



Technical Note

Project Lyminster Bypass
Note Technical Note Drainage
Author MM

Date 22nd August 2017
Ref A100789/170822
Rev -

1.0 Introduction

- 1.1 WYG Consultancy has been appointed by Persimmon Homes (the Developer) to provide a brief for the drainage network design for a section of the Lyminster Bypass near North Littlehampton.
- 1.2 Planning permission was granted on 06/06/2012 with condition 10 required to be met before works on site begin. Condition 10 of the planning decisions states that:
- 1.3 No development shall commence until such time as a scheme to dispose of surface water drainage has been submitted to, and approved in writing by, the local planning authority. The scheme shall be implemented as approved.
- 1.4 The purpose of this technical note is to enable the discharge of condition 10.
- 1.5 A drainage design has been completed in accordance with national and local drainage policy and details of the design are discussed in section 3.
- 1.6 This Technical Note describes and provides reasoning behind the design process of the Bypass' associated drainage. The drawing Bypass Drainage - A100789_501 Rev E, is appended to this note as it is one of the main sources of evidence, along with the accompanying Micro Drainage calculations, that demonstrate that condition 10 of the outline planning consent can be discharged.

2.0 Existing Conditions and Development Proposals

- 2.1 The site of the proposed development is considered to be completely Greenfield with the exception of a few non-permanent structures such as polytunnels.
- 2.2 The development proposals involve the construction of a new highway which would act as a bypass between Toddington Lane and Worthing Road. The development will also include the construction of



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two new roundabouts and a bridge. A connection between the proposed roundabout and Toddington Lane is also to be included.

- 2.3 The indicative layout of the highway and associated work can be seen in A100789_501 Rev E.

3.0 Existing Drainage

- 3.1 As the site is largely a Greenfield site, there is no existing drainage on site.

4.0 Proposed Drainage

- 4.1 It is essential to consider the drainage of any development involving a significant change in impermeable area. As such, the drainage hierarchy should be considered. The method of discharge of surface water is critical to ensuring that flood risk will not be increased elsewhere. Planning Practice Guidance and Building Regulations dictate the hierarchy for discharge options. In order of preference these are:
- ✧ To the ground (infiltration);
 - ✧ To a surface water body;
 - ✧ To a surface water sewer, highway drain or another drainage system;
 - ✧ To a combined sewer;
- 4.2 A site-wide drainage strategy issued with the Outline Planning Application, set out the agreed principles for surface water discharge.
- 4.3 Infiltration is the most preferred method of discharge; however, due to the presence of the underlying aquifer, low lying ground close to the water table and infiltration testing in the area for other sections of the bypass yielding poor infiltration rates, the use of soakaways is considered not to be feasible.
- 4.4 Therefore the method of discharge to be utilised will be discharge to a surface water body. Due to the adjoining sections of the bypass, the surface water runoff will be discharged into these adjacent



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systems before a surface water body. The bypass has a high point close to the mid-point, meaning there are two catchments, one either side of this crest.

- 4.5 The proposed drainage layout for the bypass is shown in A100789_501 Rev E.
- 4.6 Runoff from the southern section of the site is stored in two 1350mm diameter pipes with a flow control device limiting outflow to 5l/s. The flow control device discharges into the adjacent surface water system to the south.
- 4.7 Runoff from the northern section of the site is stored across two storage devices. A swale approximately 200m long is located to the west of the bypass and runs parallel to the highway. The swale collects and stores highway runoff prior to discharge through a flow control device which limits runoff to 10l/s. A storage crate, located underneath the roundabout island also connects to the flow control, allowing for additional storage during more extreme rainfall events.
- 4.8 The northern section of the highway will discharge into a swale which forms part of the drainage system for the northern section of the bypass.
- 4.9 The proposed storage crate and swale will be maintained by a Management Company appointed by the Developer.
- 4.10 Both the northern and southern highway drainage networks have been designed to operate within 1 in 100 year storm event.
- 4.11 Full details for the calculations can be seen in the attached Micro Drainage calculations.

