



Callidus Transport and Engineering

Residential Units at Lowfield Road, Reading, RG4 6NL

Addendum – Drainage Update for Existing Scheme

on behalf of Reading Borough Council

DOCUMENT VERIFICATION

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I	04/07/22	Issue Final	S Parsons	SP	R Spriggs	RS	R Spriggs	RS

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I INTRODUCTION

I.1 About this Report

I.1.1 Callidus Transport and Engineering Ltd (the consultant) has been commissioned by Reading Borough Council (the client) to provide drainage advice with respect to 28 accommodation units on land which was previously occupied by mobile homes at Lowfield Road, Reading.

I.1.2 Planning consent for the site was granted subject to planning condition under Application No. I60762. This included condition 22 regarding details of the Sustainable Urban Drainage System (SuDS). The following flood and drainage related documents were submitted in support of the planning application and to subsequently discharge the planning condition:

- Drainage Strategy v2 (Clive Onions Consulting Civil Engineer, 2016)
- Addendum – Soakaway Design v1 (Clive Onions Consulting Civil Engineer, 2016)
- Discharge of Planning Condition 22 v1 (Clive Onions Consulting Civil Engineer, 2017) – this was approved under application reference I70689

I.1.3 The units have now been constructed, as shown in Figure I-1. This includes a foul and surface water drainage system in accordance with the original planning application design. However, the original design was intended as temporary units for a period of 5 years. The current application is to extend this period to a further 10 year temporary period. As the original drainage system was designed with 5 years in mind, the extension by a further 10 years requires that the assessment is revisited, including for allowances to current policy on climate change, which is the purpose of this report.

I.1.4 Therefore, this report reviews and updates the previous Soakaway Design Report produced by Clive Onions.

I.1.5 The report covers the following in the subsequent chapter to this introduction:

- Chapter 2 review the baseline infiltration testing that was previously undertaken;
- Chapter 3 describes the soakaway design which is now as-built;
- Chapter 4 contains the updated hydraulic analysis that has been undertaken; and
- Chapter 5 provides a summary and conclusion.

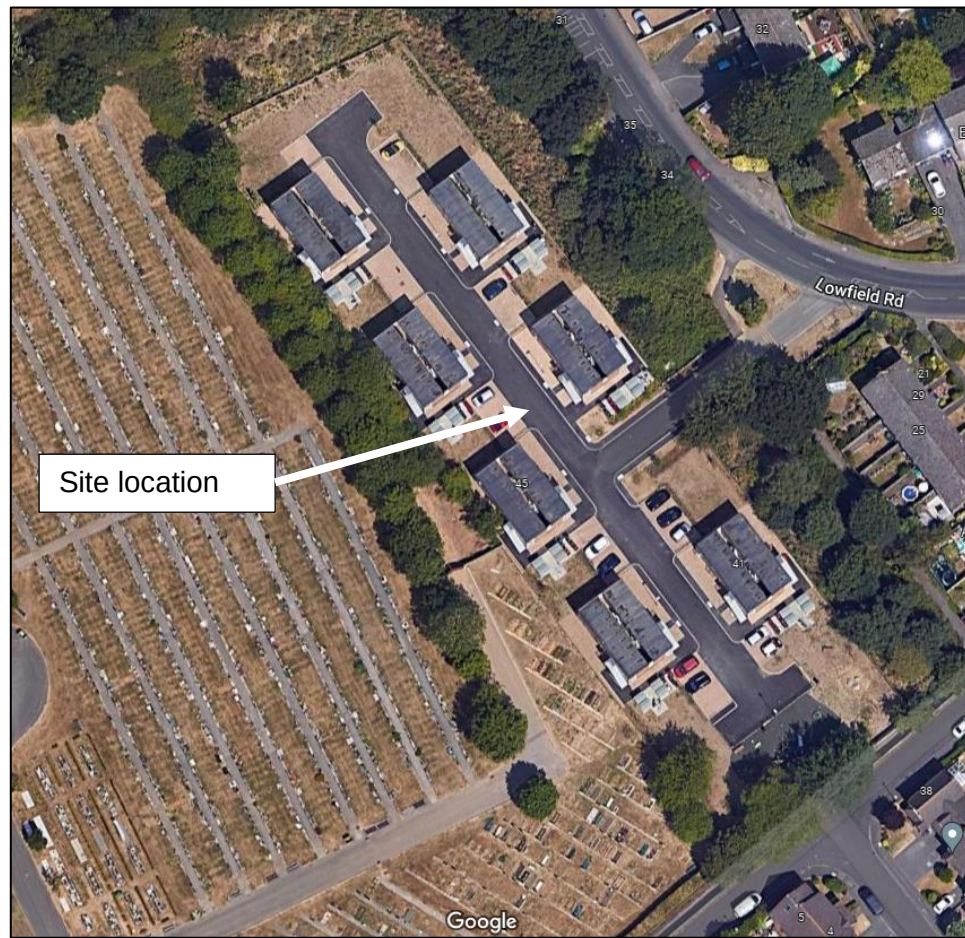


Figure 1-1: Site aerial photograph as-built (source Google Maps)

2 SOAKAWAY TESTS

2.1 Locations and Results

- 2.1.1 The site is on rising land at about 51m AOD in the south east to 55m AOD to the north west.
- 2.1.2 Soakaway tests were undertaken by Integrale Consulting Ltd on 25th and 26th July 2016 in accordance with BRE Digest 365 in the locations shown below.
- 2.1.3 The locations were chosen to provide typical results across the site, and the results are reproduced in Appendix A.



Figure 2-1 Approximate Soakaway Test Locations (Source: Clive Onions Ltd)

- 2.1.4 The average of the soakaway test results has been taken giving an infiltration rate of 5.63×10^{-6} m/s (0.02m/hr). A summary of the infiltration results is shown in Table 2-1.

	Infiltration (m/s)				Infiltration (m/hr)
	Test 1	Test 2	Test 3	Design	
TP1	8.1E-06	7.82E-06	9.99E-06	7.82E-06	0.028
TP2	3.8E-06			3.79E-06	0.014
TP3	1.1E-05	1.05E-05	8.6E-06	8.6E-06	0.031
TP4	7.1E-07			7.14E-07	0.003
TP5	1.8E-05	7.94E-06	7.19E-06	7.19E-06	0.026
Average	8.5E-06	8.75E-06	8.59E-06	5.62E-06	0.020

Table 2-1: Summary of infiltration survey results (source: Integrale survey of 2016)

3 SOAKAWAY DESIGN

- 3.1.1 The car parking spaces are formed in permeable paving with min. 350mm deep porous stone base, which is thicker than recommended for conventional permeable paving design, such as Formpave. Rainfall falling onto the permeable paving will therefore soak through the system, clean the water and infiltrate into the underlying ground.
- 3.1.2 The road is formed with a crown, falling to each side, with no kerbs except for around the hammerhead at the southern end of the site. Runoff from the road will therefore flow into the permeable paving and disperse through the system and into the ground.
- 3.1.3 Runoff from the buildings will be conveyed in rainwater pipes located centrally in the buildings to a back inlet gulley which will intercept silt etc. An underground pipe will be directed to a soakaway below the permeable paving, to disperse runoff by infiltration in the underlying ground.
- 3.1.4 The as-built arrangement as we understand it to be is shown in Appendix B, drawing no. SK001.

3.2 Typical Detail

- 3.2.1 Below is a typical detail of the drainage system, with the permeable paving, concrete ring soakaway and grave filled pit. The drawing is not to scale.

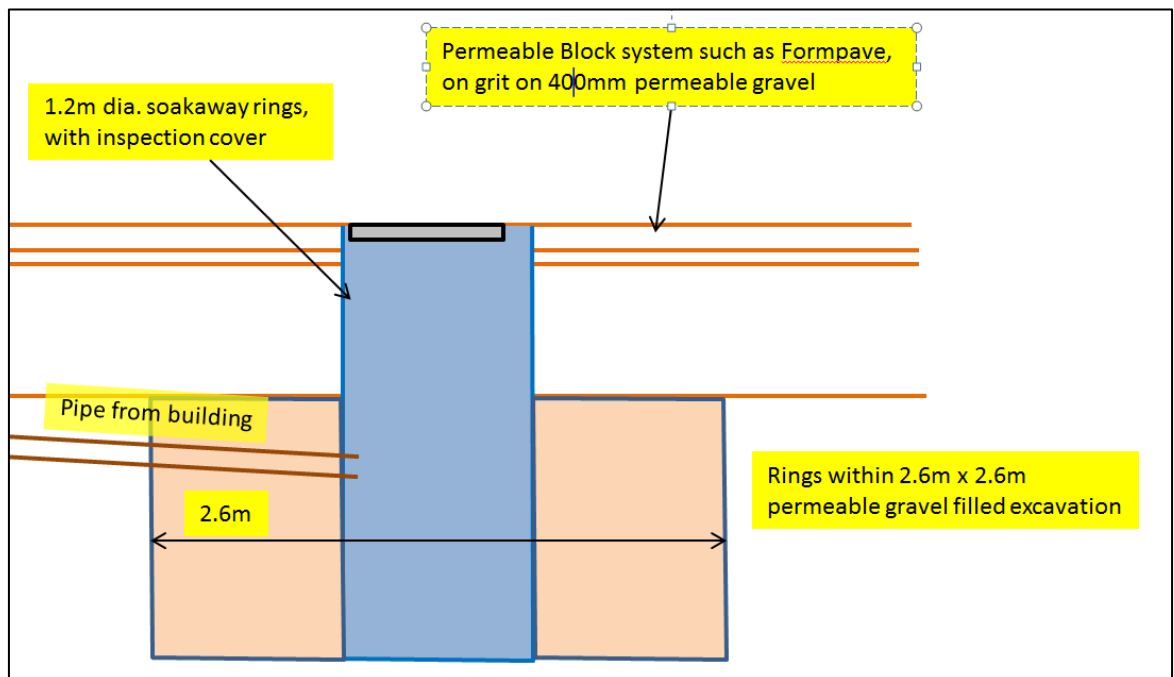


Figure 3-1 Indicative Design of the Soakaway System (Source: Clive Onions Ltd)

3.3 Site observations

3.3.1 A site visit was undertaken on Tuesday 31st May. Whilst it was not possible to observe the below ground drainage, it was apparent that the drainage system had been installed in line with the original design concept. However, it was noted that at the southern end of the scheme, the proposed permeable paving in the hammerhead had not been introduced. Instead, an ACO (or similar) channel drain had been installed along the southern channel line (see Figure 3-2). It is not known where this drains to or whether there is an additional soakaway to accommodate surface water from this part of the site.

