1

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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 0.000
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 FSR Ratio R 0.325
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 10.0
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, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	1	+40%	30/15 Summer				35.177
S1.001	S2	15 Winter	1	+40%	30/15 Summer				34.934
S1.002	S3	15 Winter	1	+40%	30/15 Summer				34.764
S2.000	S4	15 Winter	1	+40%	30/15 Summer				35.265
S2.001	S5	15 Winter	1	+40%	30/15 Summer				34.884
S1.003	S6	720 Winter	1	+40%	30/360 Winter				34.382
S1.004	S7	720 Winter	1	+40%	30/30 Winter				34.378
S1.005	S8	720 Winter	1	+40%	1/60 Summer				34.374

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.244	0.000	0.25			33.8	OK	
S1.001	S2	-0.138	0.000	0.71			71.1	OK	
S1.002	S3	-0.187	0.000	0.50			70.1	OK	
S2.000	S4	-0.182	0.000	0.32			29.7	OK	
S2.001	S5	-0.143	0.000	0.54			50.3	OK	
S1.003	S6	-0.236	0.000	0.11		422	13.9	OK	
S1.004	S7	-0.034	0.000	0.28			15.0	OK	
S1.005	S8	0.199	0.000	0.77			5.0	SURCHARGED	

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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 0.000
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 FSR Ratio R 0.325
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 10.0
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, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 40, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	30	+40%	30/15 Summer				35.653
S1.001	S2	15 Winter	30	+40%	30/15 Summer				35.528
S1.002	S3	15 Winter	30	+40%	30/15 Summer				35.132
S2.000	S4	15 Winter	30	+40%	30/15 Summer				35.547
S2.001	S5	15 Winter	30	+40%	30/15 Summer				35.312
S1.003	S6	960 Winter	30	+40%	30/360 Winter				34.761
S1.004	S7	960 Winter	30	+40%	30/30 Winter				34.758
S1.005	S8	960 Winter	30	+40%	1/60 Summer				34.755

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.232	0.000	0.59			78.4	SURCHARGED	
S1.001	S2	0.455	0.000	1.77			178.8	SURCHARGED	
S1.002	S3	0.181	0.000	1.19			167.0	SURCHARGED	
S2.000	S4	0.100	0.000	0.75			70.3	SURCHARGED	
S2.001	S5	0.285	0.000	1.30			121.5	SURCHARGED	
S1.003	S6	0.143	0.000	0.12			15.4	SURCHARGED	
S1.004	S7	0.346	0.000	0.33			17.3	SURCHARGED	
S1.005	S8	0.580	0.000	0.77			5.0	SURCHARGED	

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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	0.000
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	FSR	Ratio R	0.325
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	10.0
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, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	40, 40, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	100	+40%	30/15 Summer				36.340
S1.001	S2	15 Winter	100	+40%	30/15 Summer				36.131
S1.002	S3	15 Winter	100	+40%	30/15 Summer				35.480
S2.000	S4	15 Winter	100	+40%	30/15 Summer				36.242
S2.001	S5	15 Winter	100	+40%	30/15 Summer				35.847
S1.003	S6	960 Winter	100	+40%	30/360 Winter				35.171
S1.004	S7	960 Winter	100	+40%	30/30 Winter				35.166
S1.005	S8	960 Winter	100	+40%	1/60 Summer				35.162

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.919	0.000	0.76			100.3	SURCHARGED	
S1.001	S2	1.058	0.000	2.26			227.4	SURCHARGED	
S1.002	S3	0.529	0.000	1.57			220.7	SURCHARGED	
S2.000	S4	0.795	0.000	0.95			89.8	SURCHARGED	
S2.001	S5	0.820	0.000	1.71			159.7	SURCHARGED	
S1.003	S6	0.553	0.000	0.25			31.2	SURCHARGED	
S1.004	S7	0.754	0.000	0.64			33.7	SURCHARGED	
S1.005	S8	0.987	0.000	0.77			5.0	SURCHARGED	

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	40
Ratio R	0.325	Minimum Backdrop Height (m)	4.000
Maximum Rainfall (mm/hr)	250	Maximum Backdrop Height (m)	4.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.500
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.50
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.107	4-8	0.913	8-12	0.289

Total Area Contributing (ha) = 1.308

Total Pipe Volume (m³) = 193.751

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	23.648	0.404	58.5	0.226	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.001	95.579	0.191	500.4	0.390	0.00	0.0	0.600	o	525	Pipe/Conduit	
S1.002	9.211	0.018	511.7	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	55.98	5.19	36.191	0.226	0.0	0.0	13.7	2.06	145.5	48.0
S1.001	49.98	6.79	35.562	0.617	0.0	0.0	33.4	0.99	215.3	116.8
S1.002	49.47	6.95	35.371	0.617	0.0	0.0	33.4	0.98	212.9	116.8

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.003	66.793	0.134	498.5	0.238	0.00	0.0	0.600	\/	-1	Pipe/Conduit	
S1.004	16.393	0.033	496.8	0.157	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	33.008	0.066	500.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.000	36.491	0.073	500.0	0.185	5.00	0.0	0.600	o	300	Pipe/Conduit	
S2.001	55.098	0.370	148.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	16.074	0.032	502.3	0.111	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.007	43.927	0.088	499.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.003	47.94	7.45	35.352	0.855	0.0	0.0	44.4	2.23	5147.7	155.4
S1.004	47.07	7.75	35.219	1.012	0.0	0.0	51.6	0.91	144.0«	180.6
S1.005	45.42	8.36	35.186	1.012	0.0	0.0	51.6	0.90	143.5«	180.6
S2.000	53.22	5.87	35.788	0.185	0.0	0.0	10.7	0.70	49.2	37.3
S2.001	50.66	6.59	35.715	0.185	0.0	0.0	10.7	1.29	90.9	37.3
S1.006	43.91	8.97	35.120	1.308	0.0	0.0	62.2	0.44	7.8«	217.8
S1.007	40.34	10.62	35.088	1.308	0.0	0.0	62.2	0.44	7.8«	217.8