5.0 Approval

- 5.1 The proposed surface water drainage scheme is subject to approval from statutory undertakers: Southern Water and West Sussex County Council as the local Highway Authority.

ATTACHED:

A100789_501 Rev E – Bypass Drainage

Micro Drainage Calculations – Southern Bypass

Micro Drainage Calculations – Northern Bypass

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Micro Drainage		Network 2015.1

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 1

« - 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)	Auto Design
1.000	89.076	2.400	37.1	0.128	5.00	0.0	0.600	o	225	⊗
1.001	121.831	4.200	29.0	0.144	0.00	0.0	0.600	o	300	⊗
1.002	36.127	1.665	21.7	0.045	0.00	0.0	0.600	o	300	⊗
2.000	67.985	0.335	202.9	0.100	5.00	0.0	0.600	o	300	⊗
3.000	63.753	0.380	167.8	0.090	5.00	0.0	0.600	o	450	⊗
2.001	14.235	0.080	177.9	0.000	0.00	0.0	0.600	o	450	⊗
4.000	43.496	0.890	48.9	0.100	5.00	0.0	0.600	o	450	⊗
5.000	35.077	0.250	140.3	0.070	5.00	0.0	0.600	o	300	⊗
1.003	41.374	0.110	376.1	0.080	0.00	0.0	0.600	o	225	⊗

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.69	12.000	0.128	0.0	0.0	0.0	2.15	85.7	17.3
1.001	50.00	6.38	9.925	0.272	0.0	0.0	0.0	2.93	207.1	36.8
1.002	50.00	6.56	5.625	0.317	0.0	0.0	0.0	3.39	239.6	42.9
2.000	50.00	6.03	4.600	0.100	0.0	0.0	0.0	1.10	77.8	13.5
3.000	50.00	5.68	4.570	0.090	0.0	0.0	0.0	1.57	249.2	12.2
2.001	50.00	6.19	4.190	0.190	0.0	0.0	0.0	1.52	241.9	25.7
4.000	50.00	5.25	5.000	0.100	0.0	0.0	0.0	2.91	463.4	13.5
5.000	50.00	5.44	4.360	0.070	0.0	0.0	0.0	1.33	93.7	9.5
1.003	50.00	7.59	4.110	0.757	0.0	0.0	0.0	0.67	26.6	102.5

