

SDP

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J ob Ref: Ford Road
Arundel

Title: Surface Water Drainage Calculations Report

J ob No: E 19-003

By: Nigel J ones

Date: April 2020 (Second Issue)

Structural Design Consulting Engineers Ltd Registered No. 2601187 England
Head Office: Suite 3, Salar House, Campfield Road, St Albans, Herts AL1 5HT

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Site Drainage Plan

Surface Water Network MicroDrainage Calculations -

Outfall 1 Network

Scenario 1

Existing Drainage Ditch full to top of Bank Level

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Suite 3, Salar House 61 Campfield Road St Albans AL1 5HT	OUTFALL 1 NETWORK FORD ROAD ARUNDEL	
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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)	100	PIMP (%)	100
M5-60 (mm)	19.900	Add Flow / Climate Change (%)	40
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.053	4-8	0.019

Total Area Contributing (ha) = 0.072

Total Pipe Volume (m³) = 53.564

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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)
1	5.225	2.975	Open Manhole	600	1.000	2.250	300				
2	5.225	2.985	Open Manhole	500	1.001	2.240	300	1.000	2.240	300	
3	3.900	1.940	Open Manhole	500	1.002	1.960	300	1.001	1.960		
4	3.900	1.950	Open Manhole	600	1.003	1.950	300	1.002	1.950	300	
5	3.750	1.850	Open Manhole	600	1.004	1.900	300	1.003	1.900	300	
6	3.700	1.820	Open Manhole	600	1.005	1.880	300	1.004	1.880	300	
7	3.500	1.680	Sealed Manhole	1200	1.006	1.820	150	1.005	1.820	300	
	3.120	1.375	Open Manhole	0		OUTFALL		1.006	1.745	150	

No coordinates have been specified, layout information cannot be produced.

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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)
1.000	o		1	5.225	2.250	2.975	Open Manhole	600
1.001	→[↓]		2	5.225	2.240	1.734	Open Manhole	500
1.002	o	300	3	3.900	1.960	1.640	Open Manhole	500
1.003	o	300	4	3.900	1.950	1.650	Open Manhole	600
1.004	o	300	5	3.750	1.900	1.550	Open Manhole	600
1.005	o	300	6	3.700	1.880	1.520	Open Manhole	600
1.006	o	150	7	3.500	1.820	1.530	Sealed 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	1.400	140.0	2	5.225	2.240	2.985	Open Manhole	500
1.001	44.000	157.1	3	3.900	1.960	1.939	Open Manhole	500
1.002	1.000	100.0	4	3.900	1.950	1.650	Open Manhole	600
1.003	1.780	35.6	5	3.750	1.900	1.550	Open Manhole	600
1.004	1.900	95.0	6	3.700	1.880	1.520	Open Manhole	600
1.005	9.500	158.3	7	3.500	1.820	1.380	Sealed Manhole	1200
1.006	10.860	144.8		3.120	1.745	1.225	Open Manhole	0

Surcharged Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D, L (mm)	W (mm)
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1.006 3.120 1.745 0.000 0 0

Datum (m) 1.745 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)
15	1.255	195	1.255	375	1.255	555	1.255	735	1.255	915	1.255	1095	1.255	1275	1.255
30	1.255	210	1.255	390	1.255	570	1.255	750	1.255	930	1.255	1110	1.255	1290	1.255
45	1.255	225	1.255	405	1.255	585	1.255	765	1.255	945	1.255	1125	1.255	1305	1.255
60	1.255	240	1.255	420	1.255	600	1.255	780	1.255	960	1.255	1140	1.255	1320	1.255
75	1.255	255	1.255	435	1.255	615	1.255	795	1.255	975	1.255	1155	1.255	1335	1.255
90	1.255	270	1.255	450	1.255	630	1.255	810	1.255	990	1.255	1170	1.255	1350	1.255
105	1.255	285	1.255	465	1.255	645	1.255	825	1.255	1005	1.255	1185	1.255	1365	1.255
120	1.255	300	1.255	480	1.255	660	1.255	840	1.255	1020	1.255	1200	1.255	1380	1.255
135	1.255	315	1.255	495	1.255	675	1.255	855	1.255	1035	1.255	1215	1.255	1395	1.255
150	1.255	330	1.255	510	1.255	690	1.255	870	1.255	1050	1.255	1230	1.255	1410	1.255
165	1.255	345	1.255	525	1.255	705	1.255	885	1.255	1065	1.255	1245	1.255	1425	1.255
180	1.255	360	1.255	540	1.255	720	1.255	900	1.255	1080	1.255	1260	1.255	1440	1.255

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 7, DS/PN: 1.006, Volume (m³): 2.5

Unit Reference MD-SHE-0042-1000-1500-1000
Design Head (m) 1.500
Design Flow (l/s) 1.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 42
Invert Level (m) 1.820
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)	1.500	1.0	Kick-Flo®	0.378	0.5
Flush-Flo™	0.186	0.7	Mean Flow over Head Range	-	0.7

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	0.6	0.800	0.8	2.000	1.1	4.000	1.6	7.000	2.0
0.200	0.7	1.000	0.8	2.200	1.2	4.500	1.6	7.500	2.1
0.300	0.6	1.200	0.9	2.400	1.2	5.000	1.7	8.000	2.1
0.400	0.6	1.400	1.0	2.600	1.3	5.500	1.8	8.500	2.2
0.500	0.6	1.600	1.0	3.000	1.4	6.000	1.9	9.000	2.3
0.600	0.7	1.800	1.1	3.500	1.5	6.500	1.9	9.500	2.3

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Storage Structures for Storm

Cellular Storage Pipe: 1.001

Manning's N 0.030 Infiltration Coefficient Side (m/hr) 0.00000
 Invert Level (m) 2.240 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	44.0	44.0	1.250	44.0	44.0	1.251	0.0	44.0

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
1.000	1	0.841	0.060	0.000	0.901
1.001	2	0.586	51.677	0.000	52.263
1.002	3	0.381	0.032	0.000	0.413
1.003	4	0.551	0.083	0.000	0.635
1.004	5	0.523	0.092	0.000	0.615
1.005	6	0.515	0.608	0.000	1.122
1.006	7	1.900	0.181	0.000	2.081
Total		5.297	52.733	0.000	58.031

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.500 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 150.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 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
 Return Period(s) (years) 100
 Climate Change (%) 40