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	36.991	0.800	Open Manhole	1200	S1.000	36.191	300				
S2	36.548	0.986	Open Manhole	1500	S1.001	35.562	525	S1.000	35.787	300	
S3	36.816	1.445	Open Manhole	1500	S1.002	35.371	525	S1.001	35.371	525	
S4	36.700	1.348	Junction		S1.003	35.352	-1	S1.002	35.353	525	
S5	36.624	1.406	Junction		S1.004	35.219	450	S1.003	35.218	-1	
S6	36.757	1.571	Open Manhole	1200	S1.005	35.186	450	S1.004	35.186	450	
S7	36.588	0.800	Open Manhole	1200	S2.000	35.788	300				
S8	36.636	0.921	Open Manhole	1200	S2.001	35.715	300	S2.000	35.715	300	
S9	36.620	1.500	Open Manhole	1500	S1.006	35.120	150	S1.005	35.120	450	
								S2.001	35.345	300	375
S10	36.039	0.951	Open Manhole	1050	S1.007	35.088	150	S1.006	35.088	150	
SHWtoDitch	35.746	0.746	Open Manhole	0		OUTFALL		S1.007	35.000	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	337033.746	349103.777	337033.746	349103.777	Required	
S2	337056.436	349097.113	337056.436	349097.113	Required	
S3	337084.166	349188.580	337084.166	349188.580	Required	
S4	337089.717	349195.930			No Entry	
S5	337153.670	349176.663			No Entry	
S6	337149.049	349160.934	337149.049	349160.934	Required	
S7	337124.150	349073.123	337124.150	349073.123	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S8	337135.019	349107.958	337135.019	349107.958	Required	
S9	337177.096	349143.530	337177.096	349143.530	Required	
S10	337193.076	349145.261	337193.076	349145.261	Required	
SHWtoDitch	337236.974	349143.662			No Entry	

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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)
S1.000	o	300	S1	36.991	36.191	0.500	Open Manhole	1200
S1.001	o	525	S2	36.548	35.562	0.461	Open Manhole	1500
S1.002	o	525	S3	36.816	35.371	0.920	Open Manhole	1500
S1.003	\/	-1	S4	36.700	35.352	0.000	Junction	
S1.004	o	450	S5	36.624	35.219	0.955	Junction	
S1.005	o	450	S6	36.757	35.186	1.121	Open Manhole	1200
S2.000	o	300	S7	36.588	35.788	0.500	Open Manhole	1200
S2.001	o	300	S8	36.636	35.715	0.621	Open Manhole	1200
S1.006	o	150	S9	36.620	35.120	1.350	Open Manhole	1500
S1.007	o	150	S10	36.039	35.088	0.801	Open Manhole	1050

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)
S1.000	23.648	58.5	S2	36.548	35.787	0.461	Open Manhole	1500
S1.001	95.579	500.4	S3	36.816	35.371	0.920	Open Manhole	1500
S1.002	9.211	511.7	S4	36.700	35.353	0.822	Junction	
S1.003	66.793	498.5	S5	36.624	35.218	0.058	Junction	
S1.004	16.393	496.8	S6	36.757	35.186	1.121	Open Manhole	1200
S1.005	33.008	500.1	S9	36.620	35.120	1.050	Open Manhole	1500
S2.000	36.491	500.0	S8	36.636	35.715	0.621	Open Manhole	1200
S2.001	55.098	148.9	S9	36.620	35.345	0.975	Open Manhole	1500
S1.006	16.074	502.3	S10	36.039	35.088	0.801	Open Manhole	1050
S1.007	43.927	499.2	SHWtoDitch	35.746	35.000	0.596	Open Manhole	0

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Setting Out Information - True Coordinates (Storm)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Layout (North)
S1.000	S1	1200		337033.746	349103.777	337033.746	349103.777	
S1.001	S2	1500		337056.436	349097.113	337056.436	349097.113	
S1.002	S3	1500		337084.166	349188.580	337084.166	349188.580	
S1.003	S4			337089.717	349195.930			
S1.004	S5			337153.670	349176.663			
S1.005	S6	1200		337149.049	349160.934	337149.049	349160.934	
S2.000	S7	1200		337124.150	349073.123	337124.150	349073.123	
S2.001	S8	1200		337135.019	349107.958	337135.019	349107.958	
S1.006	S9	1500		337177.096	349143.530	337177.096	349143.530	
S1.007	S10	1050		337193.076	349145.261	337193.076	349145.261	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
S1.007	SHWtoDitch	0		337236.974	349143.662	

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.226	0.226	0.226
1.001	User	-	100	0.090	0.090	0.090
	User	-	100	0.300	0.300	0.390
1.002	-	-	100	0.000	0.000	0.000
1.003	User	-	100	0.238	0.238	0.238
1.004	User	-	100	0.157	0.157	0.157
1.005	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.185	0.185	0.185
2.001	-	-	100	0.000	0.000	0.000
1.006	User	-	100	0.111	0.111	0.111
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.308	1.308	1.308

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.007	SHWtoDitch	35.746	35.000	35.000	0	0

Simulation Criteria for Storm

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

Number of Input Hydrographs	0	Number of 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)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.325		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S9, DS/PN: S1.006, Volume (m³): 11.5

Unit Reference	MD-SHE-0125-7500-1200-7500
Design Head (m)	1.200
Design Flow (l/s)	7.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	125
Invert Level (m)	35.120
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	7.5	Kick-Flo®	0.763	6.1
Flush-Flo™	0.356	7.5	Mean Flow over Head Range	-	6.5

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)
0.100	4.5	1.200	7.5	3.000	11.5	7.000	17.3
0.200	7.1	1.400	8.1	3.500	12.4	7.500	17.9
0.300	7.5	1.600	8.6	4.000	13.2	8.000	18.4
0.400	7.5	1.800	9.1	4.500	14.0	8.500	19.0
0.500	7.4	2.000	9.5	5.000	14.7	9.000	19.5
0.600	7.1	2.200	10.0	5.500	15.4	9.500	20.0
0.800	6.2	2.400	10.4	6.000	16.1		
1.000	6.9	2.600	10.8	6.500	16.7		