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Micro Drainage				Network 2015.1							
<u>Manhole Schedules for Surface Network 1</u>											
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)
SB2/1	13.800	1.500	Open Manhole	1200	1.000	12.300	225				
SB2/2	11.400	1.575	Open Manhole	1200	1.001	9.825	300	1.000	9.900	225	
SB2/3	7.120	1.495	Open Manhole	1200	1.002	5.625	300	1.001	5.625	300	
SB2/4	6.000	1.400	Open Manhole	1200	2.000	4.600	300				
SB2/5	5.700	1.130	Open Manhole	1200	3.000	4.570	450				
SB2/6	6.600	2.410	Open Manhole	1200	2.001	4.190	450	2.000	4.265	300	
								3.000	4.190	450	
SB2/7	6.500	1.500	Open Manhole	1200	4.000	5.000	450				
SB2/8	5.790	1.430	Open Manhole	1200	5.000	4.360	300				
SB2/9	6.200	2.240	Open Manhole	1200	1.003	4.110	225	1.002	3.960	300	
								2.001	4.110	450	
								4.000	4.110	450	
								5.000	4.110	300	
SB2/10	5.200	1.200	Open Manhole	1200		OUTFALL		1.003	4.000	225	
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<u>PIPELINE SCHEDULES for Surface Network 1</u> <u>Upstream Manhole</u> <table><tr><th>PN</th><th>Hyd Sect</th><th>Diam (mm)</th><th>MH Name</th><th>C.Level (m)</th><th>I.Level (m)</th><th>D.Depth (m)</th><th>MH Connection</th><th>MH DIAM., L*W (mm)</th></tr><tr><td>1.000</td><td>o</td><td>225</td><td>SB2/1</td><td>13.800</td><td>12.300</td><td>1.275</td><td>Open Manhole</td><td>1200</td></tr><tr><td>1.001</td><td>o</td><td>300</td><td>SB2/2</td><td>11.400</td><td>9.825</td><td>1.275</td><td>Open Manhole</td><td>1200</td></tr><tr><td>1.002</td><td>o</td><td>300</td><td>SB2/3</td><td>7.120</td><td>5.625</td><td>1.195</td><td>Open Manhole</td><td>1200</td></tr><tr><td>2.000</td><td>o</td><td>300</td><td>SB2/4</td><td>6.000</td><td>4.600</td><td>1.100</td><td>Open Manhole</td><td>1200</td></tr><tr><td>3.000</td><td>o</td><td>450</td><td>SB2/5</td><td>5.700</td><td>4.570</td><td>0.680</td><td>Open Manhole</td><td>1200</td></tr><tr><td>2.001</td><td>o</td><td>450</td><td>SB2/6</td><td>6.600</td><td>4.190</td><td>1.960</td><td>Open Manhole</td><td>1200</td></tr><tr><td>4.000</td><td>o</td><td>450</td><td>SB2/7</td><td>6.500</td><td>5.000</td><td>1.050</td><td>Open Manhole</td><td>1200</td></tr><tr><td>5.000</td><td>o</td><td>300</td><td>SB2/8</td><td>5.790</td><td>4.360</td><td>1.130</td><td>Open Manhole</td><td>1200</td></tr><tr><td>1.003</td><td>o</td><td>225</td><td>SB2/9</td><td>6.200</td><td>4.110</td><td>1.865</td><td>Open Manhole</td><td>1200</td></tr></table> <u>Downstream Manhole</u> <table><tr><th>PN</th><th>Length (m)</th><th>Slope (1:X)</th><th>MH Name</th><th>C.Level (m)</th><th>I.Level (m)</th><th>D.Depth (m)</th><th>MH Connection</th><th>MH DIAM., L*W (mm)</th></tr><tr><td>1.000</td><td>89.076</td><td>37.1</td><td>SB2/2</td><td>11.400</td><td>9.900</td><td>1.275</td><td>Open Manhole</td><td>1200</td></tr><tr><td>1.001</td><td>121.831</td><td>29.0</td><td>SB2/3</td><td>7.120</td><td>5.625</td><td>1.195</td><td>Open Manhole</td><td>1200</td></tr><tr><td>1.002</td><td>36.127</td><td>21.7</td><td>SB2/9</td><td>6.200</td><td>3.960</td><td>1.940</td><td>Open Manhole</td><td>1200</td></tr><tr><td>2.000</td><td>67.985</td><td>202.9</td><td>SB2/6</td><td>6.600</td><td>4.265</td><td>2.035</td><td>Open Manhole</td><td>1200</td></tr><tr><td>3.000</td><td>63.753</td><td>167.8</td><td>SB2/6</td><td>6.600</td><td>4.190</td><td>1.960</td><td>Open Manhole</td><td>1200</td></tr><tr><td>2.001</td><td>14.235</td><td>177.9</td><td>SB2/9</td><td>6.200</td><td>4.110</td><td>1.640</td><td>Open Manhole</td><td>1200</td></tr><tr><td>4.000</td><td>43.496</td><td>48.9</td><td>SB2/9</td><td>6.200</td><td>4.110</td><td>1.640</td><td>Open Manhole</td><td>1200</td></tr><tr><td>5.000</td><td>35.077</td><td>140.3</td><td>SB2/9</td><td>6.200</td><td>4.110</td><td>1.790</td><td>Open Manhole</td><td>1200</td></tr><tr><td>1.003</td><td>41.374</td><td>376.1</td><td>SB2/10</td><td>5.200</td><td>4.000</td><td>0.975</td><td>Open Manhole</td><td>1200</td></tr></table>									PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)	1.000	o	225	SB2/1	13.800	12.300	1.275	Open Manhole	1200	1.001	o	300	SB2/2	11.400	9.825	1.275	Open Manhole	1200	1.002	o	300	SB2/3	7.120	5.625	1.195	Open Manhole	1200	2.000	o	300	SB2/4	6.000	4.600	1.100	Open Manhole	1200	3.000	o	450	SB2/5	5.700	4.570	0.680	Open Manhole	1200	2.001	o	450	SB2/6	6.600	4.190	1.960	Open Manhole	1200	4.000	o	450	SB2/7	6.500	5.000	1.050	Open Manhole	1200	5.000	o	300	SB2/8	5.790	4.360	1.130	Open Manhole	1200	1.003	o	225	SB2/9	6.200	4.110	1.865	Open Manhole	1200	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	89.076	37.1	SB2/2	11.400	9.900	1.275	Open Manhole	1200	1.001	121.831	29.0	SB2/3	7.120	5.625	1.195	Open Manhole	1200	1.002	36.127	21.7	SB2/9	6.200	3.960	1.940	Open Manhole	1200	2.000	67.985	202.9	SB2/6	6.600	4.265	2.035	Open Manhole	1200	3.000	63.753	167.8	SB2/6	6.600	4.190	1.960	Open Manhole	1200	2.001	14.235	177.9	SB2/9	6.200	4.110	1.640	Open Manhole	1200	4.000	43.496	48.9	SB2/9	6.200	4.110	1.640	Open Manhole	1200	5.000	35.077	140.3	SB2/9	6.200	4.110	1.790	Open Manhole	1200	1.003	41.374	376.1	SB2/10	5.200	4.000	0.975	Open Manhole	1200
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Setting Out Information - True Coordinates (Surface Network 1)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Layout (North)
1.000	SB2/1	1200		503137.516	103929.353	
1.001	SB2/2	1200		503146.532	104017.971	
1.002	SB2/3	1200		503135.112	104139.266	
2.000	SB2/4	1200		503201.764	104174.437	
3.000	SB2/5	1200		503131.835	104236.050	
2.001	SB2/6	1200		503133.812	104172.328	
4.000	SB2/7	1200		503125.694	104128.822	
5.000	SB2/8	1200		503084.580	104169.629	
1.003	SB2/9	1200		503119.584	104171.886	
PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
1.003	SB2/10	1200		503118.301	104213.240	