US/MH		Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth
PN	Name								(m)	(m)
1.000	1 1440 Winter		100	+40%	100/120 Winter				2.934	0.384
1.001	2 1440 Winter		100	+40%					2.933	-0.558
1.002	3 1440 Winter		100	+40%	100/15 Summer				2.933	0.673
1.003	4 1440 Winter		100	+40%	100/15 Summer				3.159	0.909
1.004	5 1440 Winter		100	+40%	100/15 Summer				3.339	1.139
1.005	6 1440 Winter		100	+40%	100/15 Summer				3.433	1.253
1.006	7 1440 Winter		100	+40%	100/15 Summer				3.500	1.530

Flooded		US/MH	Volume	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level
PN	Name							Exceeded
1.000	1		0.000	0.00		0.2	SURCHARGED	
1.001	2		0.000	0.02		25.1	OK	
1.002	3		0.000	0.77		44.6	SURCHARGED	
1.003	4		0.000	0.67		41.2	SURCHARGED	
1.004	5		0.000	0.66		35.9	SURCHARGED	
1.005	6		0.000	0.46		28.5	SURCHARGED	
1.006	7		0.000	0.07		0.9	FLOOD RISK*	1

Scenario 2

Fluvial Flood Conditions i.e. 4.12m AOD

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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)	100	PIMP (%)	100
M5-60 (mm)	19.900	Add Flow / Climate Change (%)	40
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.053	4-8	0.019

Total Area Contributing (ha) = 0.072

Total Pipe Volume (m³) = 53.564

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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)
1	5.225	2.975	Open Manhole	600	1.000	2.250	300				
2	5.225	2.985	Open Manhole	500	1.001	2.240	300	1.000	2.240	300	
3	3.900	1.940	Open Manhole	500	1.002	1.960	300	1.001	1.960		
4	3.900	1.950	Open Manhole	600	1.003	1.950	300	1.002	1.950	300	
5	3.750	1.850	Open Manhole	600	1.004	1.900	300	1.003	1.900	300	
6	3.700	1.820	Open Manhole	600	1.005	1.880	300	1.004	1.880	300	
7	3.500	1.680	Sealed Manhole	1200	1.006	1.820	150	1.005	1.820	300	
	3.120	1.375	Open Manhole	0		OUTFALL		1.006	1.745	150	

No coordinates have been specified, layout information cannot be produced.

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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)
1.000	o		1	5.225	2.250	2.975	Open Manhole	600
1.001	→[↓]		2	5.225	2.240	1.734	Open Manhole	500
1.002	o	300	3	3.900	1.960	1.640	Open Manhole	500
1.003	o	300	4	3.900	1.950	1.650	Open Manhole	600
1.004	o	300	5	3.750	1.900	1.550	Open Manhole	600
1.005	o	300	6	3.700	1.880	1.520	Open Manhole	600
1.006	o	150	7	3.500	1.820	1.530	Sealed 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	1.400	140.0	2	5.225	2.240	2.985	Open Manhole	500
1.001	44.000	157.1	3	3.900	1.960	1.939	Open Manhole	500
1.002	1.000	100.0	4	3.900	1.950	1.650	Open Manhole	600
1.003	1.780	35.6	5	3.750	1.900	1.550	Open Manhole	600
1.004	1.900	95.0	6	3.700	1.880	1.520	Open Manhole	600
1.005	9.500	158.3	7	3.500	1.820	1.380	Sealed Manhole	1200
1.006	10.860	144.8		3.120	1.745	1.225	Open Manhole	0

Surcharged Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D, L (mm)	W (mm)
---------------------	--------------	--------------	--------------	------------------	-----------	--------

1.006 3.120 1.745 0.000 0 0

Datum (m) 1.745 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)
15	2.375	195	2.375	375	2.375	555	2.375	735	2.375	915	2.375	1095	2.375	1275	2.375
30	2.375	210	2.375	390	2.375	570	2.375	750	2.375	930	2.375	1110	2.375	1290	2.375
45	2.375	225	2.375	405	2.375	585	2.375	765	2.375	945	2.375	1125	2.375	1305	2.375
60	2.375	240	2.375	420	2.375	600	2.375	780	2.375	960	2.375	1140	2.375	1320	2.375
75	2.375	255	2.375	435	2.375	615	2.375	795	2.375	975	2.375	1155	2.375	1335	2.375
90	2.375	270	2.375	450	2.375	630	2.375	810	2.375	990	2.375	1170	2.375	1350	2.375
105	2.375	285	2.375	465	2.375	645	2.375	825	2.375	1005	2.375	1185	2.375	1365	2.375
120	2.375	300	2.375	480	2.375	660	2.375	840	2.375	1020	2.375	1200	2.375	1380	2.375
135	2.375	315	2.375	495	2.375	675	2.375	855	2.375	1035	2.375	1215	2.375	1395	2.375
150	2.375	330	2.375	510	2.375	690	2.375	870	2.375	1050	2.375	1230	2.375	1410	2.375
165	2.375	345	2.375	525	2.375	705	2.375	885	2.375	1065	2.375	1245	2.375	1425	2.375
180	2.375	360	2.375	540	2.375	720	2.375	900	2.375	1080	2.375	1260	2.375	1440	2.375

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Innovyze	Network 2019.1	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 7, DS/PN: 1.006, Volume (m³): 2.5

Unit Reference MD-SHE-0042-1000-1500-1000
Design Head (m) 1.500
Design Flow (l/s) 1.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 42
Invert Level (m) 1.820
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)	1.500	1.0	Kick-Flo®	0.378	0.5
Flush-Flo™	0.186	0.7	Mean Flow over Head Range	-	0.7

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	0.6	0.800	0.8	2.000	1.1	4.000	1.6	7.000	2.0
0.200	0.7	1.000	0.8	2.200	1.2	4.500	1.6	7.500	2.1
0.300	0.6	1.200	0.9	2.400	1.2	5.000	1.7	8.000	2.1
0.400	0.6	1.400	1.0	2.600	1.3	5.500	1.8	8.500	2.2
0.500	0.6	1.600	1.0	3.000	1.4	6.000	1.9	9.000	2.3
0.600	0.7	1.800	1.1	3.500	1.5	6.500	1.9	9.500	2.3

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Storage Structures for Storm

Cellular Storage Pipe: 1.001

Manning's N 0.030 Infiltration Coefficient Side (m/hr) 0.00000
 Invert Level (m) 2.240 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	44.0	44.0	1.250	44.0	44.0	1.251	0.0	44.0

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
1.000	1	0.841	0.060	0.000	0.901
1.001	2	0.586	51.677	0.000	52.263
1.002	3	0.381	0.032	0.000	0.413
1.003	4	0.551	0.083	0.000	0.635
1.004	5	0.523	0.092	0.000	0.615
1.005	6	0.515	0.608	0.000	1.122
1.006	7	1.900	0.181	0.000	2.081
Total		5.297	52.733	0.000	58.031

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.500 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 150.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 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
 Return Period(s) (years) 100
 Climate Change (%) 40