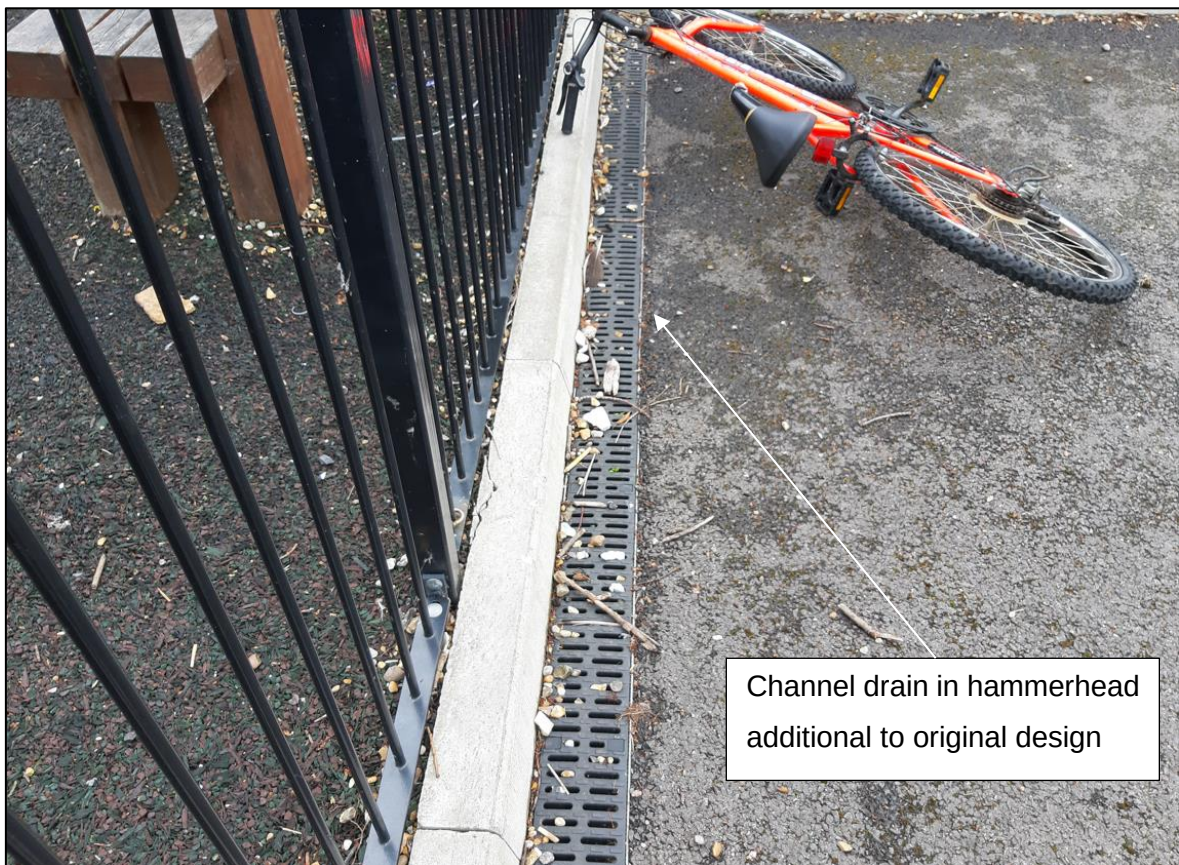


Figure 3-2: Channel drain in the hammerhead

3.3.2 The calculations in the following chapter make reference to the requirement for additional soakaway storage in this area which may already have been provided for but which has not been provided on the as-built information.

4 SOAKAWAY CALCULATIONS

4.1 Design

- 4.1.1 The soakaway assessment has been undertaken using MicroDrainage software. The calculations are based on an infiltration rate of 5.6×10^{-6} m/s with a safety factor of 1.5.
- 4.1.2 The storm return period is based on 1 in 10, 30 and 100 years. Although the lifetime of the development is only anticipated to be 10 years, climate change has been considered at 40% for each year.
- 4.1.3 The soakaway models are formed with a 1.2m dia. perforated ring, 2.5m deep, within a gravel-filled rectangle 2.6m x 2.6m.
- 4.1.4 In extreme events the soakaway overflows into the permeable paving, which provides a large area for infiltration, and the 350mm deep permeable layer. The catchment areas for the drainage system are shown in Appendix D, drawing no. SK002.
- 4.1.5 The results of testing the current arrangement are summarised in Table 4-1 with printouts in Appendix C. This shows that there is forecast to be flooding in the 30 year storm event (including climate change) to soakaways 4 and 5. There is some flooding to soakaway 1 but this is minimal and unlikely to be a significant impact.
- 4.1.6 In the 100 year storm event (including climate change), there is flooding to soakaways 1 to 5. However, 4 and 5 are the most significant.

Current		Return Period					
		10 Year		30 Year		100 Year	
Soakaway	Area (ha)	Critical Storm	Flood Volume (m3)	Critical Storm	Flood Volume (m3)	Critical Storm	Flood Volume (m3)
1	0.037	600 Min Winter	0	600 Min Winter	0.8	480 Min Winter	6.5
2	0.030	600 Min Winter	0	600 Min Winter	0	480 Min Winter	2.1
3	0.031	480 Min Winter	0	480 Min Winter	0	480 Min Winter	2.4
4	0.054	600 Min Winter	3.3	600 Min Winter	9.6	720 Min Winter	18.7
5	0.058	600 Min Winter	4.9	720 Min Winter	12.3	720 Min Winter	22.2
6	0.027	720 Min Winter	0	600 Min Winter	0	480 Min Winter	0
7	0.024	600 Min Winter	0	600 Min Winter	0	600 Min Winter	0

Table 4-1: Current flood risk

4.2 Recommendations

- 4.2.1 As the scheme is temporary for a further 10 years, it is not considered that the 100 year storm event needs to be accommodated in this case. In fact in policy terms, flooding in the 100 year would be allowed so long as it is contained on site. For this, some bunding at the

southern end of the site in the open space should be considered. However, in order to satisfy the 30 year storm event, further storage capacity is required to soakaways 4 and 5 as set out below.

- 4.2.2 In order to reduce the risk of flooding to soakaways 4 and 5, it is proposed that each soakaway has the addition of an overflow soakaway to the same design as the original soakaways. These are labelled as soakaways 4a and 5a.
- 4.2.3 The overflow soakaways can be connected by a simple overflow pipe from the original soakaway. The arrangement is shown indicatively in Appendix B, drawing no. SK003.
- 4.2.4 The results of testing these two soakaways with the additional overflow soakaways are shown below. This shows that the flood risk is resolved in the 30 year storm event and improved upon in the 100 year event.

Increased Storage		Return Period					
		10 Year		30 Year		100 Year	
Soakaway	Area (ha)	Critical Storm	Flood Volume (m3)	Critical Storm	Flood Volume (m3)	Critical Storm	Flood Volume (m3)
1	0.037	600 Min Winter	0	600 Min Winter	0.8	480 Min Winter	6.5
2	0.030	600 Min Winter	0	600 Min Winter	0	480 Min Winter	2.1
3	0.031	480 Min Winter	0	480 Min Winter	0	480 Min Winter	2.4
4 + 4a	0.054	720 Min Winter	0	480 Min Winter	0	600 Min Winter	8.0
5 + 5a	0.058	720 Min Winter	0	600 Min Winter	0	600 Min Winter	10.7
6	0.027	720 Min Winter	0	600 Min Winter	0	480 Min Winter	0
7	0.024	600 Min Winter	0	600 Min Winter	0	600 Min Winter	0

Table 4-2: Flood risk with additional soakaways

- 4.2.5 Two additional soakaways are proposed. However, if a soakaway has already been installed at the southern end of the site as part of the hammerhead drainage, it may be possible to reduce this requirement to just one.

4.3 Maintenance

- 4.3.1 It is important that maintenance measures are routinely undertaken to ensure that the drainage system remains functional and serviceable for the life of the development. An outline maintenance plan is contained Appendix D.