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.003	SB2/10	5.200	4.000	0.000	1200	0

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Online Controls for Surface Network 1

Hydro-Brake Optimum® Manhole: SB2/9, DS/PN: 1.003, Volume (m³): 16.0

Unit Reference	MD-SHE-0137-1000-1550-1000
Design Head (m)	1.550
Design Flow (l/s)	10.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	137
Invert Level (m)	4.110
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)	1.550	10.0	Kick-Flo®	0.957	8.0
Flush-Flo™	0.454	10.0	Mean Flow over Head Range	-	8.7

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)
0.100	5.0	1.200	8.8	3.000	13.6	7.000	20.4
0.200	8.9	1.400	9.5	3.500	14.7	7.500	21.1
0.300	9.7	1.600	10.1	4.000	15.6	8.000	21.8
0.400	9.9	1.800	10.7	4.500	16.5	8.500	22.4
0.500	9.9	2.000	11.3	5.000	17.4	9.000	23.1
0.600	9.8	2.200	11.8	5.500	18.2	9.500	23.7
0.800	9.2	2.400	12.3	6.000	19.0		
1.000	8.1	2.600	12.7	6.500	19.7		

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

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 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.349
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.100 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	SB2/1	15 Winter	1	+0%					12.367
1.001	SB2/2	15 Winter	1	+0%					9.904
1.002	SB2/3	15 Winter	1	+0%					5.706
2.000	SB2/4	15 Winter	1	+0%	30/60 Winter				4.683
3.000	SB2/5	15 Winter	1	+0%	30/120 Winter				4.634
2.001	SB2/6	120 Winter	1	+0%	30/15 Winter				4.454
4.000	SB2/7	15 Winter	1	+0%	100/60 Winter				5.052
5.000	SB2/8	120 Winter	1	+0%	30/15 Winter				4.454
1.003	SB2/9	120 Winter	1	+0%	1/15 Summer				4.453

