



Wokingham Major Highways Programme - South Wokingham Distributor Road (SWDR) - Western Gateway Phase 2 (WG2)

Specification Appendices - MicroDrainage Results

WMHP-TG-WG2-CA-DD-0501

(Revision P03, Date 11/08/2021)

Wokingham Major Highways Programme - South Wokingham Distributor Road (SWDR) - Western Gateway Phase 2 (WG2)

Specification Appendices - MicroDrainage Results

Wokingham Borough Council

Document no: WMHP-TG-WG2-CA-DD-0501

Revision: P03

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Document Issue Record

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P01	19/02/21	First Issue	RDS	BH	JC
P02	30/07/21	Revised for Planning Discharge and SCO Comments	RDS	BH	JC
P03	11/08/21	Omission of Calculations Resolved	MH	BH	JC

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Network 2019.1

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Network 1 - TW

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)

1

PIMP (%)

100

M5-60 (mm)

18.400

Add Flow / Climate Change (%)

0

Ratio R

0.400

Minimum Backdrop Height (m)

0.200

Maximum Rainfall (mm/hr)

50

Maximum Backdrop Height (m)

20.000

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

Network Design Table for Network 1 - TW

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
PN 1-1.000	23.580	1.467	16.1	0.052	4.00	0.0	0.600	o	225	Pipe/Conduit	
PN 1-2.000	12.583	0.075	167.8	0.081	4.00	0.0	0.600	o	225	Pipe/Conduit	
PN 1-2.001	11.632	0.105	110.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
PN 1-3.000	16.024	0.227	70.4	0.021	4.00	0.0	0.600	o	225	Pipe/Conduit	
PN 1-2.002	20.275	0.092	220.4	0.015	0.00	0.0	0.600	o	450	Pipe/Conduit	
PN 1-2.003	13.055	0.551	23.7	0.035	0.00	0.0	0.600	o	225	Pipe/Conduit	
PN 1-1.001	13.737	0.046	298.6	0.066	0.00	0.0	0.600	o	750	Pipe/Conduit	
PN 1-1.002	17.548	0.058	302.6	0.017	0.00	0.0	0.600	o	750	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
PN 1-1.000	50.00	4.12	53.109	0.052	0.0	0.0	0.0	3.28	130.4	7.0
PN 1-2.000	50.00	4.21	52.690	0.081	0.0	0.0	0.0	1.01	40.0	11.0
PN 1-2.001	50.00	4.36	52.615	0.081	0.0	0.0	0.0	1.24	49.4	11.0
PN 1-3.000	50.00	4.17	52.737	0.021	0.0	0.0	0.0	1.56	62.0	2.8
PN 1-2.002	50.00	4.61	52.285	0.117	0.0	0.0	0.0	1.37	217.2	15.8
PN 1-2.003	50.00	4.69	52.193	0.151	0.0	0.0	0.0	2.70	107.3	20.5
PN 1-1.001	50.00	4.83	51.117	0.269	0.0	0.0	0.0	1.61	713.1	36.5
PN 1-1.002	50.00	5.02	51.071	0.286	0.0	0.0	0.0	1.60	708.4	38.7

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Manhole Schedules for Network 1 - TW

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)
C1-1.000	54.534	1.425	Open Manhole	1200	PN 1-1.000	53.109	225			
C1-2.000	54.255	1.565	Open Manhole	1200	PN 1-2.000	52.690	225			
C1-2.001	54.419	1.804	Open Manhole	1200	PN 1-2.001	52.615	225	PN 1-2.000	52.615	225
C1-3.000	54.162	1.425	Open Manhole	1200	PN 1-3.000	52.737	225			
C1-2.002	54.344	2.060	Open Manhole	1350	PN 1-2.002	52.285	450	PN 1-2.001	52.510	225
								PN 1-3.000	52.510	225
C1-2.003	53.849	1.656	Open Manhole	1350	PN 1-2.003	52.193	225	PN 1-2.002	52.193	450
C1-1.001	53.660	2.543	Open Manhole	1800	PN 1-1.001	51.117	750	PN 1-1.000	51.642	225
								PN 1-2.003	51.642	225
C1-1.002	52.920	1.849	Open Manhole	1800	PN 1-1.002	51.071	750	PN 1-1.001	51.071	750
C1-1.003	52.323	1.310	Open Manhole	1800	PN 1-1.003	51.013	450	PN 1-1.002	51.013	750
C1-1.004	51.900	0.992	Open Manhole	1500	PN 1-1.004	50.908	450	PN 1-1.003	50.908	450
C1-1.005	51.950	1.050	Open Manhole	1350	PN 1-1.005	50.900	300	PN 1-1.004	50.900	450
C1-LG1060	51.990	1.390	Open Manhole	0		OUTFALL		PN 1-1.005	50.600	300