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Storage Structures for Storm

Tank or Pond Manhole: S9, DS/PN: S1.006

Invert Level (m) 35.120

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	524.0	1.200	856.8	1.500	952.8

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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 0.000
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 Ratio R 0.322
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 0.0
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, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	1	+40%	100/15 Summer				36.300
S1.001	S2	15 Winter	1	+40%	30/15 Summer				35.810
S1.002	S3	15 Winter	1	+40%	30/15 Summer				35.676
S1.003	S4	15 Winter	1	+40%					35.626
S1.004	S5	15 Winter	1	+40%	30/15 Summer				35.560
S1.005	S6	720 Winter	1	+40%	30/15 Summer				35.530
S2.000	S7	15 Winter	1	+40%	30/15 Summer				35.968
S2.001	S8	15 Winter	1	+40%	30/600 Winter				35.835
S1.006	S9	720 Winter	1	+40%	1/15 Summer				35.525
S1.007	S10	720 Winter	1	+40%					35.205

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.191	0.000	0.28			36.8	OK	
S1.001	S2	-0.277	0.000	0.41			82.2	OK	
S1.002	S3	-0.220	0.000	0.64			74.3	OK	
S1.003	S4	-1.074	0.000	0.02			97.5	OK	
S1.004	S5	-0.109	0.000	0.91			107.0	OK*	
S1.005	S6	-0.106	0.000	0.14			18.0	OK	
S2.000	S7	-0.120	0.000	0.64			29.3	OK	
S2.001	S8	-0.180	0.000	0.34			29.0	OK	
S1.006	S9	0.255	0.000	1.02			7.4	SURCHARGED	
S1.007	S10	-0.033	0.000	0.97			7.4	OK	

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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 0.000
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 Ratio R 0.322
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 0.0
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, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	30	+40%	100/15 Summer				36.389
S1.001	S2	15 Winter	30	+40%	30/15 Summer				36.202
S1.002	S3	15 Winter	30	+40%	30/15 Summer				36.031
S1.003	S4	720 Winter	30	+40%					36.025
S1.004	S5	720 Winter	30	+40%	30/15 Summer				36.025
S1.005	S6	720 Winter	30	+40%	30/15 Summer				36.023
S2.000	S7	15 Winter	30	+40%	30/15 Summer				36.196
S2.001	S8	720 Winter	30	+40%	30/600 Winter				36.022
S1.006	S9	720 Winter	30	+40%	1/15 Summer				36.021
S1.007	S10	4320 Winter	30	+40%					35.206

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.102	0.000	0.69			89.6	OK	
S1.001	S2	0.115	0.000	1.10			222.3	SURCHARGED	
S1.002	S3	0.135	0.000	1.74			203.4	SURCHARGED	
S1.003	S4	-0.675	0.000	0.01			33.8	OK	
S1.004	S5	0.356	0.000	0.34			39.9	SURCHARGED*	
S1.005	S6	0.387	0.000	0.32			39.6	SURCHARGED	
S2.000	S7	0.108	0.000	1.57			71.6	SURCHARGED	
S2.001	S8	0.007	0.000	0.09			7.4	SURCHARGED	
S1.006	S9	0.751	0.000	1.03			7.5	SURCHARGED	
S1.007	S10	-0.032	0.000	0.98			7.5	OK	

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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 0.000
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 Ratio R 0.322
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 0.0
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, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	100	+40%	100/15 Summer				36.830
S1.001	S2	15 Winter	100	+40%	30/15 Summer				36.543
S1.002	S3	960 Winter	100	+40%	30/15 Summer				36.273
S1.003	S4	960 Winter	100	+40%					36.272
S1.004	S5	960 Winter	100	+40%	30/15 Summer				36.271
S1.005	S6	960 Winter	100	+40%	30/15 Summer				36.270
S2.000	S7	15 Winter	100	+40%	30/15 Summer				36.326
S2.001	S8	960 Winter	100	+40%	30/600 Winter				36.269
S1.006	S9	960 Winter	100	+40%	1/15 Summer				36.267
S1.007	S10	7200 Winter	100	+40%					35.206

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.339	0.000	0.85			110.1	SURCHARGED	
S1.001	S2	0.456	0.000	1.37			277.5	SURCHARGED	
S1.002	S3	0.377	0.000	0.22			25.2	SURCHARGED	
S1.003	S4	-0.428	0.000	0.01			34.7	OK	
S1.004	S5	0.602	0.000	0.31			36.8	SURCHARGED*	
S1.005	S6	0.634	0.000	0.29			36.4	SURCHARGED	
S2.000	S7	0.238	0.000	2.03			92.2	SURCHARGED	
S2.001	S8	0.254	0.000	0.09			7.4	SURCHARGED	
S1.006	S9	0.997	0.000	1.03			7.5	SURCHARGED	
S1.007	S10	-0.032	0.000	0.98			7.5	OK	

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	40
Ratio R	0.325	Minimum Backdrop Height (m)	4.000
Maximum Rainfall (mm/hr)	250	Maximum Backdrop Height (m)	4.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.500
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.50
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.107	4-8	0.913	8-12	0.289

Total Area Contributing (ha) = 1.308

Total Pipe Volume (m³) = 193.751

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	23.648	0.404	58.5	0.226	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.001	95.579	0.191	500.4	0.390	0.00	0.0	0.600	o	525	Pipe/Conduit	
S1.002	9.211	0.018	511.7	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	55.98	5.19	36.191	0.226	0.0	0.0	13.7	2.06	145.5	48.0
S1.001	49.98	6.79	35.562	0.617	0.0	0.0	33.4	0.99	215.3	116.8
S1.002	49.47	6.95	35.371	0.617	0.0	0.0	33.4	0.98	212.9	116.8