5 SUMMARY AND CONCLUSIONS

5.1 Summary

- 5.1.1 Callidus Transport and Engineering Ltd (the consultant) has been commissioned by Reading Borough Council (the client) to provide drainage advice with respect to 28 accommodation units on land which was previously occupied by mobile homes at Lowfield Road, Reading.
- 5.1.2 The units have already been constructed, however they were previously intended as temporary units with a predicted lifetime of 5 years. The current application is to extend this period for a further 10 year temporary period.
- 5.1.3 This report has reviewed and updated the previous Soakaway Design Report produced by Clive Onions Consulting Civil Engineers Ltd. The existing design was chosen to provide access for inspection and maintenance and makes use of the parking areas to also provide a drainage function. A detail sourced from the previous Soakaway Design by Clive Onions Ltd has been provided.
- 5.1.4 A soakaway investigation undertaken in accordance with BRE 365 has been used to define the parameters for the soakaway design.
- 5.1.5 The results from the soakaway hydraulic analysis have shown that there is significant flooding forecast in two of the soakaways in the 30 year storm event (soakaways 4 and 5) and five of the soakaways in the 100 year storm event. However, as the scheme is for a temporary period of an additional 10 years, it is proposed that the flood risk in the 30 year event only is addressed. This requires the addition of two overflow soakaways to soakaways 4 and 5 to be of the same design as the original soakaways.
- 5.1.6 It was noted on site that a channel drain had been installed along the southern channel line of the hammerhead which has not been recorded in the information given to us. If this already drains to an additional as-built soakaway, then it may be possible to reduce the requirement for overflow soakaways to just one.

APPENDIX A

SOAKAWAY TEST RESULTS

Appendix 1 Soakaway Test Results TPs 1 - 5

Intégrale		Suite 7 Westway Farm Business Park Wick Road Bishop Sutton BS39 5XP Tel: +44 (0) 1275 333 036 email: info@integrale.uk.com	
Soil Infiltration Rate Test. BRE 365 (2007) Soakaway Design			
Job No: 1706			
Job Name: Lowerfield Road, Caversham, Reading			
Prepared By: SJ	Date: 28/07/2016	Sheet: 1 of 1	
Checked By: JH	Date: 02/08/2016		
TPI			
Date of Test: 2 tests undertaken on the 26th July, final test undertaken on 27th July.			
Length (m): 2.00	Width (m): 0.30	Depth (m): 2.00	
Remarks: Deep soakaway test.			
	Test 1	Test 2	Test 3
Effective Storage Depth _{75-25%} (m)	0.35	0.35	0.5
A = Surface Area _{50%} (m ²)	2.21	2.21	2.90
V = Effective Storage Volume _{75-25%} (m ³)	0.21	0.21	0.30
t = Time _{75-25%} (mins)	195.9	202.5517	172.667
Soil Infiltration Rate (m/s)	8.08E-06	7.82E-06	9.99E-06
Design Soil Infiltration Rate (m/s)		7.82E-06	
Time (mins) Depth to Water (m) 0 0.5 1 1.5 2 0 25 50 75 100 125 150 175 200 225 250 275 300 Test 1 Test 2 Test 3			

Intégrale

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 Wick Road
 Bishop Sutton
 BS39 5XP
 Tel: +44 (0) 1275 333 036
 email: info@integrale.uk.com

Soil Infiltration Rate Test. BRE 365 (2007) Soakaway Design

Job No: 1706

Job Name: Lowerfield Road, Caversham, Reading

Prepared By: SJ Date: 28/07/2016

Checked By: JH Date: 02/08/2016

Sheet: 1 of 1

TP2

Date of Test: 26th and 27th July 2016

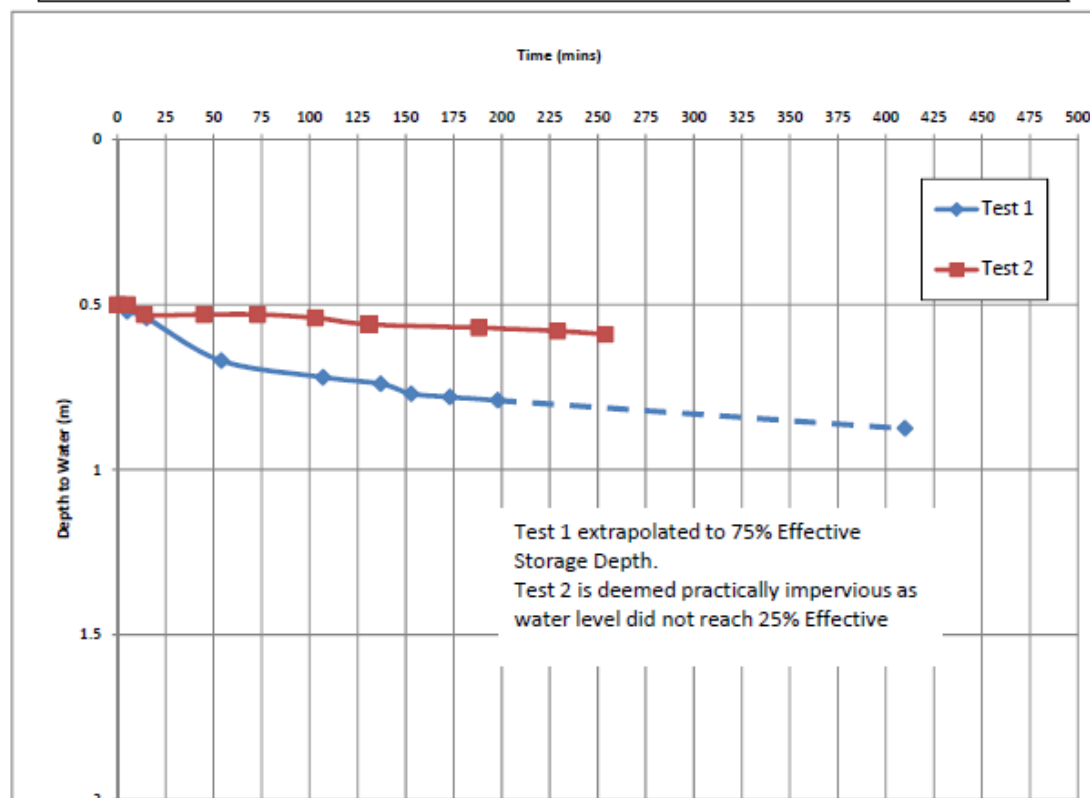
Length (m): 1.80 Width (m): 0.30 Depth (m): 1.00

Remarks: Only 2 tests undertaken due to very slow infiltration.

	Test 1	Test 2	Test 3
Effective Storage Depth _{75-25%} (m)	0.25	0.25	
A = Surface Area _{50%} (m ²)	1.59	1.59	
V = Effective Storage Volume _{75-25%} (m ³)	0.14	0.14	
t = Time _{75-25%} (mins)	373.0	n/a	
Soil Infiltration Rate (m/s)	3.79E-06	n/a	

Extrapolated Soil Infiltration Rate (m/s)

3.79E-06



Intégrale

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Soil Infiltration Rate Test. BRE 365 (2007) Soakaway Design

Job No: 1706

Job Name: Lowerfield Road, Caversham, Reading

Prepared By: SJ

Date: 28/07/2016

Sheet: 1 of 1

Checked By: JH

Date: 02/08/2016

TP3

Date of Test: 2 tests undertaken on the 26th July, final test undertaken on 27th July.

Length (m): 1.75

Width (m): 0.30

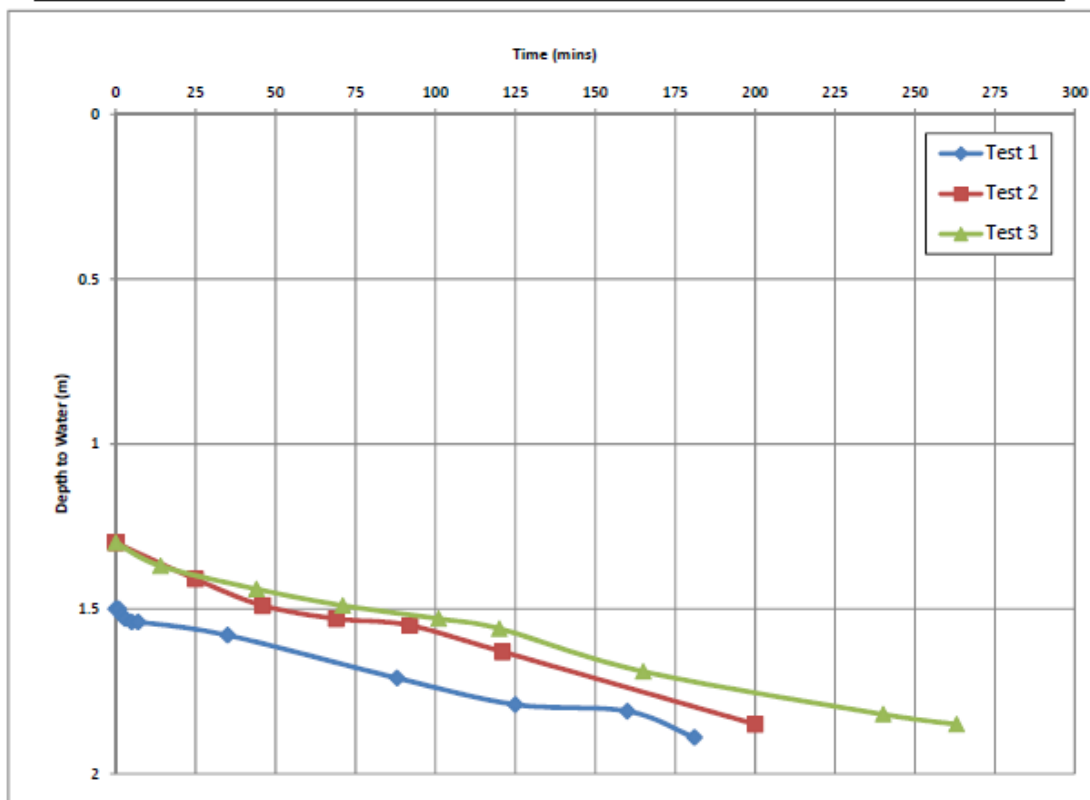
Depth (m): 2.00

Remarks: Deep soakaway test.