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
C1-1.000	480765.457	167788.445	480765.457	167788.445	Required	
C1-2.000	480802.064	167788.932	480802.064	167788.932	Required	
C1-2.001	480790.191	167793.097	480790.191	167793.097	Required	
C1-3.000	480802.306	167804.444	480802.306	167804.444	Required	
C1-2.002	480786.287	167804.054	480786.287	167804.054	Required	
C1-2.003	480767.720	167812.198	480767.720	167812.198	Required	
C1-1.001	480754.937	167809.548	480754.937	167809.548	Required	



Micro
Drainage

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MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
C1-1.002	480746.117	167820.079	480746.117	167820.079	Required	
C1-1.003	480731.327	167829.523	480731.327	167829.523	Required	
C1-1.004	480702.244	167841.233	480702.244	167841.233	Required	
C1-1.005	480700.452	167842.734	480700.452	167842.734	Required	
C1-LG1060	480615.821	167873.430			No Entry	

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PIPELINE SCHEDULES for Network 1 - TW

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)
PN 1-1.000	o	225	C1-1.000	54.534	53.109	1.200	Open Manhole	1200
PN 1-2.000	o	225	C1-2.000	54.255	52.690	1.340	Open Manhole	1200
PN 1-2.001	o	225	C1-2.001	54.419	52.615	1.579	Open Manhole	1200
PN 1-3.000	o	225	C1-3.000	54.162	52.737	1.200	Open Manhole	1200
PN 1-2.002	o	450	C1-2.002	54.344	52.285	1.610	Open Manhole	1350
PN 1-2.003	o	225	C1-2.003	53.849	52.193	1.431	Open Manhole	1350
PN 1-1.001	o	750	C1-1.001	53.660	51.117	1.793	Open Manhole	1800
PN 1-1.002	o	750	C1-1.002	52.920	51.071	1.099	Open Manhole	1800
PN 1-1.003	o	450	C1-1.003	52.323	51.013	0.860	Open Manhole	1800
PN 1-1.004	o	450	C1-1.004	51.900	50.908	0.542	Open Manhole	1500
PN 1-1.005	o	300	C1-1.005	51.950	50.900	0.750	Open Manhole	1350

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)
PN 1-1.000	23.580	16.1	C1-1.001	53.660	51.642	1.793	Open Manhole	1800
PN 1-2.000	12.583	167.8	C1-2.001	54.419	52.615	1.579	Open Manhole	1200
PN 1-2.001	11.632	110.4	C1-2.002	54.344	52.510	1.610	Open Manhole	1350
PN 1-3.000	16.024	70.4	C1-2.002	54.344	52.510	1.610	Open Manhole	1350
PN 1-2.002	20.275	220.4	C1-2.003	53.849	52.193	1.206	Open Manhole	1350
PN 1-2.003	13.055	23.7	C1-1.001	53.660	51.642	1.793	Open Manhole	1800
PN 1-1.001	13.737	298.6	C1-1.002	52.920	51.071	1.099	Open Manhole	1800
PN 1-1.002	17.548	302.6	C1-1.003	52.323	51.013	0.560	Open Manhole	1800
PN 1-1.003	31.352	298.6	C1-1.004	51.900	50.908	0.542	Open Manhole	1500
PN 1-1.004	2.338	300.0	C1-1.005	51.950	50.900	0.600	Open Manhole	1350
PN 1-1.005	90.026	300.1	C1-LG1060	51.990	50.600	1.090	Open Manhole	0