US/MH		Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth
PN	Name								(m)	(m)
1.000	1 1440 Winter		100	+40%	100/120 Winter				3.020	0.470
1.001	2 1440 Winter		100	+40%					3.020	-0.471
1.002	3 1440 Winter		100	+40%	100/15 Summer				3.018	0.758
1.003	4 1440 Winter		100	+40%	100/15 Summer				3.251	1.001
1.004	5 1440 Winter		100	+40%	100/15 Summer				3.439	1.239
1.005	6 1440 Winter		100	+40%	100/15 Summer				3.541	1.361
1.006	7 1440 Winter		100	+40%	100/15 Summer				3.500	1.530

Flooded		US/MH	Volume	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level
PN	Name							Exceeded
1.000	1		0.000	0.00		0.2	SURCHARGED	
1.001	2		0.000	0.02		26.1	OK	
1.002	3		0.000	0.80		46.4	SURCHARGED	
1.003	4		0.000	0.70		42.8	SURCHARGED	
1.004	5		0.000	0.68		36.8	SURCHARGED	
1.005	6		0.000	0.48		29.4	SURCHARGED	
1.006	7		0.000	0.07		1.0	FLOOD RISK*	3

Outfall 2 Network

Scenario 1

Existing Drainage Ditch full to top of Bank Level

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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)	100	PIMP (%)	100
M5-60 (mm)	19.900	Add Flow / Climate Change (%)	40
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.054	4-8	0.012

Total Area Contributing (ha) = 0.066

Total Pipe Volume (m³) = 39.044

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Suite 3, Salar House 61 Campfield Road St Albans AL1 5HT	OUTFALL 2 NETWORK FORD ROAD ARUNDEL	
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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)
1	5.375	1.055	Open Manhole	500	1.000	4.320	100				
2	5.375	1.071	Open Manhole	500	1.001	4.304		1.000	4.304	100	
3	5.375	1.081	Open Manhole	500	1.002	4.294	300	1.001	4.294		
4	5.375	1.091	Open Manhole	500	1.003	4.284		1.002	4.284	300	
5	5.375	1.103	Open Manhole	500	1.004	4.272	300	1.003	4.272		
6	5.375	1.118	Open Manhole	500	1.005	4.257		1.004	4.257	300	
7	5.375	1.134	Open Manhole	500	1.006	4.241	150	1.005	4.241		
8	2.650	1.000	Sealed Manhole	500	1.007	1.650	150	1.006	1.650	150	
9	2.500	1.200	Sealed Manhole	1200	1.008	1.300	150	1.007	1.300	150	
	2.000	0.850	Open Manhole	0		OUTFALL		1.008	1.150	150	

No coordinates have been specified, layout information cannot be produced.

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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)
1.000	o		1	5.375	4.320	0.955	Open Manhole	500
1.001	- \ /		2	5.375	4.304	0.570	Open Manhole	500
1.002	o	300	3	5.375	4.294	0.791	Open Manhole	500
1.003	- \ /		4	5.375	4.284	0.590	Open Manhole	500
1.004	o	300	5	5.375	4.272	0.803	Open Manhole	500
1.005	- \ /		6	5.375	4.257	0.617	Open Manhole	500
1.006	o	150	7	5.375	4.241	0.984	Open Manhole	500
1.007	o	150	8	2.650	1.650	0.850	Sealed Manhole	500
1.008	o	150	9	2.500	1.300	1.050	Sealed 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	1.600	100.0	2	5.375	4.304	0.971	Open Manhole	500
1.001	5.000	500.0	3	5.375	4.294	0.580	Open Manhole	500
1.002	3.200	320.0	4	5.375	4.284	0.791	Open Manhole	500
1.003	6.000	500.0	5	5.375	4.272	0.602	Open Manhole	500
1.004	4.450	296.7	6	5.375	4.257	0.813	Open Manhole	500
1.005	8.000	500.0	7	5.375	4.241	0.633	Open Manhole	500
1.006	6.000	2.3	8	2.650	1.650	0.850	Sealed Manhole	500
1.007	6.800	19.4	9	2.500	1.300	1.050	Sealed Manhole	1200
1.008	12.800	85.3		2.000	1.150	0.700	Open Manhole	0

Surcharged Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
------------------------	-----------------	-----------------	-----------------	------------------------	-------------	-----------

1.008 2.000 1.150 0.000 0 0

Datum (m) 1.150 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)
5	1.350	45	1.350	85	1.350	125	1.350	165	1.350	205	1.350	245	1.350
10	1.350	50	1.350	90	1.350	130	1.350	170	1.350	210	1.350	250	1.350
15	1.350	55	1.350	95	1.350	135	1.350	175	1.350	215	1.350	255	1.350
20	1.350	60	1.350	100	1.350	140	1.350	180	1.350	220	1.350	260	1.350
25	1.350	65	1.350	105	1.350	145	1.350	185	1.350	225	1.350	265	1.350
30	1.350	70	1.350	110	1.350	150	1.350	190	1.350	230	1.350	270	1.350
35	1.350	75	1.350	115	1.350	155	1.350	195	1.350	235	1.350	275	1.350
40	1.350	80	1.350	120	1.350	160	1.350	200	1.350	240	1.350	280	1.350

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Surcharged Outfall Details for Storm