	Test 1	Test 2	Test 3
Effective Storage Depth _{75-25%} (m)	0.25	0.35	0.35
A = Surface Area _{50%} (m ²)	1.55	1.96	1.96
V = Effective Storage Volume _{75-25%} (m ³)	0.13	0.18	0.18
t = Time _{75-25%} (mins)	123.7	148.962	180.93
Soil Infiltration Rate (m/s)	1.14E-05	1.05E-05	8.64E-06

Design Soil Infiltration Rate (m/s)

8.64E-06



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Soil Infiltration Rate Test. BRE 365 (2007) Soakaway Design

Job No: 1706

Job Name: Lowerfield Road, Caversham, Reading

Prepared By: SJ Date: 28/07/2016

Sheet: 1 of 1

Checked By: JH Date: 02/08/2016

TP4

Date of Test: 26th and 27th July 2016

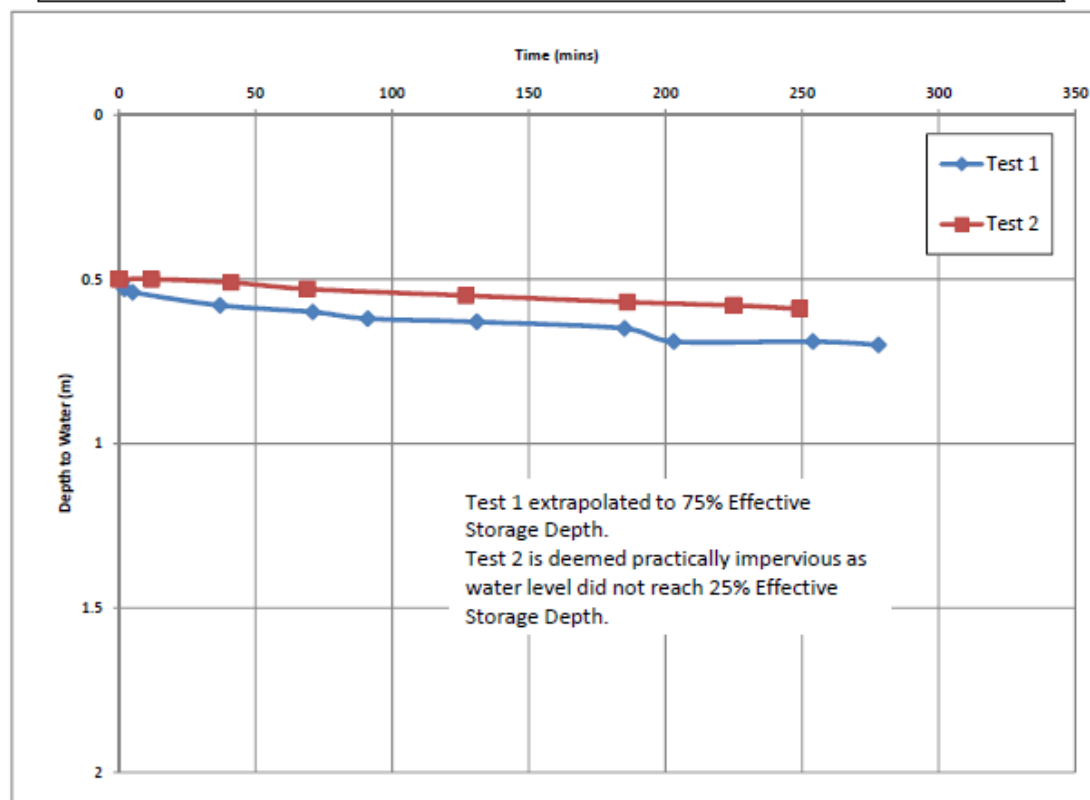
Length (m): 1.80 Width (m): 0.30 Depth (m): 1.00

Remarks: Shallow soakaway test. Only 2 tests completed due to very slow infiltration.

	Test 1	Test 2	Test 3
Effective Storage Depth _{75-25%} (m)	0.25	0.25	
A = Surface Area _{25%} (m ²)	1.59	1.59	
V = Effective Storage Volume _{75-25%} (m ³)	0.14	0.14	
t = Time _{75-25%} (mins)	1981.0	n/a	
Soil Infiltration Rate (m/s)	7.14E-07	n/a	

Extrapolated Soil Infiltration Rate (m/s)

7.14E-07



Intégrale

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 Westway Farm Business Park
 Wick Road
 Bishop Sutton
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 Tel: +44 (0) 1275 333 036
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Soil Infiltration Rate Test. BRE 365 (2007) Soakaway Design

Job No: 1706

Job Name: Lowerfield Road, Caversham, Reading

Prepared By: SJ

Date: 28/07/2016

Sheet: 1 of 1

Checked By: JH

Date: 02/08/2016

TP5

Date of Test: 2 tests undertaken on the 26th July, final test undertaken on 27th July.

Length (m): 1.80

Width (m): 0.30

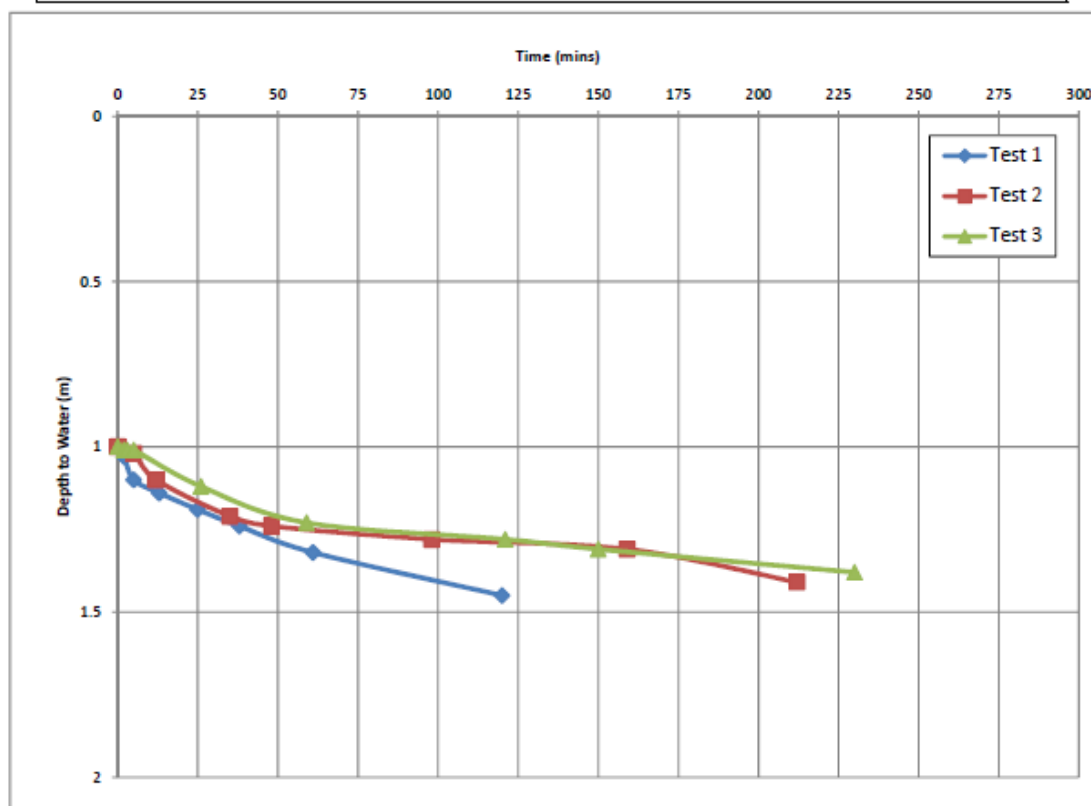
Depth (m): 1.50

Remarks: Deep soakaway test.