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)					
1.000	SB2/1	-0.158	0.000	0.19		16.3	OK	
1.001	SB2/2	-0.221	0.000	0.15		30.9	OK	
1.002	SB2/3	-0.219	0.000	0.16		35.4	OK	
2.000	SB2/4	-0.217	0.000	0.17		12.3	OK	
3.000	SB2/5	-0.386	0.000	0.05		11.1	OK	
2.001	SB2/6	-0.186	0.000	0.04		7.1	OK	
4.000	SB2/7	-0.398	0.000	0.03		12.6	OK	

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

PN	US/MH Name	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)			Flow (l/s)		
5.000	SB2/8	-0.206	0.000	0.04		3.1	OK	
1.003	SB2/9	0.118	0.000	0.39		9.8	SURCHARGED	

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

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 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.349
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.100 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	SB2/1	15 Winter	30	+0%					12.410
1.001	SB2/2	15 Winter	30	+0%					9.962
1.002	SB2/3	15 Winter	30	+0%					5.765
2.000	SB2/4	120 Winter	30	+0%	30/60 Winter				5.047
3.000	SB2/5	120 Winter	30	+0%	30/120 Winter				5.045
2.001	SB2/6	120 Winter	30	+0%	30/15 Winter				5.045
4.000	SB2/7	15 Winter	30	+0%	100/60 Winter				5.081
5.000	SB2/8	120 Winter	30	+0%	30/15 Winter				5.046
1.003	SB2/9	120 Winter	30	+0%	1/15 Summer				5.045

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)					
1.000	SB2/1	-0.115	0.000	0.46		38.8	OK	
1.001	SB2/2	-0.163	0.000	0.41		82.5	OK	
1.002	SB2/3	-0.160	0.000	0.43		96.1	OK	
2.000	SB2/4	0.147	0.000	0.14		10.4	SURCHARGED	
3.000	SB2/5	0.025	0.000	0.04		9.2	SURCHARGED	
2.001	SB2/6	0.405	0.000	0.07		12.6	SURCHARGED	
4.000	SB2/7	-0.369	0.000	0.07		30.8	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1								
PN	US/MH Name	Surcharged		Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Level Exceeded
		Depth (m)	Volume (m³)	Flow			Status	
5.000	SB2/8	0.386	0.000	0.08		6.8	SURCHARGED	
1.003	SB2/9	0.710	0.000	0.39		9.9	SURCHARGED	

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

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 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.349
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.100 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	SB2/1	15 Winter	100	+30%					12.454
1.001	SB2/2	15 Winter	100	+30%					10.015
1.002	SB2/3	15 Winter	100	+30%					5.820
2.000	SB2/4	240 Winter	100	+30%	30/60 Winter				5.692
3.000	SB2/5	240 Winter	100	+30%	30/120 Winter				5.690
2.001	SB2/6	240 Winter	100	+30%	30/15 Winter				5.690
4.000	SB2/7	240 Winter	100	+30%	100/60 Winter				5.689
5.000	SB2/8	240 Winter	100	+30%	30/15 Winter				5.690
1.003	SB2/9	240 Winter	100	+30%	1/15 Summer				5.689

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)					
1.000	SB2/1	-0.071	0.000	0.78		65.2	OK	
1.001	SB2/2	-0.110	0.000	0.69		138.6	OK	
1.002	SB2/3	-0.105	0.000	0.73		161.4	OK	
2.000	SB2/4	0.792	0.000	0.13		9.8	SURCHARGED	
3.000	SB2/5	0.670	0.000	0.04		9.0	FLOOD RISK	
2.001	SB2/6	1.050	0.000	0.11		18.3	SURCHARGED	
4.000	SB2/7	0.239	0.000	0.03		10.7	SURCHARGED	

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

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)			Flow (l/s)		
5.000	SB2/8	1.030	0.000	0.08		6.8	FLOOD RISK	
1.003	SB2/9	1.354	0.000	0.40		10.1	SURCHARGED	

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.200	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Surface Network 1