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)
325	1.350	465	1.350	605	1.350	745	1.350	885	1.350	1025	1.350	1165	1.350	1305	1.350
330	1.350	470	1.350	610	1.350	750	1.350	890	1.350	1030	1.350	1170	1.350	1310	1.350
335	1.350	475	1.350	615	1.350	755	1.350	895	1.350	1035	1.350	1175	1.350	1315	1.350
340	1.350	480	1.350	620	1.350	760	1.350	900	1.350	1040	1.350	1180	1.350	1320	1.350
345	1.350	485	1.350	625	1.350	765	1.350	905	1.350	1045	1.350	1185	1.350	1325	1.350
350	1.350	490	1.350	630	1.350	770	1.350	910	1.350	1050	1.350	1190	1.350	1330	1.350
355	1.350	495	1.350	635	1.350	775	1.350	915	1.350	1055	1.350	1195	1.350	1335	1.350
360	1.350	500	1.350	640	1.350	780	1.350	920	1.350	1060	1.350	1200	1.350	1340	1.350
365	1.350	505	1.350	645	1.350	785	1.350	925	1.350	1065	1.350	1205	1.350	1345	1.350
370	1.350	510	1.350	650	1.350	790	1.350	930	1.350	1070	1.350	1210	1.350	1350	1.350
375	1.350	515	1.350	655	1.350	795	1.350	935	1.350	1075	1.350	1215	1.350	1355	1.350
380	1.350	520	1.350	660	1.350	800	1.350	940	1.350	1080	1.350	1220	1.350	1360	1.350
385	1.350	525	1.350	665	1.350	805	1.350	945	1.350	1085	1.350	1225	1.350	1365	1.350
390	1.350	530	1.350	670	1.350	810	1.350	950	1.350	1090	1.350	1230	1.350	1370	1.350
395	1.350	535	1.350	675	1.350	815	1.350	955	1.350	1095	1.350	1235	1.350	1375	1.350
400	1.350	540	1.350	680	1.350	820	1.350	960	1.350	1100	1.350	1240	1.350	1380	1.350
405	1.350	545	1.350	685	1.350	825	1.350	965	1.350	1105	1.350	1245	1.350	1385	1.350
410	1.350	550	1.350	690	1.350	830	1.350	970	1.350	1110	1.350	1250	1.350	1390	1.350
415	1.350	555	1.350	695	1.350	835	1.350	975	1.350	1115	1.350	1255	1.350	1395	1.350
420	1.350	560	1.350	700	1.350	840	1.350	980	1.350	1120	1.350	1260	1.350	1400	1.350
425	1.350	565	1.350	705	1.350	845	1.350	985	1.350	1125	1.350	1265	1.350	1405	1.350
430	1.350	570	1.350	710	1.350	850	1.350	990	1.350	1130	1.350	1270	1.350	1410	1.350
435	1.350	575	1.350	715	1.350	855	1.350	995	1.350	1135	1.350	1275	1.350	1415	1.350
440	1.350	580	1.350	720	1.350	860	1.350	1000	1.350	1140	1.350	1280	1.350	1420	1.350
445	1.350	585	1.350	725	1.350	865	1.350	1005	1.350	1145	1.350	1285	1.350	1425	1.350
450	1.350	590	1.350	730	1.350	870	1.350	1010	1.350	1150	1.350	1290	1.350	1430	1.350
455	1.350	595	1.350	735	1.350	875	1.350	1015	1.350	1155	1.350	1295	1.350	1435	1.350
460	1.350	600	1.350	740	1.350	880	1.350	1020	1.350	1160	1.350	1300	1.350	1440	1.350

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 9, DS/PN: 1.008, Volume (m³): 1.5

Unit Reference MD-SHE-0042-1000-1500-1000
Design Head (m) 1.500
Design Flow (l/s) 1.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 42
Invert Level (m) 1.300
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)	1.500	1.0	Kick-Flo®	0.378	0.5
Flush-Flo™	0.186	0.7	Mean Flow over Head Range	-	0.7

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	0.6	0.800	0.8	2.000	1.1	4.000	1.6	7.000	2.0
0.200	0.7	1.000	0.8	2.200	1.2	4.500	1.6	7.500	2.1
0.300	0.6	1.200	0.9	2.400	1.2	5.000	1.7	8.000	2.1
0.400	0.6	1.400	1.0	2.600	1.3	5.500	1.8	8.500	2.2
0.500	0.6	1.600	1.0	3.000	1.4	6.000	1.9	9.000	2.3
0.600	0.7	1.800	1.1	3.500	1.5	6.500	1.9	9.500	2.3

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Storage Structures for Storm

Tank or Pond Pipe: 1.001

Manning's N 0.030 Invert Level (m) 4.304

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	20.0	0.500	20.0	0.501	0.0

Tank or Pond Pipe: 1.003

Manning's N 0.030 Invert Level (m) 4.284

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	24.0	0.500	24.0	0.501	0.0

Tank or Pond Pipe: 1.005

Manning's N 0.030 Invert Level (m) 4.257

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	32.0	0.500	32.0	0.501	0.0

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
1.000	1	0.207	0.009	0.000	0.216
1.001	2	0.210	9.009	0.000	9.219
1.002	3	0.212	0.191	0.000	0.403
1.003	4	0.214	11.011	0.000	11.225
1.004	5	0.217	0.279	0.000	0.496
1.005	6	0.220	15.015	0.000	15.235
1.006	7	0.223	0.097	0.000	0.320
1.007	8	0.196	0.105	0.000	0.301
1.008	9	1.357	0.216	0.000	1.573
Total		3.056	35.932	0.000	38.988

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 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 3 Number of Real Time Controls 0

Synthetic Rainfall Details

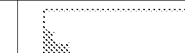
Rainfall Model FSR M5-60 (mm) 19.500 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 150.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 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
 Return Period(s) (years) 100
 Climate Change (%) 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth
									(m)	(m)
1.000	1	180 Winter	100	+40%	100/15 Summer				4.659	0.239
1.001	2	180 Winter	100	+40%					4.659	-0.146
1.002	3	180 Winter	100	+40%	100/120 Winter				4.659	0.065
1.003	4	180 Winter	100	+40%					4.658	-0.127
1.004	5	180 Winter	100	+40%	100/60 Winter				4.659	0.087
1.005	6	180 Winter	100	+40%					4.658	-0.100
1.006	7	180 Winter	100	+40%	100/15 Summer				4.658	0.267
1.007	8	120 Winter	100	+40%	100/15 Summer				2.650	0.850
1.008	9	120 Winter	100	+40%	100/15 Summer				2.500	1.050

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap. (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.00	0.0	SURCHARGED	
1.001	2	0.000	0.00	3.2	OK	
1.002	3	0.000	0.03	1.7	SURCHARGED	
1.003	4	0.000	0.00	4.2	OK	
1.004	5	0.000	0.07	3.1	SURCHARGED	
1.005	6	0.000	0.01	4.9	OK	

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

PN	US/MH Name	Flooded		Pipe		Status	Level Exceeded
		Volume (m³)	Flow / Overflow Cap. (l/s)	Flow (l/s)			
1.006	7	0.000	0.03	3.4	SURCHARGED		
1.007	8	0.000	0.11	3.9	FLOOD RISK*		24
1.008	9	0.000	0.07	1.2	FLOOD RISK*		24

Scenario 2

Fluvial Flood Conditions i.e. 4.12m AOD

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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)	100	PIMP (%)	100
M5-60 (mm)	19.900	Add Flow / Climate Change (%)	40
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.054	4-8	0.012

Total Area Contributing (ha) = 0.066

Total Pipe Volume (m³) = 39.044

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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)
1	5.375	1.055	Open Manhole	500	1.000	4.320	100				
2	5.375	1.071	Open Manhole	500	1.001	4.304		1.000	4.304	100	
3	5.375	1.081	Open Manhole	500	1.002	4.294	300	1.001	4.294		
4	5.375	1.091	Open Manhole	500	1.003	4.284		1.002	4.284	300	
5	5.375	1.103	Open Manhole	500	1.004	4.272	300	1.003	4.272		
6	5.375	1.118	Open Manhole	500	1.005	4.257		1.004	4.257	300	
7	5.375	1.134	Open Manhole	500	1.006	4.241	150	1.005	4.241		
8	2.650	1.000	Sealed Manhole	500	1.007	1.650	150	1.006	1.650	150	
9	2.500	1.200	Sealed Manhole	1200	1.008	1.300	150	1.007	1.300	150	
	2.000	0.850	Open Manhole	0		OUTFALL		1.008	1.150	150	

No coordinates have been specified, layout information cannot be produced.