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<u>Simulation Criteria for Network 1 - TW</u> <u>Synthetic Rainfall Details</u> <table><tr><td>Rainfall Model</td><td>FSR</td><td>Profile Type</td><td>Summer</td></tr><tr><td>Return Period (years)</td><td>30</td><td>Cv (Summer)</td><td>0.750</td></tr><tr><td>Region</td><td>England and Wales</td><td>Cv (Winter)</td><td>0.840</td></tr><tr><td>M5-60 (mm)</td><td>18.400</td><td>Storm Duration (mins)</td><td>30</td></tr><tr><td>Ratio R</td><td>0.400</td><td></td><td></td></tr></table>			Rainfall Model	FSR	Profile Type	Summer	Return Period (years)	30	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	18.400	Storm Duration (mins)	30	Ratio R	0.400		
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<u>Online Controls for Network 1 - TW</u>																																																																										
<u>Hydro-Brake® Optimum Manhole: C1-1.004, DS/PN: PN 1-1.004, Volume (m³): 6.5</u>																																																																										
Unit Reference MD-SHE-0330-6160-0505-6160 Design Head (m)0.505 Design Flow (l/s)61.6 Flush-Flo™Calculated ObjectiveMinimise upstream storage ApplicationSurface Sump AvailableYes Diameter (mm)330 Invert Level (m)50.908 Minimum Outlet Pipe Diameter (mm)375 Suggested Manhole Diameter (mm)1800																																																																										
<table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>0.505</td><td>61.6</td></tr><tr><td>Flush-Flo™</td><td>0.418</td><td>61.6</td></tr><tr><td>Kick-Flo®</td><td>0.493</td><td>60.9</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>39.0</td></tr></table>			Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	0.505	61.6	Flush-Flo™	0.418	61.6	Kick-Flo®	0.493	60.9	Mean Flow over Head Range	-	39.0																																																									
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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																																																																										
<table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>9.8</td><td>1.200</td><td>93.7</td><td>3.000</td><td>146.4</td><td>7.000</td><td>219.9</td></tr><tr><td>0.200</td><td>33.7</td><td>1.400</td><td>101.0</td><td>3.500</td><td>157.9</td><td>7.500</td><td>227.8</td></tr><tr><td>0.300</td><td>59.5</td><td>1.600</td><td>107.7</td><td>4.000</td><td>168.6</td><td>8.000</td><td>235.5</td></tr><tr><td>0.400</td><td>61.5</td><td>1.800</td><td>114.1</td><td>4.500</td><td>178.6</td><td>8.500</td><td>242.9</td></tr><tr><td>0.500</td><td>61.3</td><td>2.000</td><td>120.1</td><td>5.000</td><td>188.1</td><td>9.000</td><td>250.0</td></tr><tr><td>0.600</td><td>66.9</td><td>2.200</td><td>125.8</td><td>5.500</td><td>194.3</td><td>9.500</td><td>257.0</td></tr><tr><td>0.800</td><td>76.9</td><td>2.400</td><td>131.3</td><td>6.000</td><td>203.2</td><td></td><td></td></tr><tr><td>1.000</td><td>85.7</td><td>2.600</td><td>136.5</td><td>6.500</td><td>211.7</td><td></td><td></td></tr></table>			Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	9.8	1.200	93.7	3.000	146.4	7.000	219.9	0.200	33.7	1.400	101.0	3.500	157.9	7.500	227.8	0.300	59.5	1.600	107.7	4.000	168.6	8.000	235.5	0.400	61.5	1.800	114.1	4.500	178.6	8.500	242.9	0.500	61.3	2.000	120.1	5.000	188.1	9.000	250.0	0.600	66.9	2.200	125.8	5.500	194.3	9.500	257.0	0.800	76.9	2.400	131.3	6.000	203.2			1.000	85.7	2.600	136.5	6.500	211.7		
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																			
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Summary of Critical Results by Maximum Level (Rank 1) for Network 1 - TW

Simulation Criteria

Areal Reduction Factor 1.000

Hot Start (mins) 0

Hot Start Level (mm) 0

Manhole Headloss Coeff (Global) 0.500

Foul Sewage per hectare (l/s) 0.000

Additional Flow - % of Total Flow 0.000

MADD Factor * 10m³/ha Storage 2.000

Inlet Coefficient 0.800

Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0

Number of Online Controls 1

Number of Offline Controls 1

Number of Storage Structures 0

Number of Time/Area Diagrams 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR