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.003	66.793	0.134	498.5	0.238	0.00	0.0	0.600	\/	-1	Pipe/Conduit	
S1.004	16.393	0.033	496.8	0.157	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	33.008	0.066	500.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.000	36.491	0.073	500.0	0.185	5.00	0.0	0.600	o	300	Pipe/Conduit	
S2.001	55.098	0.370	148.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	16.074	0.032	502.3	0.111	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.007	43.927	0.088	499.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.003	47.94	7.45	35.352	0.855	0.0	0.0	44.4	2.23	5147.7	155.4
S1.004	47.07	7.75	35.219	1.012	0.0	0.0	51.6	0.91	144.0«	180.6
S1.005	45.42	8.36	35.186	1.012	0.0	0.0	51.6	0.90	143.5«	180.6
S2.000	53.22	5.87	35.788	0.185	0.0	0.0	10.7	0.70	49.2	37.3
S2.001	50.66	6.59	35.715	0.185	0.0	0.0	10.7	1.29	90.9	37.3
S1.006	43.91	8.97	35.120	1.308	0.0	0.0	62.2	0.44	7.8«	217.8
S1.007	40.34	10.62	35.088	1.308	0.0	0.0	62.2	0.44	7.8«	217.8

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.226	0.226	0.226
1.001	User	-	100	0.090	0.090	0.090
	User	-	100	0.300	0.300	0.390
1.002	-	-	100	0.000	0.000	0.000
1.003	User	-	100	0.238	0.238	0.238
1.004	User	-	100	0.157	0.157	0.157
1.005	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.185	0.185	0.185
2.001	-	-	100	0.000	0.000	0.000
1.006	User	-	100	0.111	0.111	0.111
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.308	1.308	1.308

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.007	SHWtoDitch	35.746	35.000	35.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of 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	Winter
Return Period (years)	1000	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	15
Ratio R	0.325		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S9, DS/PN: S1.006, Volume (m³): 11.5

Unit Reference	MD-SHE-0125-7500-1200-7500
Design Head (m)	1.200
Design Flow (l/s)	7.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	125
Invert Level (m)	35.120
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	7.5	Kick-Flo®	0.763	6.1
Flush-Flo™	0.356	7.5	Mean Flow over Head Range	-	6.5

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)
0.100	4.5	1.200	7.5	3.000	11.5	7.000	17.3
0.200	7.1	1.400	8.1	3.500	12.4	7.500	17.9
0.300	7.5	1.600	8.6	4.000	13.2	8.000	18.4
0.400	7.5	1.800	9.1	4.500	14.0	8.500	19.0
0.500	7.4	2.000	9.5	5.000	14.7	9.000	19.5
0.600	7.1	2.200	10.0	5.500	15.4	9.500	20.0
0.800	6.2	2.400	10.4	6.000	16.1		
1.000	6.9	2.600	10.8	6.500	16.7		

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Storage Structures for Storm

Tank or Pond Manhole: S9, DS/PN: S1.006

Invert Level (m) 35.120

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	524.0	1.200	856.8	1.500	952.8

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Summary of Results for 15 minute 1000 year Winter (Storm)

Margin for Flood Risk Warning (mm) 0.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS Status OFF

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	36.991	0.500	0.370	1.00			129.6	FLOOD
S1.001	S2	36.615	0.528	12.617	1.41			286.0	FLOOD
S1.002	S3	36.370	0.474	0.000	2.42			283.4	SURCHARGED
S1.003	S4	36.315	-0.385	0.000	0.08			409.6	OK
S1.004	S5	36.226	0.557	0.000	2.59			302.8	SURCHARGED*
S1.005	S6	35.936	0.300	0.000	2.41			301.5	SURCHARGED
S2.000	S7	36.553	0.465	0.000	2.29			103.9	SURCHARGED
S2.001	S8	36.163	0.148	0.000	1.20			103.1	SURCHARGED
S1.006	S9	35.650	0.380	0.000	1.03			7.5	SURCHARGED
S1.007	S10	35.206	-0.032	0.000	0.98			7.5	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	40
Ratio R	0.322	Minimum Backdrop Height (m)	4.000
Maximum Rainfall (mm/hr)	250	Maximum Backdrop Height (m)	4.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.112	4-8	0.794	8-12	0.249

Total Area Contributing (ha) = 1.154

Total Pipe Volume (m³) = 35.835

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	70.400	0.349	201.7	0.216	5.00	0.0	0.600	o	375	Pipe/Conduit	
S1.001	38.927	0.121	321.0	0.290	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.002	58.934	0.333	177.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	52.79	5.92	35.046	0.216	0.0	0.0	12.3	1.27	140.5	43.2
S1.001	50.51	6.57	34.697	0.506	0.0	0.0	27.7	1.01	111.1	96.9
S1.002	48.21	7.29	34.576	0.506	0.0	0.0	27.7	1.36	150.1	96.9

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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
S2.000	52.241	0.420	124.4	0.186	5.00	0.0	0.600	o	300	Pipe/Conduit	
S2.001	51.166	0.409	125.1	0.150	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	45.521	0.206	221.0	0.154	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.004	42.527	0.012	3543.9	0.080	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.005	12.267	0.025	490.7	0.078	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.000	53.96	5.62	35.147	0.186	0.0	0.0	10.9	1.41	99.6	38.1
S2.001	51.69	6.23	34.727	0.336	0.0	0.0	18.8	1.40	99.3	65.9
S1.003	46.42	7.91	34.243	0.996	0.0	0.0	50.1	1.21	134.2«	175.3
S1.004	40.79	10.32	34.037	1.076	0.0	0.0	50.1	0.29	32.6«	175.3
S1.005	39.89	10.77	34.025	1.154	0.0	0.0	50.1	0.45	7.9«	175.3

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.216	0.216	0.216
1.001	User	-	100	0.147	0.147	0.147
	User	-	100	0.143	0.143	0.290
1.002	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.186	0.186	0.186
2.001	User	-	100	0.150	0.150	0.150
1.003	User	-	100	0.154	0.154	0.154
1.004	User	-	100	0.080	0.080	0.080
1.005	User	-	100	0.078	0.078	0.078
				Total	Total	Total
				1.154	1.154	1.154