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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)
1.000	o		1	5.375	4.320	0.955	Open Manhole	500
1.001	- \ /		2	5.375	4.304	0.570	Open Manhole	500
1.002	o	300	3	5.375	4.294	0.791	Open Manhole	500
1.003	- \ /		4	5.375	4.284	0.590	Open Manhole	500
1.004	o	300	5	5.375	4.272	0.803	Open Manhole	500
1.005	- \ /		6	5.375	4.257	0.617	Open Manhole	500
1.006	o	150	7	5.375	4.241	0.984	Open Manhole	500
1.007	o	150	8	2.650	1.650	0.850	Sealed Manhole	500
1.008	o	150	9	2.500	1.300	1.050	Sealed 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	1.600	100.0	2	5.375	4.304	0.971	Open Manhole	500
1.001	5.000	500.0	3	5.375	4.294	0.580	Open Manhole	500
1.002	3.200	320.0	4	5.375	4.284	0.791	Open Manhole	500
1.003	6.000	500.0	5	5.375	4.272	0.602	Open Manhole	500
1.004	4.450	296.7	6	5.375	4.257	0.813	Open Manhole	500
1.005	8.000	500.0	7	5.375	4.241	0.633	Open Manhole	500
1.006	6.000	2.3	8	2.650	1.650	0.850	Sealed Manhole	500
1.007	6.800	19.4	9	2.500	1.300	1.050	Sealed Manhole	1200
1.008	12.800	85.3		2.000	1.150	0.700	Open Manhole	0

Surcharged Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
------------------------	-----------------	-----------------	-----------------	------------------------	-------------	-----------

1.008 2.000 1.150 0.000 0 0

Datum (m) 1.150 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)
5	2.970	45	2.970	85	2.970	125	2.970	165	2.970	205	2.970	245	2.970
10	2.970	50	2.970	90	2.970	130	2.970	170	2.970	210	2.970	250	2.970
15	2.970	55	2.970	95	2.970	135	2.970	175	2.970	215	2.970	255	2.970
20	2.970	60	2.970	100	2.970	140	2.970	180	2.970	220	2.970	260	2.970
25	2.970	65	2.970	105	2.970	145	2.970	185	2.970	225	2.970	265	2.970
30	2.970	70	2.970	110	2.970	150	2.970	190	2.970	230	2.970	270	2.970
35	2.970	75	2.970	115	2.970	155	2.970	195	2.970	235	2.970	275	2.970
40	2.970	80	2.970	120	2.970	160	2.970	200	2.970	240	2.970	280	2.970

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 9, DS/PN: 1.008, Volume (m³): 1.5

Unit Reference MD-SHE-0047-1000-1000-1000
Design Head (m) 1.000
Design Flow (l/s) 1.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 47
Invert Level (m) 1.300
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)	1.000	1.0	Kick-Flo®	0.415	0.7
Flush-Flo™	0.205	0.8	Mean Flow over Head Range	-	0.8

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	0.8	0.800	0.9	2.000	1.4	4.000	1.9	7.000	2.4
0.200	0.8	1.000	1.0	2.200	1.4	4.500	2.0	7.500	2.5
0.300	0.8	1.200	1.1	2.400	1.5	5.000	2.1	8.000	2.6
0.400	0.7	1.400	1.2	2.600	1.5	5.500	2.2	8.500	2.7
0.500	0.7	1.600	1.2	3.000	1.6	6.000	2.3	9.000	2.7
0.600	0.8	1.800	1.3	3.500	1.8	6.500	2.3	9.500	2.8

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Storage Structures for Storm

Tank or Pond Pipe: 1.001

Manning's N 0.030 Invert Level (m) 4.304

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	20.0	0.500	20.0	0.501	0.0

Tank or Pond Pipe: 1.003

Manning's N 0.030 Invert Level (m) 4.284

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	24.0	0.500	24.0	0.501	0.0

Tank or Pond Pipe: 1.005

Manning's N 0.030 Invert Level (m) 4.257

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	32.0	0.500	32.0	0.501	0.0

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
1.000	1	0.207	0.009	0.000	0.216
1.001	2	0.210	9.009	0.000	9.219
1.002	3	0.212	0.191	0.000	0.403
1.003	4	0.214	11.011	0.000	11.225
1.004	5	0.217	0.279	0.000	0.496
1.005	6	0.220	15.015	0.000	15.235
1.006	7	0.223	0.097	0.000	0.320
1.007	8	0.196	0.105	0.000	0.301
1.008	9	1.357	0.216	0.000	1.573
Total		3.056	35.932	0.000	38.988

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 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 3 Number of Real Time Controls 0

Synthetic Rainfall Details

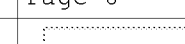
Rainfall Model FSR M5-60 (mm) 19.500 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 150.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 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
 Return Period(s) (years) 100
 Climate Change (%) 40

US/MH		Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth
PN	Name								(m)	(m)
1.000	1 360 Winter		100	+40%	100/15 Summer				4.718	0.298
1.001	2 360 Winter		100	+40%					4.718	-0.087
1.002	3 360 Winter		100	+40%	100/60 Winter				4.718	0.124
1.003	4 360 Winter		100	+40%					4.718	-0.067
1.004	5 360 Winter		100	+40%	100/60 Winter				4.718	0.146
1.005	6 360 Winter		100	+40%					4.718	-0.040
1.006	7 360 Winter		100	+40%	100/15 Summer				4.718	0.327
1.007	8 120 Winter		100	+40%	100/15 Summer				2.650	0.850
1.008	9 120 Winter		100	+40%	100/15 Summer				2.500	1.050

Flooded		Pipe		Status	Level Exceeded
US/MH PN	Name	Volume (m³)	Flow / Overflow Cap. (l/s)	Flow (l/s)	
1.000	1	0.000	0.00	0.0	SURCHARGED
1.001	2	0.000	0.00	1.9	OK
1.002	3	0.000	0.02	0.8	SURCHARGED
1.003	4	0.000	0.00	2.6	OK
1.004	5	0.000	0.03	1.2	SURCHARGED
1.005	6	0.000	0.00	2.9	OK