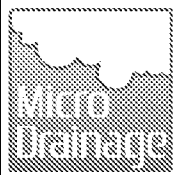
« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	7.257	0.098	74.1	0.139	5.00	0.0	0.600	o	225	⚡
2.000	2.335	0.411	5.7	0.139	5.00	0.0	0.600	o	225	⚡
1.001	81.951	4.012	20.4	0.034	0.00	0.0	0.600	o	225	⚡
1.002	103.954	0.139	750.0	0.128	0.00	0.0	0.600	o	1350	⚡
1.003	115.001	0.153	750.2	0.162	0.00	0.0	0.600	o	1350	⚡
1.004	42.565	0.207	205.6	0.000	0.00	0.0	0.600	o	225	⚡

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	48.83	5.08	9.152	0.139	0.0	0.0	0.0	1.52	60.5	18.4
2.000	49.12	5.01	9.390	0.139	0.0	0.0	0.0	9.59	219.7	18.5
1.001	47.02	5.55	8.979	0.312	0.0	0.0	0.0	2.91	115.6	39.7
1.002	43.08	6.74	8.842	0.440	0.0	0.0	0.0	1.46	2090.6	51.3
1.003	39.52	8.05	8.703	0.602	0.0	0.0	0.0	1.46	2090.4	64.4
1.004	37.71	8.83	8.550	0.602	0.0	0.0	0.0	0.91	36.1	64.4

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<u>Manhole Schedules for Surface Network 1</u>											
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)
S9	10.502	1.350	Open Manhole	1200	1.000	9.152	225				
S2	10.400	1.010	Open Manhole	1200	2.000	9.390	225				
S7	10.404	1.425	Open Manhole	1200	1.001	8.979	225	1.000	9.054	225	75
								2.000	8.979	225	
S3	7.066	3.224	Open Manhole	2250	1.002	3.842	1350	1.001	4.967	225	
S4	6.838	3.135	Open Manhole	2250	1.003	3.703	1350	1.002	3.703	1350	
S5	5.988	2.439	Open Manhole	2250	1.004	3.550	225	1.003	3.550	1350	
S6	5.978	2.635	Open Manhole	1200		OUTFALL		1.004	3.343	225	
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PIPELINE SCHEDULES for Surface Network 1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	S9	10.502	9.152	1.125	Open Manhole	1200
2.000	o	225	S2	10.400	9.330	0.785	Open Manhole	1200
1.001	o	225	S7	10.404	8.979	1.200	Open Manhole	1200
1.002	o	1350	S3	7.066	3.842	1.874	Open Manhole	2250
1.003	o	1350	S4	6.838	3.703	1.785	Open Manhole	2250
1.004	o	225	S5	5.388	3.550	2.213	Open Manhole	2250

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	7.257	74.1	S7	10.404	9.054	1.125	Open Manhole	1200
2.000	2.335	5.7	S7	10.404	8.979	1.200	Open Manhole	1200
1.001	81.951	20.4	S3	7.066	4.967	1.874	Open Manhole	2250
1.002	103.954	750.0	S4	6.838	3.703	1.785	Open Manhole	2250
1.003	115.001	750.2	S5	5.388	3.550	1.089	Open Manhole	2250
1.004	42.565	205.6	S6	5.978	3.343	2.410	Open Manhole	1200

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Setting Out Information - True Coordinates (Surface Network 1)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Layout (North)
1.000	S9	1200		503117.514	103739.426	
2.000	S2	1200		503108.344	103741.243	
1.001	S7	1200		503110.274	103739.928	
1.002	S3	2250		503093.771	103659.656	
1.003	S4	2250		503088.138	103555.855	
1.004	S5	2250		503099.289	103441.396	
1.004	S6	1200		503104.887	103399.201	

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004	S6	5.978	3.343	0.000	1200	0

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Online Controls for Surface Network 1

Hydro-Brake Optimum® Manhole: S5, DS/PN: 1.004, Volume (m³): 171.1

Unit Reference MD-SHE-0097-5000-1600-5000	
Design Head (m)	1.600
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	97
Invert Level (m)	3.550
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)	1.600	5.0	Kick-Flo®	0.865	3.8
Flush-Flo™	0.425	4.7	Mean Flow over Head Range	-	4.2