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.005	SHWtoDitch	35.100	34.000	34.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of 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	FSR	Profile Type	Winter
Return Period (years)	1000	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	15
Ratio R	0.322		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S8, DS/PN: S1.005, Volume (m³): 7.2

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	34.025
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	Mean Flow over Head Range	-	4.4

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	3.4	1.200	5.0	3.000	7.7	7.000	11.5
0.200	4.7	1.400	5.4	3.500	8.3	7.500	11.8
0.300	5.0	1.600	5.7	4.000	8.8	8.000	12.2
0.400	5.0	1.800	6.0	4.500	9.3	8.500	12.6
0.500	4.9	2.000	6.3	5.000	9.8	9.000	12.9
0.600	4.7	2.200	6.6	5.500	10.2	9.500	13.3
0.800	4.1	2.400	6.9	6.000	10.7		
1.000	4.6	2.600	7.2	6.500	11.1		

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Storage Structures for Storm

Cellular Storage Manhole: S6, DS/PN: S1.003

Invert Level (m) 34.243 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	921.0	0.0	0.401	0.0	0.0
0.400	921.0	0.0			

Tank or Pond Manhole: S8, DS/PN: S1.005

Invert Level (m) 34.025

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	294.0	1.200	553.5	1.500	631.1

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Summary of Results for 15 minute 1000 year Winter (Storm)

Margin for Flood Risk Warning (mm) 10.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	36.542	1.121	1.419	0.82			109.4	FLOOD
S1.001	S2	36.293	1.220	3.090	2.40			242.3	FLOOD
S1.002	S3	35.594	0.643	0.000	1.69			237.9	SURCHARGED
S2.000	S4	36.650	1.203	0.599	1.08			101.3	FLOOD
S2.001	S5	36.227	1.200	0.033	1.94			182.1	FLOOD
S1.003	S6	34.511	-0.107	0.000	0.57			69.7	OK
S1.004	S7	34.445	0.033	0.000	1.32			69.4	SURCHARGED
S1.005	S8	34.418	0.243	0.000	0.77			5.0	SURCHARGED

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ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 800 Urban 0.000
Area (ha) 3.019 Soil 0.450 Region Number Region 4

Results l/s

QBAR Rural 15.5
QBAR Urban 15.5

Q100 years 39.8

Q1 year 12.9
Q30 years 30.4
Q100 years 39.8

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Appendix F

FloodFlow Analysis

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	40
Ratio R	0.325	Minimum Backdrop Height (m)	4.000
Maximum Rainfall (mm/hr)	250	Maximum Backdrop Height (m)	4.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.500
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.50
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.107	4-8	0.913	8-12	0.289

Total Area Contributing (ha) = 1.308

Total Pipe Volume (m³) = 193.751

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	23.648	0.404	58.5	0.226	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.001	95.579	0.191	500.4	0.390	0.00	0.0	0.600	o	525	Pipe/Conduit	
S1.002	9.211	0.018	511.7	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	55.98	5.19	36.191	0.226	0.0	0.0	13.7	2.06	145.5	48.0
S1.001	49.98	6.79	35.562	0.617	0.0	0.0	33.4	0.99	215.3	116.8
S1.002	49.47	6.95	35.371	0.617	0.0	0.0	33.4	0.98	212.9	116.8

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.003	66.793	0.134	498.5	0.238	0.00	0.0	0.600	\/	-1	Pipe/Conduit	
S1.004	16.393	0.033	496.8	0.157	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	33.008	0.066	500.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.000	36.491	0.073	500.0	0.185	5.00	0.0	0.600	o	300	Pipe/Conduit	
S2.001	55.098	0.370	148.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	16.074	0.032	502.3	0.111	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.007	43.927	0.088	499.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.003	47.94	7.45	35.352	0.855	0.0	0.0	44.4	2.23	5147.7	155.4
S1.004	47.07	7.75	35.219	1.012	0.0	0.0	51.6	0.91	144.0«	180.6
S1.005	45.42	8.36	35.186	1.012	0.0	0.0	51.6	0.90	143.5«	180.6
S2.000	53.22	5.87	35.788	0.185	0.0	0.0	10.7	0.70	49.2	37.3
S2.001	50.66	6.59	35.715	0.185	0.0	0.0	10.7	1.29	90.9	37.3
S1.006	43.91	8.97	35.120	1.308	0.0	0.0	62.2	0.44	7.8«	217.8
S1.007	40.34	10.62	35.088	1.308	0.0	0.0	62.2	0.44	7.8«	217.8

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.226	0.226	0.226
1.001	User	-	100	0.090	0.090	0.090
	User	-	100	0.300	0.300	0.390
1.002	-	-	100	0.000	0.000	0.000
1.003	User	-	100	0.238	0.238	0.238
1.004	User	-	100	0.157	0.157	0.157
1.005	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.185	0.185	0.185
2.001	-	-	100	0.000	0.000	0.000
1.006	User	-	100	0.111	0.111	0.111
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.308	1.308	1.308

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.007	SHWtoDitch	35.746	35.000	35.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of 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	Winter
Return Period (years)	1000	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	15
Ratio R	0.325		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S9, DS/PN: S1.006, Volume (m³): 11.5

Unit Reference	MD-SHE-0125-7500-1200-7500
Design Head (m)	1.200
Design Flow (l/s)	7.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	125
Invert Level (m)	35.120
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	7.5	Kick-Flo®	0.763	6.1
Flush-Flo™	0.356	7.5	Mean Flow over Head Range	-	6.5

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)
0.100	4.5	1.200	7.5	3.000	11.5	7.000	17.3
0.200	7.1	1.400	8.1	3.500	12.4	7.500	17.9
0.300	7.5	1.600	8.6	4.000	13.2	8.000	18.4
0.400	7.5	1.800	9.1	4.500	14.0	8.500	19.0
0.500	7.4	2.000	9.5	5.000	14.7	9.000	19.5
0.600	7.1	2.200	10.0	5.500	15.4	9.500	20.0
0.800	6.2	2.400	10.4	6.000	16.1		
1.000	6.9	2.600	10.8	6.500	16.7		