	Test 1	Test 2	Test 3
Effective Storage Depth _{75-25%} (m)	0.25	0.25	0.25
A = Surface Area _{50%} (m ²)	1.59	1.59	1.59
V = Effective Storage Volume _{75-25%} (m ³)	0.14	0.14	0.14
t = Time _{75-25%} (mins)	77.0	178.31	196.79
Soil Infiltration Rate (m/s)	1.84E-05	7.94E-06	7.19E-06

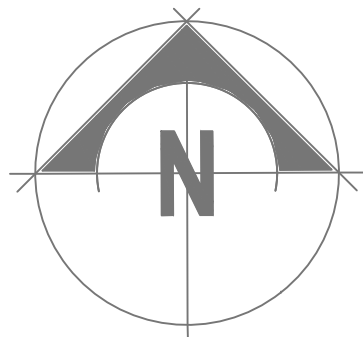
Design Soil Infiltration Rate (m/s)

7.19E-06



APPENDIX B

DRAINAGE PLANS



PLAN

NOTES

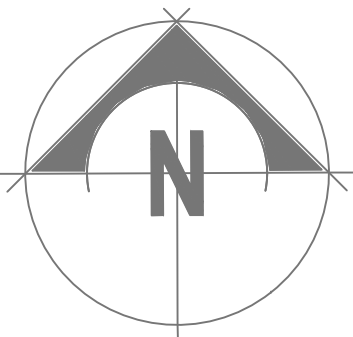
- Contours shown indicative only in the absence of an as-built survey.
- Catchments areas indicative only in the absence of as-built drainage records and road contours

P01	SAH	RS	21/05/22	Drawing Created
REV	NAME	CHECK	DATE	NATURE OF REVISION
REVISIONS				

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Callidus Project No.	TE1565	Rev:	POI
Dwg. No:	I565-CAL-DR-ZZ-DR-D-SK001	Project Title:	Lowfield Road, Reading RG4 6NL
Drawing Title:	Assumed As-built Drainage Layout	Client:	Reading Borough Council





Manhole No.	Pipe No.	Private IMP	Total IMP
Soakaway 1			367.405
Road 1	1.000	240.976	
rwp 1	2.000	126.429	
Soakaway 2			301.664
Road 2	1.000	174.850	
rwp 2	2.000	126.814	
Soakaway 3			306.288
Road 3	2.000	179.859	
rwp 3	1.000	126.429	
Soakaway 4			533.403
Road 4	1.000	406.974	
rwp 4	2.000	126.429	
Soakaway 5			576.885
Road 5	1.000	450.456	
rwp 5	2.000	126.429	
Soakaway 6			265.019
Road 6	1.000	138.590	
rwp 6	2.000	126.429	
Soakaway 7			241.540
Road 7	1.000	114.814	
rwp 7	2.000	126.726	

PLAN

NOTES

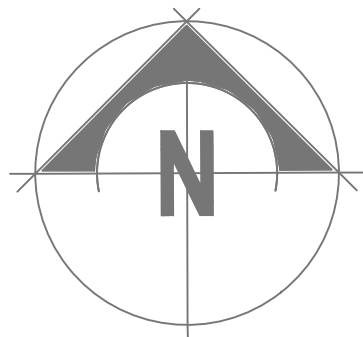
- Contours shown indicative only in the absence of an as-built survey.
- Catchments areas indicative only in the absence of as-built drainage records and road contours

P01	SAH	RS	21/05/22	Drawing Created
REV	NAME	CHECK	DATE	NATURE OF REVISION
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Callidus Project No.	TE1565		
Dwg. No.	I565-CAL-DR-ZZ-DR-D-SK002	Rev:	POI
Project Title:	Lowfield Road, Reading RG4 6NL	Drawing Title:	Assumed As-built Drainage Catchment Area
Client:	Reading Borough Council		





PLAN

NOTES

- Contours shown indicative only in the absence of an as-built survey.
- Catchments areas indicative only in the absence of as-built drainage records and road contours

3 PRINCES STREET • BATH • BA1 1HL		Callidus Project No. TE1565	
T +44 (0) 1225 303 523		Dwg. No: I565-CAL-DR-ZZ-DR-D-SK003	
E info@callidusgroup.co.uk		Project Title: Lowfield Road, Reading RG4 6NL	
W www.callidusgroup.co.uk		Drawing Title: Additional Drainage Layout	
Registered in England & Wales No. 6719513		Client: Reading Borough Council	
STATUS: PRELIMINARY		Rev: P01	
SCALE: 1:250			
PAPER SIZE: @ A1			

P01	SAH	RS	21/05/22	Drawing Created
REV	NAME	CHECK	DATE	NATURE OF REVISION
REVISIONS				

APPENDIX C

MICRODRAINAGE RESULTS

Soakaway 1

Callidus Transport & Engineering Ltd		Page 0
127 Hampton Road Bristol BS6 6JE		
Date 31/05/2022 12:06 File Soakaway 1.mdx	Designed by Sam Parsons Checked by	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Pipe Sizes STANDARD Manhole Sizes STANDARD

Designed with Level Soffits

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
1.000	6.391	0.300	21.3	0.024	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	7.085	0.425	16.7	0.013	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	3.459	0.025	138.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

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	5.05	53.500	0.024	0.0	0.0	0.0	2.19	38.7	3.2
2.000	50.00	5.06	53.625	0.013	0.0	0.0	0.0	1.90	14.9	1.7
1.001	50.00	5.13	51.500	0.037	0.0	0.0	0.0	0.85	15.1	5.0

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Storage Structures for Surface Network 1

Porous Car Park Manhole: Permeable paving 1, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.02000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	13.9	Slope (1:X)	0.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	53.500	Cap Volume Depth (m)	0.350

Lined Soakaway Manhole: Soakaway 1, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.02000	Ring Diameter (m)	1.20
Infiltration Coefficient Side (m/hr)	0.02000	Pit Multiplier	2.2
Safety Factor	1.5	Number Required	1
Porosity	0.30	Cap Volume Depth (m)	2.000
Invert Level (m)	51.500	Cap Infiltration Depth (m)	0.000

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Micro Drainage

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 Storage Structures 2

Number of Online Controls 1

Number of Time/Area Diagrams 0

Number of Offline Controls 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR

Ratio R 0.400

Region England and Wales Cv (Summer) 0.750

M5-60 (mm) 18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status OFF

DVD Status ON

Inertia Status ON

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years) 10

Climate Change (%) 40

PN

US/MH Name

Event

US/CL (m)

Water Level (m)

Surcharged Depth (m)

Flooded Volume (m³)

1.000

Permeable paving 1

600 minute 10 year Winter I+40%

54.006

53.706

0.056

0.000

2.000

rw 1

600 minute 10 year Winter I+40%

54.375

53.707

-0.018

0.000

1.001

Soakaway 1

600 minute 10 year Winter I+40%

54.191

53.706

2.056

0.000

PN

US/MH Name

Flow / Cap.

Infil. Flow (l/s)

Infil. Vol (m³)

Maximum Vol (m³)

Discharge Vol (m³)

Pipe Flow (l/s)

Status

1.000

Permeable paving 1

0.02

0.2

5.160

3.096

5.945

0.7

SURCHARGED

2.000

rw 1

0.03

0.001

5.981

0.4

OK

1.001

Soakaway 1

0.00

0.1

6.077

8.405

0.000

0.0

SURCHARGED

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

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 0

Number of Storage Structures 2

Number of Time/Area Diagrams 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model

Region England and Wales

M5-60 (mm)

FSR

Ratio R 0.400

Cv (Summer) 0.750

18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status

DVD Status

Inertia Status

300.0

OFF

ON

ON

Profile(s)

Duration(s) (mins)

Return Period(s) (years)

Climate Change (%)

Summer and Winter

15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

30

40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	Permeable paving	1 600 minute 30 year Winter I+40%	54.006	54.007	0.357	0.815
2.000	rw	1 600 minute 30 year Winter I+40%	54.375	54.010	0.285	0.000
1.001	Soakaway	1 600 minute 30 year Winter I+40%	54.191	54.008	2.358	0.000

PN	US/MH Name	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	Permeable paving	1 0.03	0.2	8.178	6.080	5.995	0.9	FLOOD
2.000	rw	1 0.04			0.003	7.559	0.6	SURCHARGED
1.001	Soakaway	1 0.00	0.1	6.410	8.747	0.000	0.0	FLOOD RISK

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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 Storage Structures 2						
Number of Online Controls 1		Number of Time/Area Diagrams 0						
Number of Offline Controls 0		Number of Real Time Controls 0						
Synthetic Rainfall Details								
Rainfall Model		FSR		Ratio R 0.400				
Region England and Wales Cv (Summer) 0.750								
M5-60 (mm)		18.700 Cv (Winter) 0.840						
Margin for Flood Risk Warning (mm)				300.0				
Analysis Timestep 2.5 Second Increment (Extended)								
DTS Status				OFF				
DVD Status				ON				
Inertia Status				ON				
Profile(s)				Summer and Winter				
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080						
Return Period(s) (years)				100				
Climate Change (%)				40				
Water Surcharged								
PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)			
1.000	Permeable paving 1	480 minute 100 year Winter I+40%	54.006	54.013	0.363			
2.000	rwf 1	120 minute 100 year Winter I+40%	54.375	54.031	0.306			
1.001	Soakaway 1	180 minute 100 year Winter I+40%	54.191	54.019	2.369			
Pipe								
PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)
1.000	Permeable paving 1	6.540	0.04	0.2	8.659	11.805	4.451	1.3
2.000	rwf 1	0.000	0.17			0.003	6.653	2.4
1.001	Soakaway 1	0.000	0.00	0.1	1.929	8.759	0.000	0.0
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Soakaway 2

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STORM SEWER DESIGN by the Modified Rational Method

Pipe Sizes STANDARD Manhole Sizes STANDARD

Designed with Level Soffits

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
1.000	5.479	0.300	18.3	0.017	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	7.478	0.550	13.6	0.013	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	3.997	0.025	159.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

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	5.04	52.550	0.017	0.0	0.0	0.0	2.37	41.8	2.3
2.000	50.00	5.06	52.800	0.013	0.0	0.0	0.0	2.11	16.5	1.7
1.001	50.00	5.14	50.550	0.030	0.0	0.0	0.0	0.79	14.0	4.0

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Storage Structures for Surface Network 4

Porous Car Park Manhole: Permeable paving 2, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.02000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	13.9	Slope (1:X)	0.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	52.550	Cap Volume Depth (m)	0.350

Lined Soakaway Manhole: Soakaway 2, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.02000	Ring Diameter (m)	1.20
Infiltration Coefficient Side (m/hr)	0.02000	Pit Multiplier	2.2
Safety Factor	1.5	Number Required	1
Porosity	0.30	Cap Volume Depth (m)	2.000
Invert Level (m)	50.550	Cap Infiltration Depth (m)	0.000

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Network 2020.1.3

Micro Drainage

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

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 Storage Structures 2

Number of Online Controls 1

Number of Time/Area Diagrams 0

Number of Offline Controls 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model

FSR

Ratio R 0.400

Region England and Wales Cv (Summer) 0.750

M5-60 (mm)

18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)

300.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status

OFF

DVD Status

ON

Inertia Status

ON

Profile(s)

Summer and Winter

Duration(s) (mins)

15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years)

30

Climate Change (%)

40

PN

US/MH Name

Event

US/CL (m)

Water Level (m)

Surcharged Depth (m)

Flooded Volume (m³)

1.000

Permeable paving 2

600 minute 30 year Winter I+40%

53.092

52.786

0.086

0.000

2.000

rw 2

15 minute 30 year Winter I+40%

53.550

52.843

-0.057

0.000

1.001

Soakaway 2

600 minute 30 year Winter I+40%

53.041

52.786

2.086

0.000

PN

US/MH Name

Flow / Cap.