Region England and Wales

M5-60 (mm) 18.400

Ratio R 0.400

Cv (Summer) 0.750

Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

Analysis Timestep Fine

DTS Status ON

DVD Status OFF

Inertia Status OFF

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

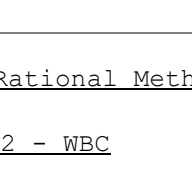
Return Period(s) (years) 1, 30, 100

Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow
PN 1-1.000	C1-1.000	15 Winter	100	+40%			
PN 1-2.000	C1-2.000	15 Winter	100	+40%	100/15 Summer		
PN 1-2.001	C1-2.001	15 Winter	100	+40%	100/15 Summer		
PN 1-3.000	C1-3.000	15 Winter	100	+40%			
PN 1-2.002	C1-2.002	15 Winter	100	+40%			
PN 1-2.003	C1-2.003	15 Winter	100	+40%			
PN 1-1.001	C1-1.001	15 Winter	100	+40%	100/15 Summer		
PN 1-1.002	C1-1.002	15 Winter	100	+40%	100/15 Summer		
PN 1-1.003	C1-1.003	15 Winter	100	+40%	30/15 Summer		
PN 1-1.004	C1-1.004	15 Winter	100	+40%	30/15 Summer	100/15 Summer	100/15 Summer
PN 1-1.005	C1-1.005	15 Winter	100	+40%	100/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Pipe Flow (l/s)	Status
PN 1-1.000	C1-1.000		53.187	-0.147	0.000	0.26	31.3	OK
PN 1-2.000	C1-2.000		53.018	0.103	0.000	1.40	48.4	SURCHARGED

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Network 2 - WBC

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	18.400	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	20.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.600
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Network 2 - WBC

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
PN 2-1.000	46.099	2.294	20.1	0.058	4.00	0.0	0.600	o	150	Pipe/Conduit		
PN 2-1.001	19.728	0.067	294.4	0.029	0.00	0.0	0.600	o	225	Pipe/Conduit		

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
PN 2-1.000	50.00	4.34	54.068	0.058	0.0	0.0	0.0	2.26	39.9	7.8
PN 2-1.001	50.00	4.77	51.699	0.087	0.0	0.0	0.0	0.76	30.1	11.8

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Micro
Drainage

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Manhole Schedules for Network 2 - WBC

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)
C2-2.000	54.818	0.750	Open Manhole	1200	PN 2-1.000	54.068	150			
C2-1.001	53.097	1.398	Open Manhole	1200	PN 2-1.001	51.699	225	PN 2-1.000	51.774	150
C2-1.001	52.540	0.908	Open Manhole	0		OUTFALL		PN 2-1.001	51.632	225

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
C2-2.000	480801.410	167763.525	480801.410	167763.525	Required	
C2-1.001	480826.040	167802.492	480826.040	167802.492	Required	
C2-	480838.840	167817.503			No Entry	



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Area Summary for Network 2 - WBC

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.010	0.010	0.010
	User	-	100	0.007	0.007	0.017
	User	-	100	0.024	0.024	0.041
	User	-	100	0.002	0.002	0.043
	User	-	50	0.001	0.001	0.044
	User	-	50	0.016	0.008	0.052
	User	-	100	0.006	0.006	0.058
1.001	User	-	100	0.005	0.005	0.005
	User	-	100	0.005	0.005	0.009
	User	-	100	0.009	0.009	0.018
	User	-	100	0.008	0.008	0.026
	User	-	100	0.003	0.003	0.029
				Total	Total	Total
				0.095	0.087	0.087

Free Flowing Outfall Details for Network 2 - WBC

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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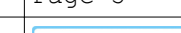
PN 2-1.001	C2-	52.540	51.632	0.000	0	0
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Simulation Criteria for Network 2 - WBC

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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 Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.400	Storm Duration (mins)	30
Ratio R	0.400		

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Summary of Critical Results by Maximum Level (Rank 1) for Network 2 - WBC

Simulation Criteria

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

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.400	Cv (Winter)	0.840

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 (%)	0, 0, 40

		Water	Surcharged	Flooded			Pipe		
	US/MH	Level	Depth	Volume	Flow /	Overflow	Flow		Level
PN	Name	(m)	(m)	(m³)	Cap.	(l/s)	(l/s)	Status	Exceeded
PN 2-1.000	C2-2.000	54.179	-0.039	0.000	0.90		35.0		OK
PN 2-1.001	C2-1.001	52.096	0.172	0.000	1.87		50.9	SURCHARGED	