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Storage Structures for Storm

Tank or Pond Manhole: S9, DS/PN: S1.006

Invert Level (m) 35.120

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	524.0	1.200	856.8	1.500	952.8

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Summary of Results for 15 minute 1000 year Winter (Storm)

Margin for Flood Risk Warning (mm) 0.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS Status OFF

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	36.991	0.500	0.370	1.00			129.6	FLOOD
S1.001	S2	36.615	0.528	12.617	1.41			286.0	FLOOD
S1.002	S3	36.370	0.474	0.000	2.42			283.4	SURCHARGED
S1.003	S4	36.315	-0.385	0.000	0.08			409.6	OK
S1.004	S5	36.226	0.557	0.000	2.59			302.8	SURCHARGED*
S1.005	S6	35.936	0.300	0.000	2.41			301.5	SURCHARGED
S2.000	S7	36.553	0.465	0.000	2.29			103.9	SURCHARGED
S2.001	S8	36.163	0.148	0.000	1.20			103.1	SURCHARGED
S1.006	S9	35.650	0.380	0.000	1.03			7.5	SURCHARGED
S1.007	S10	35.206	-0.032	0.000	0.98			7.5	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	40
Ratio R	0.322	Minimum Backdrop Height (m)	4.000
Maximum Rainfall (mm/hr)	250	Maximum Backdrop Height (m)	4.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.112	4-8	0.794	8-12	0.249

Total Area Contributing (ha) = 1.154

Total Pipe Volume (m³) = 35.835

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	70.400	0.349	201.7	0.216	5.00	0.0	0.600	o	375	Pipe/Conduit	
S1.001	38.927	0.121	321.0	0.290	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.002	58.934	0.333	177.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	52.79	5.92	35.046	0.216	0.0	0.0	12.3	1.27	140.5	43.2
S1.001	50.51	6.57	34.697	0.506	0.0	0.0	27.7	1.01	111.1	96.9
S1.002	48.21	7.29	34.576	0.506	0.0	0.0	27.7	1.36	150.1	96.9

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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
S2.000	52.241	0.420	124.4	0.186	5.00	0.0	0.600	o	300	Pipe/Conduit	
S2.001	51.166	0.409	125.1	0.150	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	45.521	0.206	221.0	0.154	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.004	42.527	0.012	3543.9	0.080	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.005	12.267	0.025	490.7	0.078	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.000	53.96	5.62	35.147	0.186	0.0	0.0	10.9	1.41	99.6	38.1
S2.001	51.69	6.23	34.727	0.336	0.0	0.0	18.8	1.40	99.3	65.9
S1.003	46.42	7.91	34.243	0.996	0.0	0.0	50.1	1.21	134.2«	175.3
S1.004	40.79	10.32	34.037	1.076	0.0	0.0	50.1	0.29	32.6«	175.3
S1.005	39.89	10.77	34.025	1.154	0.0	0.0	50.1	0.45	7.9«	175.3

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.216	0.216	0.216
1.001	User	-	100	0.147	0.147	0.147
	User	-	100	0.143	0.143	0.290
1.002	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.186	0.186	0.186
2.001	User	-	100	0.150	0.150	0.150
1.003	User	-	100	0.154	0.154	0.154
1.004	User	-	100	0.080	0.080	0.080
1.005	User	-	100	0.078	0.078	0.078
				Total	Total	Total
				1.154	1.154	1.154

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.005	SHWtoDitch	35.100	34.000	34.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of 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	FSR	Profile Type	Winter
Return Period (years)	1000	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	15
Ratio R	0.322		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S8, DS/PN: S1.005, Volume (m³): 7.2

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	34.025
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	Mean Flow over Head Range	-	4.4

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	3.4	1.200	5.0	3.000	7.7	7.000	11.5
0.200	4.7	1.400	5.4	3.500	8.3	7.500	11.8
0.300	5.0	1.600	5.7	4.000	8.8	8.000	12.2
0.400	5.0	1.800	6.0	4.500	9.3	8.500	12.6
0.500	4.9	2.000	6.3	5.000	9.8	9.000	12.9
0.600	4.7	2.200	6.6	5.500	10.2	9.500	13.3
0.800	4.1	2.400	6.9	6.000	10.7		
1.000	4.6	2.600	7.2	6.500	11.1		

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Storage Structures for Storm

Cellular Storage Manhole: S6, DS/PN: S1.003

Invert Level (m) 34.243 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	921.0	0.0	0.401	0.0	0.0
0.400	921.0	0.0			

Tank or Pond Manhole: S8, DS/PN: S1.005

Invert Level (m) 34.025

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	294.0	1.200	553.5	1.500	631.1

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Summary of Results for 15 minute 1000 year Winter (Storm)

Margin for Flood Risk Warning (mm) 10.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	36.542	1.121	1.419	0.82			109.4	FLOOD
S1.001	S2	36.293	1.220	3.090	2.40			242.3	FLOOD
S1.002	S3	35.594	0.643	0.000	1.69			237.9	SURCHARGED
S2.000	S4	36.650	1.203	0.599	1.08			101.3	FLOOD
S2.001	S5	36.227	1.200	0.033	1.94			182.1	FLOOD
S1.003	S6	34.511	-0.107	0.000	0.57			69.7	OK
S1.004	S7	34.445	0.033	0.000	1.32			69.4	SURCHARGED
S1.005	S8	34.418	0.243	0.000	0.77			5.0	SURCHARGED