Infil. Flow (l/s)

Infil. Vol (m³)

Maximum Vol (m³)

Discharge Vol (m³)

Pipe Flow (l/s)

Status

1.000

Permeable paving 2

0.02

0.2

5.415

3.545

4.502

0.7

SURCHARGED

2.000

rw 2

0.38

0.000

2.641

5.7

OK

1.001

Soakaway 2

0.00

0.1

6.128

8.418

0.000

0.0

FLOOD RISK

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4								
Simulation Criteria								
Areal Reduction Factor 1.000		Additional Flow - % of Total Flow 0.000						
Hot Start (mins) 0		MADD Factor * 10m³/ha Storage 2.000						
Hot Start Level (mm) 0		Inlet Coeffiecient 0.800						
Manhole Headloss Coeff (Global) 0.500		Flow per Person per Day (l/per/day) 0.000						
Foul Sewage per hectare (l/s) 0.000								
Number of Input Hydrographs 0		Number of Storage Structures 2						
Number of Online Controls 1		Number of Time/Area Diagrams 0						
Number of Offline Controls 0		Number of Real Time Controls 0						
Synthetic Rainfall Details								
Rainfall Model		FSR		Ratio R 0.400				
Region England and Wales Cv (Summer)		0.750						
M5-60 (mm)		18.700 Cv (Winter)		0.840				
Margin for Flood Risk Warning (mm)		300.0						
Analysis Timestep 2.5 Second Increment (Extended)								
DTS Status		OFF						
DVD Status		ON						
Inertia Status		ON						
Profile(s)		Summer and Winter						
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080						
Return Period(s) (years)		100						
Climate Change (%)		40						
Water Surcharged								
PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)			
1.000	Permeable paving 2	480 minute 100 year Winter I+40%	53.092	53.044	0.344			
2.000	rwf 2	360 minute 100 year Winter I+40%	53.550	53.046	0.146			
1.001	Soakaway 2	480 minute 100 year Winter I+40%	53.041	53.044	2.344			
Pipe								
PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)
1.000	Permeable paving 2	0.000	0.03	0.2	8.171	5.262	3.945	1.0
2.000	rwf 2	0.000	0.07			0.002	8.794	1.0
1.001	Soakaway 2	2.081	0.00	0.1	5.173	10.797	0.000	0.0
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4														
<table><thead><tr><th>PN</th><th>US/MH Name</th><th>Status</th></tr></thead><tbody><tr><td>1.000</td><td>Permeable paving 2</td><td>FLOOD RISK</td></tr><tr><td>2.000</td><td>rwp 2</td><td>SURCHARGED</td></tr><tr><td>1.001</td><td>Soakaway 2</td><td>FLOOD</td></tr></tbody></table>			PN	US/MH Name	Status	1.000	Permeable paving 2	FLOOD RISK	2.000	rwp 2	SURCHARGED	1.001	Soakaway 2	FLOOD
PN	US/MH Name	Status												
1.000	Permeable paving 2	FLOOD RISK												
2.000	rwp 2	SURCHARGED												
1.001	Soakaway 2	FLOOD												
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Soakaway 3

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STORM SEWER DESIGN by the Modified Rational Method

Pipe Sizes STANDARD Manhole Sizes STANDARD

Designed with Level Soffits

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
1.000	9.834	0.148	66.3	0.013	5.00	0.0	0.600	o	100	Pipe/Conduit		
2.000	5.024	0.025	201.0	0.018	5.00	0.0	0.600	o	150	Pipe/Conduit		
1.001	3.799	0.025	152.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		

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	5.17	51.773	0.013	0.0	0.0	0.0	0.95	7.4	1.7
2.000	50.00	5.12	51.650	0.018	0.0	0.0	0.0	0.71	12.5	2.4
1.001	50.00	5.25	49.925	0.031	0.0	0.0	0.0	0.81	14.4	4.1

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Storage Structures for Surface Network 5

Porous Car Park Manhole: Permeable paving 3, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	0.02000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	13.9	Slope (1:X)	0.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	51.650	Cap Volume Depth (m)	0.350

Lined Soakaway Manhole: Soakaway 3, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.02000	Ring Diameter (m)	1.20
Infiltration Coefficient Side (m/hr)	0.02000	Pit Multiplier	2.2
Safety Factor	1.5	Number Required	1
Porosity	0.30	Cap Volume Depth (m)	2.000
Invert Level (m)	49.925	Cap Infiltration Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 5

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 0

Number of Storage Structures 2

Number of Time/Area Diagrams 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model

Region England and Wales

M5-60 (mm)

FSR

Ratio R 0.400

Cv (Summer) 0.750

18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status OFF

DVD Status ON

Inertia Status ON

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years) 10

Climate Change (%) 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	rwp 3	15 minute 10 year Winter I+40%	52.800	51.832	-0.041	0.000
2.000	Permeable paving 3	480 minute 10 year Winter I+40%	52.262	51.765	-0.035	0.000
1.001	Soakaway 3	480 minute 10 year Winter I+40%	52.284	51.765	1.690	0.000

PN	US/MH Name	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	rwp 3	0.64			0.000	2.080	4.5	OK
2.000	Permeable paving 3	0.06	0.2	3.897	1.723	3.933	0.6	OK
1.001	Soakaway 3	0.00	0.1	4.394	7.461	0.000	0.0	SURCHARGED

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 5

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 0

Number of Storage Structures 2

Number of Time/Area Diagrams 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model

Region England and Wales

M5-60 (mm)

FSR

Ratio R 0.400

Cv (Summer) 0.750

18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status

DVD Status

Inertia Status

300.0

OFF

ON

ON

Profile(s)

Duration(s) (mins)

Return Period(s) (years)

Climate Change (%)

Summer and Winter

15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

30

40

PN

US/MH Name

Event

US/CL (m)

Water Level (m)

Flooded Depth (m)

Flooded Volume (m³)

1.000

rwp

3 480 minute 30 year Winter I+40%

52.800

51.909

0.036

0.000

2.000

Permeable paving

3 480 minute 30 year Winter I+40%

52.262

51.908

0.108

0.000

1.001

Soakaway

3 480 minute 30 year Winter I+40%

52.284

51.908

1.833

0.000

PN

US/MH Name

Flow / Cap.

Infil. Flow (l/s)

Infil. Vol (m³)

Maximum Discharge Vol (m³)

Pipe Flow (l/s)

Status

1.000

rwp

3 0.09

0.001

7.192

0.6

SURCHARGED

2.000

Permeable paving

3 0.08

0.2

6.294

3.877

3.699

0.8

SURCHARGED

1.001

Soakaway

3 0.00

0.1

4.762

8.093

0.000

0.0

SURCHARGED

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 5								
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 Storage Structures 2						
Number of Online Controls 1		Number of Time/Area Diagrams 0						
Number of Offline Controls 0		Number of Real Time Controls 0						
Synthetic Rainfall Details								
Rainfall Model		FSR		Ratio R 0.400				
Region England and Wales Cv (Summer) 0.750								
M5-60 (mm)		18.700 Cv (Winter) 0.840						
Margin for Flood Risk Warning (mm)				300.0				
Analysis Timestep 2.5 Second Increment (Extended)								
DTS Status				OFF				
DVD Status				ON				
Inertia Status				ON				
Profile(s)				Summer and Winter				
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080						
Return Period(s) (years)				100				
Climate Change (%)				40				
Water Surcharged								
PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)			
1.000	rw 3	240 minute 100 year Winter I+40%	52.800	52.274	0.401			
2.000	Permeable paving 3	480 minute 100 year Winter I+40%	52.262	52.264	0.464			
1.001	Soakaway 3	180 minute 100 year Winter I+40%	52.284	52.267	2.192			
Pipe								
PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Flow (l/s)
1.000	rw 3	0.000	0.20			0.004	8.012	1.4
2.000	Permeable paving 3	2.419	0.09	0.2	8.855	7.685	3.035	0.9
1.001	Soakaway 3	0.000	0.00	0.1	1.893	8.557	0.000	0.0
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Soakaway 4

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Storage Structures for Surface Network 6

Porous Car Park Manhole: Permeable paving 4, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.02000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	13.9	Slope (1:X)	0.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	50.750	Cap Volume Depth (m)	0.350