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

PN	US/MH Name	Flooded		Pipe		Status	Level Exceeded
		Volume (m³)	Flow / Overflow Cap. (l/s)	Flow (l/s)			
1.006	7	0.000	0.01	1.2	SURCHARGED		
1.007	8	0.000	0.10	3.3	FLOOD RISK*		24
1.008	9	0.000	0.05	0.8	FLOOD RISK*		24

Outfall 3 Network

Scenario 1

Existing Drainage Ditch full to top of Bank Level

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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)	100	PIMP (%)	100
M5-60 (mm)	19.900	Add Flow / Climate Change (%)	40
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.098	4-8	0.036

Total Area Contributing (ha) = 0.134

Total Pipe Volume (m³) = 75.190

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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)
1	2.800	0.900	Open Manhole	500	1.000	1.800	225				
2	2.800	0.915	Open Manhole	500	1.001	1.885	225	1.000	1.885	225	
3	2.800	0.960	Open Manhole	500	1.002	1.840	225	1.001	1.840	225	
4	2.800	1.000	Open Manhole	500	1.003	1.800	225	1.002	1.800	225	
5	2.700	1.100	Open Manhole	500	1.004	1.600	225	1.003	1.600	225	
6	2.500	1.200	Open Manhole	1200	1.005	1.300	225	1.004	1.300	225	
	2.020	0.870	Open Manhole	0		OUTFALL		1.005	1.150	225	

No coordinates have been specified, layout information cannot be produced.

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd	Diam	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	Sect	(mm)	Name	(m)	(m)	(m)	Connection	(mm)
1.000	o		1	2.800	1.800	0.675	Open Manhole	500
1.001	→[↓]		2	2.800	1.885	0.464	Open Manhole	500
1.002	o	225	3	2.800	1.840	0.735	Open Manhole	500
1.003	o	225	4	2.800	1.800	0.775	Open Manhole	500
1.004	o	225	5	2.700	1.600	0.875	Open Manhole	500
1.005	o	225	6	2.500	1.300	0.975	Open Manhole	1200

Downstream Manhole

PN	Length	Slope	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	(m)	(1:X)	Name	(m)	(m)	(m)	Connection	(mm)
1.000	1.200	80.0	2	2.800	1.885	0.690	Open Manhole	500
1.001	22.000	488.9	3	2.800	1.840	0.509	Open Manhole	500
1.002	1.000	25.0	4	2.800	1.800	0.775	Open Manhole	500
1.003	9.600	48.0	5	2.700	1.600	0.875	Open Manhole	500
1.004	15.000	50.0	6	2.500	1.300	0.975	Open Manhole	1200
1.005	12.900	86.0		2.620	1.150	0.645	Open Manhole	0

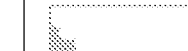
Surcharged Outfall Details for Storm

Outfall	Outfall	C. Level	I. Level	Min	D,L	W
Pipe Number	Name	(m)	(m)	I. Level (m)	(mm)	(mm)

1.005 2.020 1.150 0.000 0 0

Datum (m) 1.150 Offset (mins) 0

Time	Depth	Time	Depth	Time	Depth	Time	Depth	Time	Depth	Time	Depth	Time	Depth
(mins)	(m)	(mins)	(m)	(mins)	(m)	(mins)	(m)	(mins)	(m)	(mins)	(m)	(mins)	(m)
5	0.850	75	0.850	145	0.850	215	0.850	285	0.850	355	0.850	425	0.850
10	0.850	80	0.850	150	0.850	220	0.850	290	0.850	360	0.850	430	0.850
15	0.850	85	0.850	155	0.850	225	0.850	295	0.850	365	0.850	435	0.850
20	0.850	90	0.850	160	0.850	230	0.850	300	0.850	370	0.850	440	0.850
25	0.850	95	0.850	165	0.850	235	0.850	305	0.850	375	0.850	445	0.850
30	0.850	100	0.850	170	0.850	240	0.850	310	0.850	380	0.850	450	0.850
35	0.850	105	0.850	175	0.850	245	0.850	315	0.850	385	0.850	455	0.850
40	0.850	110	0.850	180	0.850	250	0.850	320	0.850	390	0.850	460	0.850
45	0.850	115	0.850	185	0.850	255	0.850	325	0.850	395	0.850	465	0.850
50	0.850	120	0.850	190	0.850	260	0.850	330	0.850	400	0.850	470	0.850
55	0.850	125	0.850	195	0.850	265	0.850	335	0.850	405	0.850	475	0.850
60	0.850	130	0.850	200	0.850	270	0.850	340	0.850	410	0.850	480	0.850
65	0.850	135	0.850	205	0.850	275	0.850	345	0.850	415	0.850	485	0.850
70	0.850	140	0.850	210	0.850	280	0.850	350	0.850	420	0.850	490	0.850

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Surcharged Outfall Details for Storm

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)
565	0.850	675	0.850	785	0.850	895	0.850	1005	0.850	1115	0.850	1225	0.850	1335	0.850
570	0.850	680	0.850	790	0.850	900	0.850	1010	0.850	1120	0.850	1230	0.850	1340	0.850
575	0.850	685	0.850	795	0.850	905	0.850	1015	0.850	1125	0.850	1235	0.850	1345	0.850
580	0.850	690	0.850	800	0.850	910	0.850	1020	0.850	1130	0.850	1240	0.850	1350	0.850
585	0.850	695	0.850	805	0.850	915	0.850	1025	0.850	1135	0.850	1245	0.850	1355	0.850
590	0.850	700	0.850	810	0.850	920	0.850	1030	0.850	1140	0.850	1250	0.850	1360	0.850
595	0.850	705	0.850	815	0.850	925	0.850	1035	0.850	1145	0.850	1255	0.850	1365	0.850
600	0.850	710	0.850	820	0.850	930	0.850	1040	0.850	1150	0.850	1260	0.850	1370	0.850
605	0.850	715	0.850	825	0.850	935	0.850	1045	0.850	1155	0.850	1265	0.850	1375	0.850
610	0.850	720	0.850	830	0.850	940	0.850	1050	0.850	1160	0.850	1270	0.850	1380	0.850
615	0.850	725	0.850	835	0.850	945	0.850	1055	0.850	1165	0.850	1275	0.850	1385	0.850
620	0.850	730	0.850	840	0.850	950	0.850	1060	0.850	1170	0.850	1280	0.850	1390	0.850
625	0.850	735	0.850	845	0.850	955	0.850	1065	0.850	1175	0.850	1285	0.850	1395	0.850
630	0.850	740	0.850	850	0.850	960	0.850	1070	0.850	1180	0.850	1290	0.850	1400	0.850
635	0.850	745	0.850	855	0.850	965	0.850	1075	0.850	1185	0.850	1295	0.850	1405	0.850
640	0.850	750	0.850	860	0.850	970	0.850	1080	0.850	1190	0.850	1300	0.850	1410	0.850
645	0.850	755	0.850	865	0.850	975	0.850	1085	0.850	1195	0.850	1305	0.850	1415	0.850
650	0.850	760	0.850	870	0.850	980	0.850	1090	0.850	1200	0.850	1310	0.850	1420	0.850
655	0.850	765	0.850	875	0.850	985	0.850	1095	0.850	1205	0.850	1315	0.850	1425	0.850
660	0.850	770	0.850	880	0.850	990	0.850	1100	0.850	1210	0.850	1320	0.850	1430	0.850
665	0.850	775	0.850	885	0.850	995	0.850	1105	0.850	1215	0.850	1325	0.850	1435	0.850
670	0.850	780	0.850	890	0.850	1000	0.850	1110	0.850	1220	0.850	1330	0.850	1440	0.850