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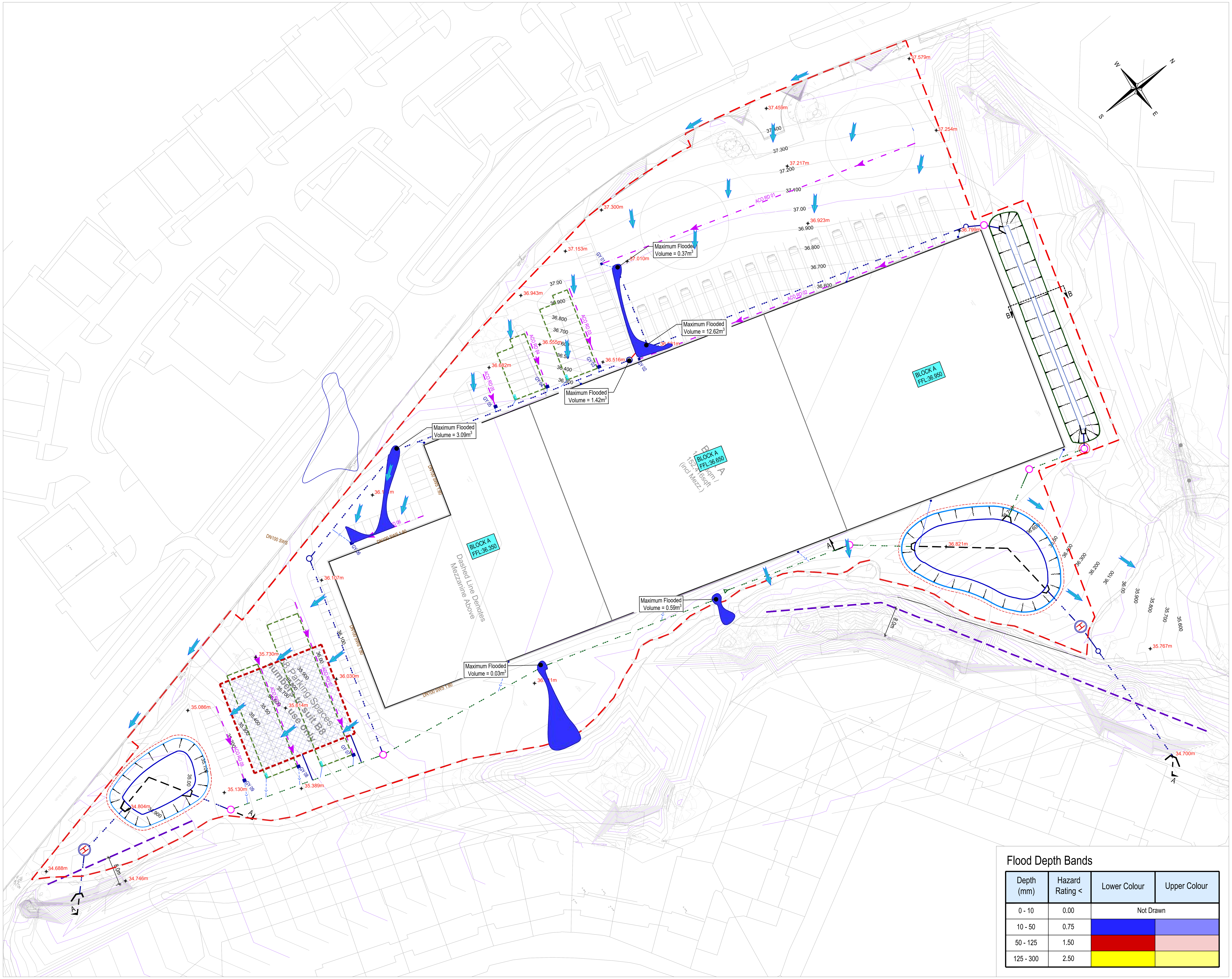

Safety, Health & Environmental Information:
In addition to the hazards and risks normally associated with the types of work detailed on this drawing, please note the significant hazards identified by symbols below,
INDICATES A RESIDUAL RISK AS A WARNING
INDICATES A RESIDUAL RISK FOR INFORMATION
and described below:
Construction/Maintenance/Cleaning/Demolition
Refer to Drawing:

General Notes:

1. Do not scale from this drawing.
2. All dimensions are in millimetres (mm), all levels in metres (m) unless noted otherwise.
3. Discrepancies or omissions are to be reported to the Engineer prior to work commencing.
4. Materials and workmanship are to comply in all respects with current British Standard Specifications, Codes of Practice, and Building Regulations Approved Documents.
5. The copyright of this drawing is vested in the Engineer and must not be copied or reproduced without written consent.
6. The Contractor is to check and verify all building and site dimensions, levels and sewer invert levels at connection points before work commences.
7. This drawing is to be read in conjunction with all relevant specifications and drawings issued by the Engineer, Architect and other Specialists.

Drainage Key

Symbol	Description
DN XXX SWS 1:XX	Proposed Surface Water Sewer
SXX	Proposed Surface Water Manhole, refer to Drawing S5A-BML-XX-XX-DR-C-0500 for Details
SXX (H)	Proposed Surface Hydro Brake Chamber, refer to Drawing S5A-BML-XX-XX-DR-C-0500 for Details
SXX (C)	Proposed Ridgistorm Separate Catchpit, refer to Drawing S5A-BML-XX-XX-DR-C-0500 for Details
	Proposed Manhole with installed Orifice Plate on one of the pipes
•RWP	Rain Water Pipe Location
--->--->--->--->-	DN150 Gully/RWP Connector
DN XXX SWS 1:XX	Proposed Filter Drain
XX --->--->--->-	Proposed Permavoid Diffuser Unit, refer to Drawing S5A-BML-XX-XX-DR-C-0500 for Details
GY XX --->—	Proposed Road Gully
FFL:29.500	Assumed Finished Floor Level
	Site Boundary

Flood Depth Bands

Depth (mm)	Hazard Rating <	Lower Colour	Upper Colour
0 - 10	0.00	Not Drawn	
10 - 50	0.75		
50 - 125	1.50		
125 - 300	2.50		