Lined Soakaway Manhole: Soakaway 4, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.02000	Ring Diameter (m)	1.20
Infiltration Coefficient Side (m/hr)	0.02000	Pit Multiplier	2.2
Safety Factor	1.5	Number Required	1
Porosity	0.30	Cap Volume Depth (m)	2.000
Invert Level (m)	48.750	Cap Infiltration Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6

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 0

Number of Storage Structures 2

Number of Time/Area Diagrams 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model

Region England and Wales

M5-60 (mm)

FSR

Ratio R 0.400

Cv (Summer) 0.750

18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status

DVD Status

Inertia Status

300.0

OFF

ON

ON

Profile(s)

Duration(s) (mins)

Return Period(s) (years)

Climate Change (%)

Summer and Winter

15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

10

40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	Permeable paving	4 600 minute 10 year Summer I+40%	51.449	51.406	0.506	0.000
2.000	rwp	4 240 minute 10 year Winter I+40%	51.825	51.406	0.231	0.000
1.001	Soakaway	4 600 minute 10 year Winter I+40%	51.402	51.405	2.505	3.321

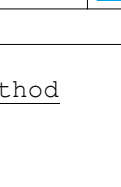
PN	US/MH Name	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	Permeable paving	4 0.05	0.2	8.630	5.267	8.415	1.6	FLOOD RISK
2.000	rwp	4 0.06			0.003	4.809	0.8	SURCHARGED
1.001	Soakaway	4 0.00	0.1	6.511	12.208	0.000	0.0	FLOOD

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6								
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 Storage Structures		2		
Number of Online Controls		1		Number of Time/Area Diagrams		0		
Number of Offline Controls		0		Number of Real Time Controls		0		
Synthetic Rainfall Details								
Rainfall Model		FSR		Ratio R		0.400		
Region England and Wales		Cv (Summer)		0.750				
M5-60 (mm)		18.700		Cv (Winter)		0.840		
Margin for Flood Risk Warning (mm)		300.0						
Analysis Timestep		2.5 Second Increment (Extended)						
DTS Status		OFF						
DVD Status		ON						
Inertia Status		ON						
Profile(s)		Summer and Winter						
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080						
Return Period(s) (years)		30						
Climate Change (%)		40						
Water Surcharged Flooded								
PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)	Volume (m³)		
1.000	Permeable paving 4	120 minute 30 year Winter I+40%	51.449	51.414	0.514	0.000		
2.000	rwf 4	120 minute 30 year Winter I+40%	51.825	51.416	0.241	0.000		
1.001	Soakaway 4	600 minute 30 year Winter I+40%	51.402	51.412	2.512	9.559		
Pipe								
PN	US/MH Name	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	Permeable paving 4	0.15	0.2	2.255	5.267	8.077	5.2	FLOOD RISK
2.000	rwf 4	0.12			0.003	5.042	1.8	SURCHARGED
1.001	Soakaway 4	0.00	0.1	6.614	18.446	0.003	0.0	FLOOD
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6								
Simulation Criteria								
Areal Reduction Factor 1.000		Additional Flow - % of Total Flow 0.000						
Hot Start (mins) 0		MADD Factor * 10m³/ha Storage 2.000						
Hot Start Level (mm) 0		Inlet Coeffiecient 0.800						
Manhole Headloss Coeff (Global) 0.500		Flow per Person per Day (l/per/day) 0.000						
Foul Sewage per hectare (l/s) 0.000								
Number of Input Hydrographs 0		Number of Storage Structures 2						
Number of Online Controls 1		Number of Time/Area Diagrams 0						
Number of Offline Controls 0		Number of Real Time Controls 0						
Synthetic Rainfall Details								
Rainfall Model		FSR		Ratio R 0.400				
Region England and Wales Cv (Summer) 0.750								
M5-60 (mm)		18.700 Cv (Winter) 0.840						
Margin for Flood Risk Warning (mm)				300.0				
Analysis Timestep 2.5 Second Increment (Extended)								
DTS Status				OFF				
DVD Status				ON				
Inertia Status				ON				
Profile(s)				Summer and Winter				
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080						
Return Period(s) (years)				100				
Climate Change (%)				40				
Water Surcharged								
PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)			
1.000	Permeable paving 4	60 minute 100 year Winter I+40%	51.449	51.440	0.540			
2.000	rw 4	60 minute 100 year Winter I+40%	51.825	51.442	0.267			
1.001	Soakaway 4	720 minute 100 year Winter I+40%	51.402	51.421	2.521			
Pipe								
PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Discharge Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)
1.000	Permeable paving 4	0.000	0.30	0.2	1.169	5.267	10.565	10.2
2.000	rw 4	0.000	0.25			0.003	5.475	3.8
1.001	Soakaway 4	18.658	0.00	0.1	8.084	27.545	0.026	0.0
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6														
<table><thead><tr><th>PN</th><th>US/MH Name</th><th>Status</th></tr></thead><tbody><tr><td>1.000</td><td>Permeable paving 4</td><td>FLOOD RISK</td></tr><tr><td>2.000</td><td> rwp 4</td><td>SURCHARGED</td></tr><tr><td>1.001</td><td> Soakaway 4</td><td>FLOOD</td></tr></tbody></table>			PN	US/MH Name	Status	1.000	Permeable paving 4	FLOOD RISK	2.000	rwp 4	SURCHARGED	1.001	Soakaway 4	FLOOD
PN	US/MH Name	Status												
1.000	Permeable paving 4	FLOOD RISK												
2.000	rwp 4	SURCHARGED												
1.001	Soakaway 4	FLOOD												
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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 6

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	18.700	Add Flow / Climate Change (%)	0
Ratio R	0.400	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

Network Design Table for Surface Network 6

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
1.000	4.400	0.300	14.7	0.041	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	8.632	0.625	13.8	0.013	5.00	0.0	0.600	o	100	Pipe/Conduit	
3.000	4.945	0.050	98.9	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	4.063	0.050	81.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.03	50.750	0.041	0.0	0.0	0.0	2.64	46.7	5.6
2.000	50.00	5.07	51.075	0.013	0.0	0.0	0.0	2.09	16.4	1.7
3.000	50.00	5.08	48.750	0.000	0.0	0.0	0.0	1.01	17.9	0.0
1.001	50.00	5.14	48.750	0.054	0.0	0.0	0.0	1.12	19.7	7.3

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Storage Structures for Surface Network 6

Porous Car Park Manhole: Permeable paving 4, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.02000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	13.9	Slope (1:X)	0.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	50.750	Cap Volume Depth (m)	0.350

Lined Soakaway Manhole: Additional soakaway 4A, DS/PN: 3.000

Infiltration Coefficient Base (m/hr)	0.02000	Ring Diameter (m)	1.20
Infiltration Coefficient Side (m/hr)	0.02000	Pit Multiplier	2.2
Safety Factor	1.5	Number Required	1
Porosity	0.30	Cap Volume Depth (m)	2.000
Invert Level (m)	48.750	Cap Infiltration Depth (m)	0.000

Lined Soakaway Manhole: Soakaway 4, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.02000	Ring Diameter (m)	1.20
Infiltration Coefficient Side (m/hr)	0.02000	Pit Multiplier	2.2
Safety Factor	1.5	Number Required	1
Porosity	0.30	Cap Volume Depth (m)	2.000
Invert Level (m)	48.750	Cap Infiltration Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6								
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 Storage Structures		3				
Number of Online Controls 1		Number of Time/Area Diagrams		0				
Number of Offline Controls 0		Number of Real Time Controls		0				
Synthetic Rainfall Details								
Rainfall Model		FSR		Ratio R 0.400				
Region England and Wales Cv (Summer)		0.750						
M5-60 (mm)		18.700 Cv (Winter)		0.840				
Margin for Flood Risk Warning (mm)		300.0						
Analysis Timestep 2.5 Second Increment (Extended)								
DTS Status		OFF						
DVD Status		ON						
Inertia Status		ON						
Profile(s)		Summer and Winter						
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080						
Return Period(s) (years)		10						
Climate Change (%)		40						
Water Surcharged								
PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)			
1.000	Permeable paving 4	720 minute 10 year Winter I+40%	51.449	50.843	-0.057			
2.000	rw 4	15 minute 10 year Winter I+40%	51.825	51.112	-0.063			
3.000	Additional soakaway 4A	720 minute 10 year Winter I+40%	51.336	50.842	1.942			
1.001	Soakaway 4	720 minute 10 year Winter I+40%	51.402	50.843	1.943			
Flooded								
PN	US/MH Name	Volume (m³)	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)
1.000	Permeable paving 4	0.000	0.03	0.2	3.814	1.396	16.181	1.1
2.000	rw 4	0.000	0.29			0.000	2.080	4.5
3.000	Additional soakaway 4A	0.000	0.00	0.1	6.657	8.126	-11.132	0.0
1.001	Soakaway 4	0.000	0.00	0.1	6.676	8.340	0.000	0.0
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6																	
<table><thead><tr><th>PN</th><th>US/MH Name</th><th>Status</th></tr></thead><tbody><tr><td>1.000</td><td>Permeable paving 4</td><td>OK</td></tr><tr><td>2.000</td><td>rwp 4</td><td>OK</td></tr><tr><td>3.000</td><td>Additional soakaway 4A</td><td>SURCHARGED</td></tr><tr><td>1.001</td><td>Soakaway 4</td><td>SURCHARGED</td></tr></tbody></table>			PN	US/MH Name	Status	1.000	Permeable paving 4	OK	2.000	rwp 4	OK	3.000	Additional soakaway 4A	SURCHARGED	1.001	Soakaway 4	SURCHARGED
PN	US/MH Name	Status															
1.000	Permeable paving 4	OK															
2.000	rwp 4	OK															
3.000	Additional soakaway 4A	SURCHARGED															
1.001	Soakaway 4	SURCHARGED															
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6								
Simulation Criteria								
Areal Reduction Factor		1.000		Additional Flow - % of Total Flow		0.000		
Hot Start (mins)		0		MADD Factor * 10m³/ha Storage		2.000		
Hot Start Level (mm)		0		Inlet Coeffiecient		0.800		
Manhole Headloss Coeff (Global)		0.500		Flow per Person per Day (l/per/day)		0.000		
Foul Sewage per hectare (l/s)		0.000						
Number of Input Hydrographs		0		Number of Storage Structures		3		
Number of Online Controls		1		Number of Time/Area Diagrams		0		
Number of Offline Controls		0		Number of Real Time Controls		0		
Synthetic Rainfall Details								
Rainfall Model		FSR		Ratio R		0.400		
Region England and Wales Cv (Summer)		M5-60 (mm)		18.700 Cv (Winter)		0.840		
Margin for Flood Risk Warning (mm)		300.0						
Analysis Timestep		2.5 Second Increment (Extended)						
DTS Status		OFF						
DVD Status		ON						
Inertia Status		ON						
Profile(s)		Summer and Winter						
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080						
Return Period(s) (years)		30						
Climate Change (%)		40						
Water Surcharged								
PN	US/MH Name	Event			US/CL (m)	Level (m)	Depth (m)	
1.000	Permeable paving 4	480 minute 30 year Winter I+40%			51.449	51.214	0.314	
2.000	rw 4	480 minute 30 year Winter I+40%			51.825	51.215	0.040	
3.000	Additional soakaway 4A	480 minute 30 year Winter I+40%			51.336	51.214	2.314	
1.001	Soakaway 4	480 minute 30 year Winter I+40%			51.402	51.214	2.314	
Flooded								
PN	US/MH Name	Volume (m³)	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)
1.000	Permeable paving 4	0.000	0.06	0.2	6.161	5.262	16.913	2.0
2.000	rw 4	0.000	0.04			0.001	7.192	0.6
3.000	Additional soakaway 4A	0.000	0.00	0.1	4.967	8.546	-11.973	0.0
1.001	Soakaway 4	0.000	0.00	0.1	4.983	8.797	0.000	0.0
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6		