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	3.1	1.200	4.4	3.000	6.7	7.000	10.0
0.200	4.3	1.400	4.7	3.500	7.2	7.500	10.3
0.300	4.6	1.600	5.0	4.000	7.7	8.000	10.7
0.400	4.7	1.800	5.3	4.500	8.1	8.500	11.0
0.500	4.7	2.000	5.5	5.000	8.5	9.000	11.3
0.600	4.6	2.200	5.8	5.500	8.9	9.500	11.6
0.800	4.1	2.400	6.0	6.000	9.3		
1.000	4.0	2.600	6.3	6.500	9.7		

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

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 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.350
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.200 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s)

Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S9	15 Winter	1	+0%	100/15 Summer				9.252
2.000	S2	15 Winter	1	+0%	100/15 Summer				9.458
1.001	S7	15 Winter	1	+0%	100/15 Summer				9.071
1.002	S3	120 Winter	1	+0%					4.031
1.003	S4	120 Winter	1	+0%	100/240 Winter				4.031
1.004	S5	120 Winter	1	+0%	1/15 Summer				4.031

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)					
1.000	S9	-0.125	0.000	0.40		17.6	OK	
2.000	S2	-0.157	0.000	0.20		17.7	OK	
1.001	S7	-0.133	0.000	0.35		39.2	OK	
1.002	S3	-1.161	0.000	0.01		19.3	OK	
1.003	S4	-1.022	0.000	0.01		20.3	OK	
1.004	S5	0.256	0.000	0.14		4.7	SURCHARGED	

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

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 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.350
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.200 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s)

Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S9	15 Winter	30	+0%	100/15 Summer				9.333
2.000	S2	15 Winter	30	+0%	100/15 Summer				9.501
1.001	S7	15 Winter	30	+0%	100/15 Summer				9.143
1.002	S3	240 Winter	30	+0%					4.448
1.003	S4	240 Winter	30	+0%	100/240 Winter				4.449
1.004	S5	240 Winter	30	+0%	1/15 Summer				4.449

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)					
1.000	S9	-0.044	0.000	0.98		43.2	OK	
2.000	S2	-0.114	0.000	0.48		43.4	OK	
1.001	S7	-0.061	0.000	0.87		97.5	OK	
1.002	S3	-0.744	0.000	0.02		27.9	OK	
1.003	S4	-0.604	0.000	0.01		23.0	OK	
1.004	S5	0.674	0.000	0.14		4.7	SURCHARGED	

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

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	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)		19.200 Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