P01	DH/AM	17/09/21	Preliminary Issue
Rev	By / Chk'd	Date	Description

PRELIMINARY DRAWING
This drawing is not to be used for construction

Client

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BarnsleyMarshall

Project

Site 5a, Wrexham

Drawing

Flood Flow Analysis
100-Year + 40% CC
15min Winter Storm Event

By DH/AM Date 03/09/21

Drawing No. S5A-BML-XX-XX-DR-C-0504

Revision P01

BML Job No. 1000-02

Status -

Drawing Scale at A1: 1:500

CAD Filename: C:\Users\MarcelRichards\bmshare\BM Server - Share\Projects\1000-02 Site 5a, Wrexham\Information - Working\DWG\S5A-BML-XX-XX-DR-C-0504 P01 - Flood Flow Analysis 100-Year + 40%CC.dwg

Appendix G

Welsh Water Sewer Maps

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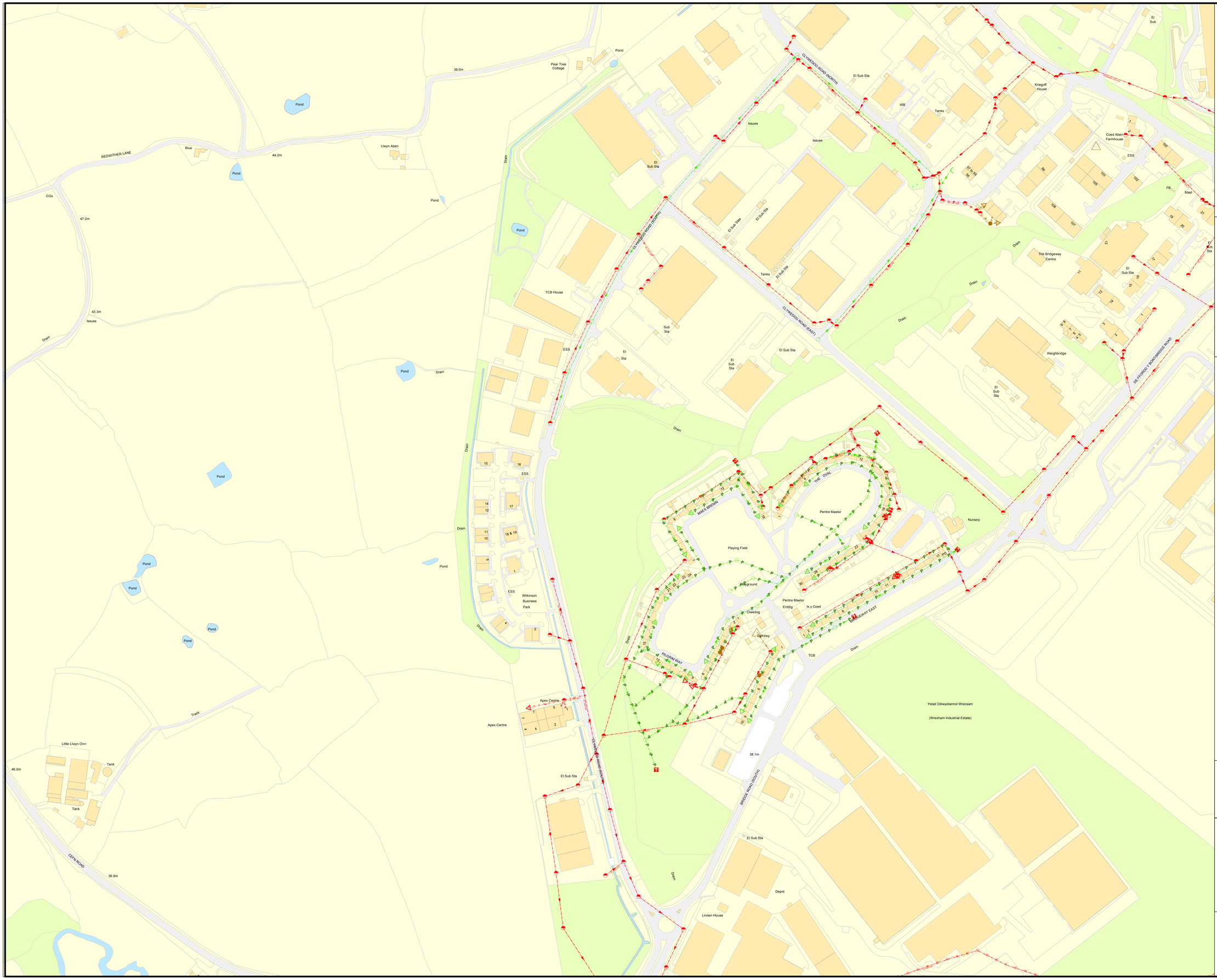

Dwr Cymru
Welsh Water

Site 5a Wrexham Industrial Estate Clywedog
Road South Wrexham Industrial Estate
Abenbury Pentre Maelor LL13 9XS

N
W E
S

LEGEND(Representative of most common features)

Waste network:

- Foul chamber
- Surface water chamber
- Combined chamber
- Combined sewer overflow
- Special purpose chamber
- Treatment works
- Pumping station
- Outfall
- Lamphole
- Storm Overflow
- Rising main
- Gravity sewer
- Private sewer
- Private sewer subject to Sect. 104 adoption agreement
- Private Sewer Transfer
- Lateral Drain
- Inspection Chamber

NB: Sewer symbol colour indicates the type.
RED - Combined
GREEN - Surface Water
BROWN - Foul
Purple - Former S24 sewers (for indicative purposes only)

Notes:

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases, pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be asbestos cement (AC) or Pitch Fibre (PF) . It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation

Dŵr Cymru Cyfyngedig ('the Company') gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its accuracy is given or implied. The information provided does not disclose the existence of any other underground apparatus. The onus of locating apparatus before carrying out any excavations rests entirely on you. The information which is supplied by the Company, is done so in accordance with the statutory requirements of sections 196 and 199 of the Water Industry Act 1991 which is based upon the best information available and, in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of a water main, service pipe, sewer, lateral drain or disposal main and any associated apparatus laid before 1 September 1989, or, if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the Company's right to be compensated for any damage to its apparatus.

Service pipes are not generally shown but their presence should be anticipated.

EXACT LOCATIONS OF ALL APPARATUS TO BE DETERMINED ON SITE.

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