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 6, DS/PN: 1.005, Volume (m³): 1.9

Unit Reference MD-SHE-0067-2000-1000-2000
Design Head (m) 1.000
Design Flow (l/s) 2.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 67
Invert Level (m) 1.300
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)	1.000	2.0	Kick-Flo®	0.599	1.6
Flush-Flo™	0.296	1.9	Mean Flow over Head Range	-	1.7

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	1.6	0.800	1.8	2.000	2.7	4.000	3.8	7.000	4.9
0.200	1.9	1.000	2.0	2.200	2.9	4.500	4.0	7.500	5.1
0.300	1.9	1.200	2.2	2.400	3.0	5.000	4.2	8.000	5.2
0.400	1.9	1.400	2.3	2.600	3.1	5.500	4.4	8.500	5.4
0.500	1.8	1.600	2.5	3.000	3.3	6.000	4.6	9.000	5.5
0.600	1.6	1.800	2.6	3.500	3.5	6.500	4.7	9.500	5.7

SDP Consulting Engineers		Page 6
Suite 3, Salar House 61 Campfield Road St Albans AL1 5HT	OUTFALL 3 NETWORK FORD ROAD ARUNDEL	
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Storage Structures for Storm

Cellular Storage Pipe: 1.001

Manning's N 0.030 Infiltration Coefficient Side (m/hr) 0.00000
 Invert Level (m) 1.885 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	172.0	172.0	0.450	172.0	172.0	0.451	0.0	172.0

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
1.000	1	0.177	0.028	0.000	0.205
1.001	2	0.180	71.939	0.000	72.118
1.002	3	0.188	0.020	0.000	0.208
1.003	4	0.196	0.362	0.000	0.558
1.004	5	0.216	0.563	0.000	0.779
1.005	6	1.357	0.489	0.000	1.846
Total		2.314	73.400	0.000	75.714

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.500 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

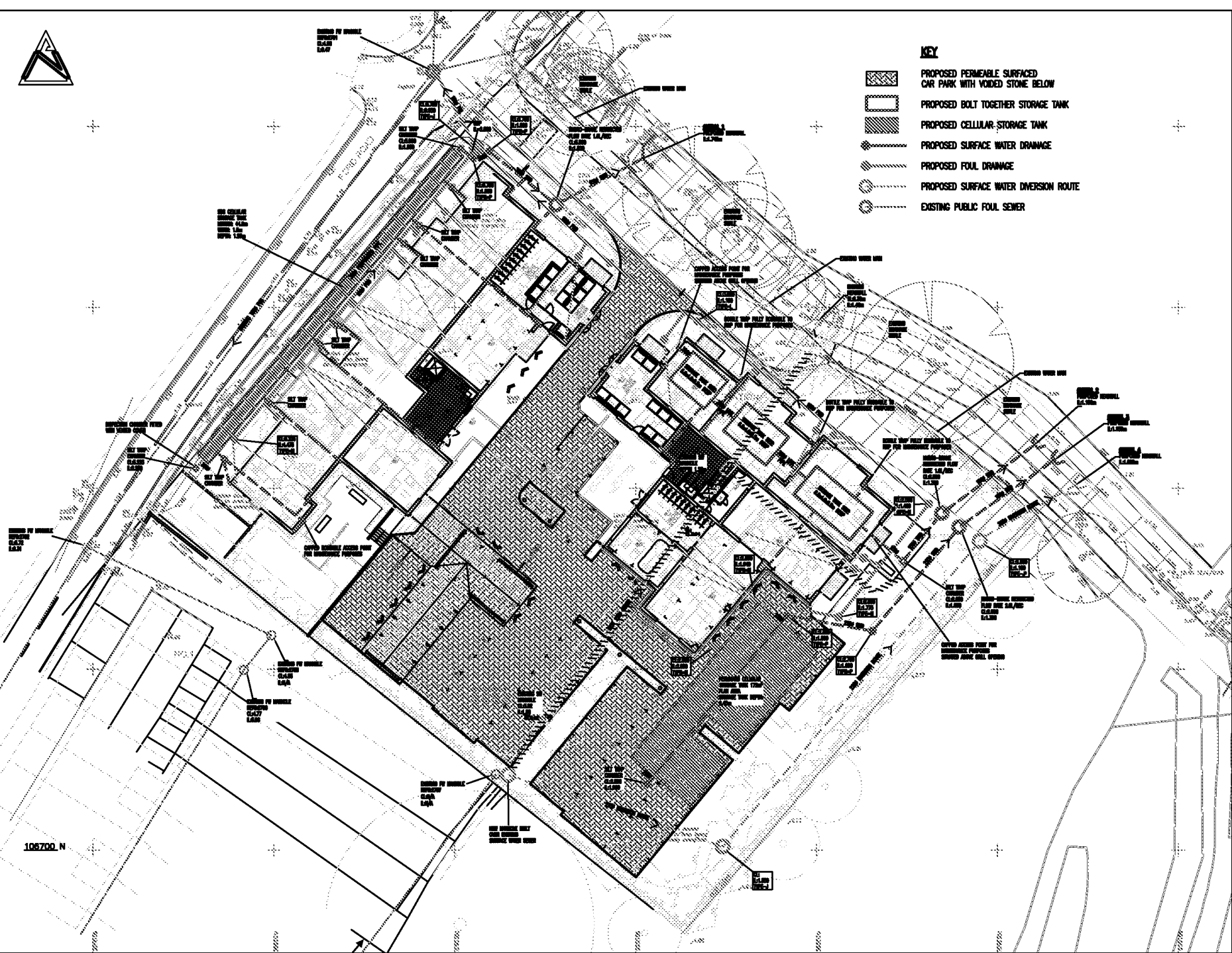
Margin for Flood Risk Warning (mm) 150.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status ON
 Inertia Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
 Return Period(s) (years) 100
 Climate Change (%) 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth
									(m)	(m)
1.000	1	720 Winter	100	+40%	100/360 Winter				2.147	0.022
1.001	2	720 Winter	100	+40%					2.147	-0.189
1.002	3	720 Winter	100	+40%	100/120 Summer				2.147	0.082
1.003	4	720 Winter	100	+40%	100/60 Summer				2.160	0.135
1.004	5	720 Winter	100	+40%	100/15 Summer				2.176	0.351
1.005	6	720 Winter	100	+40%	100/15 Summer				2.182	0.657