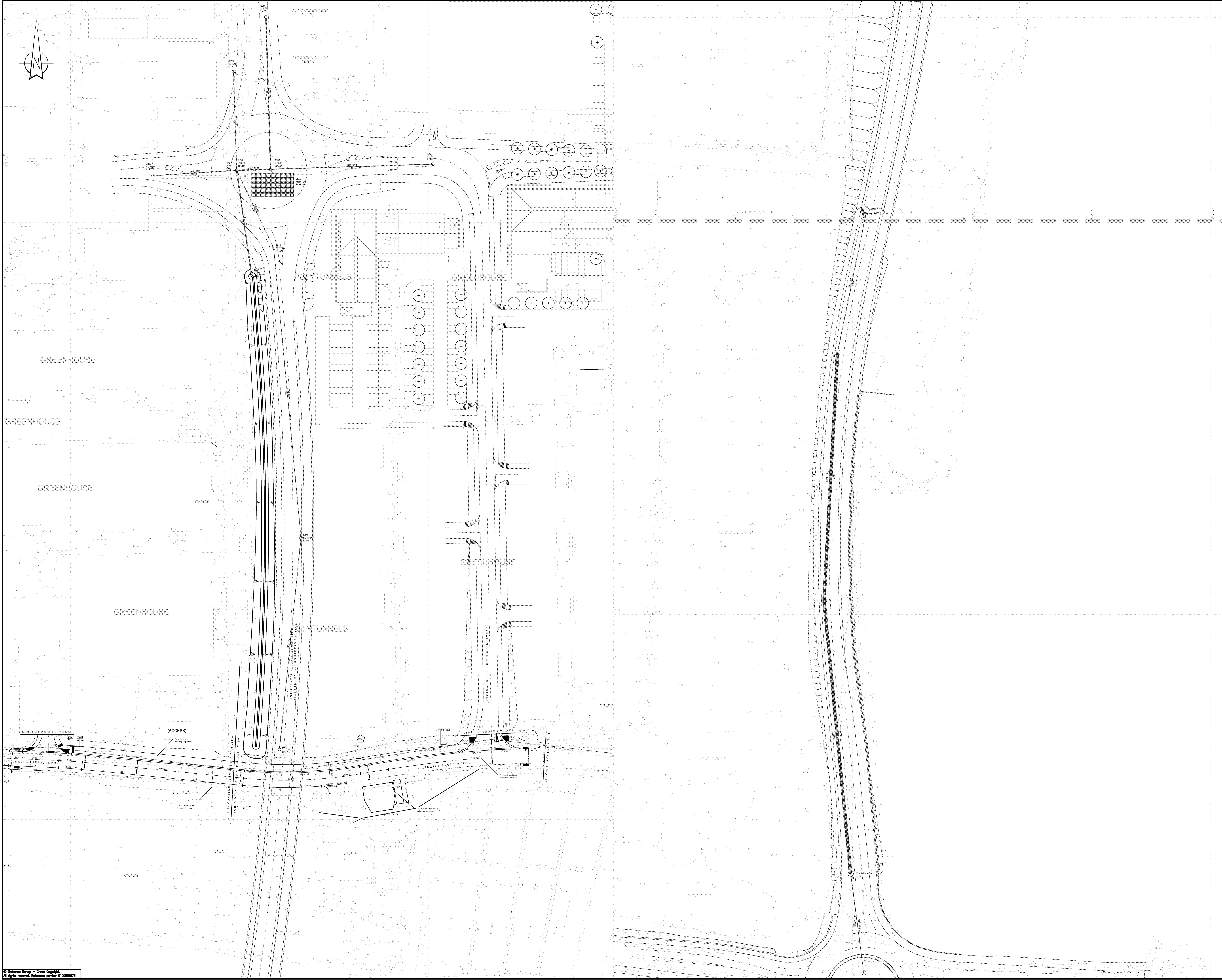
Profile(s)

Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440	Summer and Winter
Return Period(s) (years)	1, 30, 100	
Climate Change (%)	0, 0, 30	

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S9	15 Winter	100	+30%	100/15 Summer				10.236
2.000	S2	15 Winter	100	+30%	100/15 Summer				10.234
1.001	S7	15 Winter	100	+30%	100/15 Summer				10.074
1.002	S3	360 Winter	100	+30%					5.184
1.003	S4	360 Winter	100	+30%	100/240 Winter				5.181
1.004	S5	360 Winter	100	+30%	1/15 Summer				5.182

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)					
1.000	S9	0.859	0.000	1.31		57.7	FLOOD RISK	
2.000	S2	0.619	0.000	0.62		55.8	FLOOD RISK	
1.001	S7	0.870	0.000	1.10		124.1	SURCHARGED	
1.002	S3	-0.008	0.000	0.02		34.8	OK	
1.003	S4	0.128	0.000	0.02		26.9	SURCHARGED	
1.004	S5	1.407	0.000	0.15		5.0	SURCHARGED	

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— Kerb Drainage

--- Surface Water Drainage

REV		DETAILS		DRAWN BY		CHECKED BY		DATE	
CLIENT: PERSIMMON HOMES									
PROJECT: NORTH LITTLEHAMPTON									
DRAWING TITLE: BYPASS DRAINAGE									
SCALE: 1:500					SHEET SIZE: A0				
DRAWN: PG			CHECKED: MP			DATE: 19.05.17			
WYG Transport part of WYG group 5th Floor, Longcross Court 47 Newport Road, Cardiff, CF24 0AD t: 029 2062 6200 f: 029 2045 5321 e: transport.cardiff@wyg.com									
DRAWING NUMBER: A100789_501						REVISION: E			