PN	US/MH Name	Flooded		Pipe		Status	Level Exceeded
		Volume (m ³)	Flow / Cap. (l/s)	Flow (l/s)	Overflow (l/s)		
1.000	1	0.000	0.00	0.0		SURCHARGED	
1.001	2	0.000	0.00	6.4		OK	
1.002	3	0.000	0.10	3.1		SURCHARGED	
1.003	4	0.000	0.05	2.9		SURCHARGED	
1.004	5	0.000	0.04	2.7		SURCHARGED	
1.005	6	0.000	0.03	1.7		SURCHARGED	

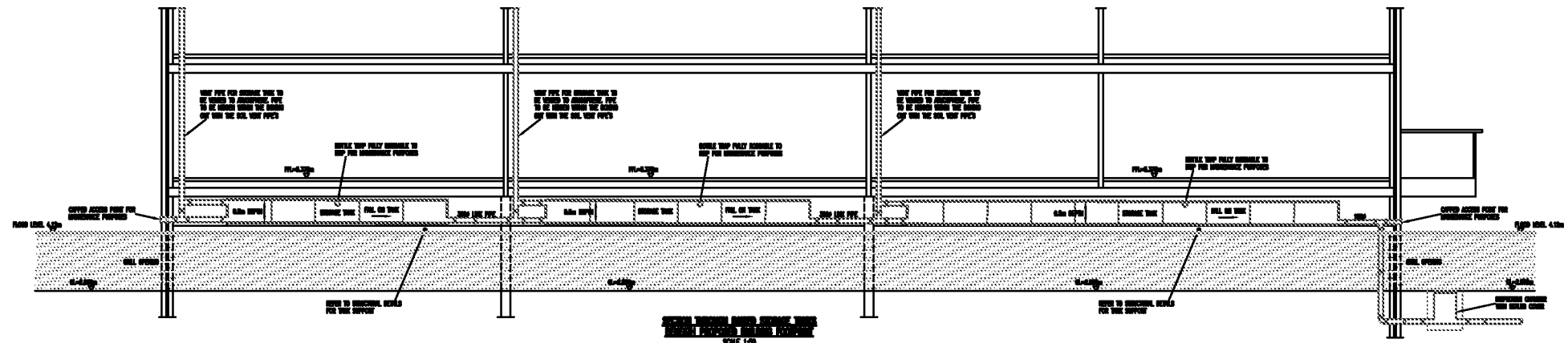
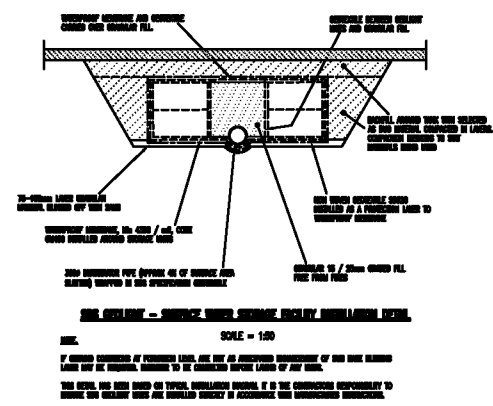
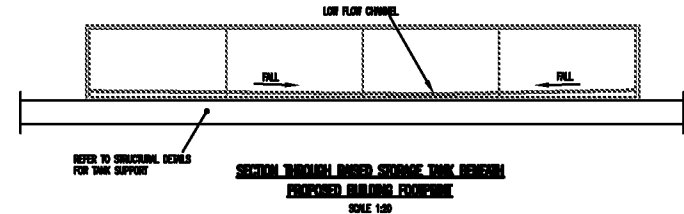
Site Drainage Plan



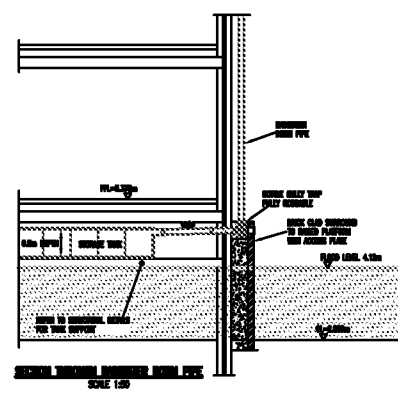
SITE DRAINAGE PLAN
SCALE 1:200

ALL PROPOSED INSPECTION CHAMBERS & MANHOLES THAT HAVE A COVER LEVEL LOWER THAN THAT OF THE FLOOD LEVEL OF 4.12m TO BE FITTED WITH A SEALED COVER.

AN ADDITIONAL STORAGE VOLUME OF 184m³ IS PROVIDED WITHIN THE PERMEABLE PAVING SUB-BASE STORAGE STONE (30% VOID RATIO) BASED ON A DEPTH OF 400mm. THIS WILL HELP COMPENSATE FOR THE FLUMINAL FLOOD WATER

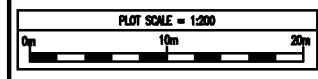


TRENCH THROUGH RAISED STORAGE TANK
SCALE 1:50



TRENCH THROUGH RAISED STORAGE TANK
SCALE 1:50

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEER'S COMMENTS. ANY DISCREPANCIES FOUND BETWEEN INFORMATION SHOWN ON THIS OR ANY OTHER DRAWING SHALL BE REFERRED TO THE ENGINEER IMMEDIATELY AND PRIOR TO ANY WORK COMMENCING ON SITE.



B	APR 20	DRAINAGE PROPOSAL, REVISIONS TO SITE COMMENTS RECEIVED BY CIVIL, DATED 22/04/20	NU
A	APR 20	DRAINAGE PROPOSAL, REVISIONS TO SITE COMMENTS RECEIVED BY CIVIL, DATED 22/04/20	NU

PLANNING

OAKFORD HOMES

FORD ROAD, ARUNDEL

Strategy Site Drainage Plan & Drainage Construction Details

SDP CONSULTING ENGINEERS

1000	NU	Feb 20
1000	NU	Feb 20
1000	NU	Feb 20