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6								
Simulation Criteria								
Areal Reduction Factor 1.000		Additional Flow - % of Total Flow		0.000				
Hot Start (mins) 0		MADD Factor * 10m³/ha Storage		2.000				
Hot Start Level (mm) 0		Inlet Coeffiecient		0.800				
Manhole Headloss Coeff (Global) 0.500		Flow per Person per Day (l/per/day)		0.000				
Foul Sewage per hectare (l/s) 0.000								
Number of Input Hydrographs 0		Number of Storage Structures		3				
Number of Online Controls 1		Number of Time/Area Diagrams		0				
Number of Offline Controls 0		Number of Real Time Controls		0				
Synthetic Rainfall Details								
Rainfall Model		FSR		Ratio R 0.400				
Region England and Wales Cv (Summer)		0.750						
M5-60 (mm)		18.700 Cv (Winter)		0.840				
Margin for Flood Risk Warning (mm)		300.0						
Analysis Timestep		2.5 Second Increment (Extended)						
DTS Status		OFF						
DVD Status		ON						
Inertia Status		ON						
Profile(s)		Summer and Winter						
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080						
Return Period(s) (years)		100						
Climate Change (%)		40						
Water Surcharged								
PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)			
1.000	Permeable paving 4	180 minute 100 year Winter I+40%	51.449	51.362	0.462			
2.000	rwf 4	180 minute 100 year Winter I+40%	51.825	51.364	0.189			
3.000	Additional soakaway 4A	600 minute 100 year Winter I+40%	51.336	51.344	2.444			
1.001	Soakaway 4	180 minute 100 year Winter I+40%	51.402	51.357	2.457			
Flooded								
PN	US/MH Name	Volume (m³)	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)
1.000	Permeable paving 4	0.000	0.16	0.2	3.383	5.265	14.693	5.5
2.000	rwf 4	0.000	0.12			0.002	7.428	1.8
3.000	Additional soakaway 4A	8.042	0.02	0.1	6.424	16.726	-14.521	0.3
1.001	Soakaway 4	0.000	0.00	0.1	1.891	8.959	0.001	0.0
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6																				
<table><tr><td></td><td>US/MH</td><td></td></tr><tr><td>PN</td><td>Name</td><td>Status</td></tr><tr><td>1.000</td><td>Permeable paving 4</td><td>FLOOD RISK</td></tr><tr><td>2.000</td><td> rwp 4</td><td>SURCHARGED</td></tr><tr><td>3.000</td><td>Additional soakaway 4A</td><td>FLOOD</td></tr><tr><td>1.001</td><td> Soakaway 4</td><td>FLOOD RISK</td></tr></table>				US/MH		PN	Name	Status	1.000	Permeable paving 4	FLOOD RISK	2.000	rwp 4	SURCHARGED	3.000	Additional soakaway 4A	FLOOD	1.001	Soakaway 4	FLOOD RISK
	US/MH																			
PN	Name	Status																		
1.000	Permeable paving 4	FLOOD RISK																		
2.000	rwp 4	SURCHARGED																		
3.000	Additional soakaway 4A	FLOOD																		
1.001	Soakaway 4	FLOOD RISK																		
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Soakway 5

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STORM SEWER DESIGN by the Modified Rational Method

Pipe Sizes STANDARD Manhole Sizes STANDARD

Designed with Level Soffits

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
1.000	4.423	0.300	14.7	0.045	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	7.840	0.147	53.3	0.013	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	4.415	0.025	176.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

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
1.000	50.00	5.03	51.500	0.045	0.0	0.0	0.0	2.64	46.6	6.1
2.000	50.00	5.12	51.347	0.013	0.0	0.0	0.0	1.06	8.3	1.7
1.001	50.00	5.22	49.500	0.058	0.0	0.0	0.0	0.75	13.3	7.8

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Storage Structures for Surface Network 7

Porous Car Park Manhole: Permeable paving 5, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.02000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	13.9	Slope (1:X)	0.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	51.500	Cap Volume Depth (m)	0.350

Lined Soakaway Manhole: Soakaway 5, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.02000	Ring Diameter (m)	1.20
Infiltration Coefficient Side (m/hr)	0.02000	Pit Multiplier	2.2
Safety Factor	1.5	Number Required	1
Porosity	0.30	Cap Volume Depth (m)	2.000
Invert Level (m)	49.500	Cap Infiltration Depth (m)	0.000

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Micro
Drainage

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 7

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 Storage Structures 2

Number of Online Controls 1

Number of Time/Area Diagrams 0

Number of Offline Controls 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR

Ratio R 0.400

Region England and Wales Cv (Summer) 0.750

M5-60 (mm) 18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status OFF

DVD Status ON

Inertia Status ON

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years) 10

Climate Change (%) 40

PN

US/MH Name

Event

US/CL (m)

Water Level (m)

Surcharged Depth (m)

Flooded Volume (m³)

1.000

Permeable paving

5 180 minute 10 year Winter I+40%

52.222

51.932

0.282

0.000

2.000

rwf

5 600 minute 10 year Winter I+40%

51.900

51.905

0.458

4.868

1.001

Soakaway

5 180 minute 10 year Winter I+40%

52.352

51.929

2.279

0.000

PN

US/MH Name

Flow / Cap.

Infil. Flow (l/s)

Infil. Vol (m³)

Maximum Vol (m³)

Discharge Vol (m³)

Pipe Flow (l/s)

Status

1.000

Permeable paving

5 0.10

0.2

3.302

5.261

6.518

3.5

FLOOD RISK

2.000

rwf

5 0.05

4.873

5.847

0.4

FLOOD

1.001

Soakaway

5 0.00

0.1

1.915

8.629

0.000

0.0

SURCHARGED

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 7

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 Storage Structures 2

Number of Online Controls 1

Number of Time/Area Diagrams 0

Number of Offline Controls 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model

FSR

Ratio R 0.400

Region England and Wales

Cv (Summer) 0.750

M5-60 (mm)

18.700

Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)

300.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status

OFF

DVD Status

ON

Inertia Status

ON

Profile(s)

Summer and Winter

Duration(s) (mins)

15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years)

30

Climate Change (%)

40

PN

US/MH

Name

Event

US/CL

Water Level

Surcharged Depth

Flooded Volume

(m)

(m)

(m)

(m³)

1.000

Permeable paving

5

120 minute 30 year Winter I+40%

52.222

51.994

0.344

0.000

2.000

rw

5

720 minute 30 year Winter I+40%

51.900

51.912

0.465

12.327

1.001

Soakaway

5

120 minute 30 year Winter I+40%

52.352

51.985

2.335

0.000

PN

US/MH

Name

Flow / Cap.

Infil. Flow (l/s)

Infil. Vol (m³)

Maximum Vol (m³)

Discharge Vol (m³)

Pipe Flow (l/s)

Status

1.000

Permeable paving

5

0.16

0.2

2.272

5.262

10.042

5.6

FLOOD RISK

2.000

rw

5

0.05

12.332

7.580

0.4

FLOOD

1.001

Soakaway

5

0.00

0.1

1.284

8.692

0.000

0.0

SURCHARGED

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 7							
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 Storage Structures 2					
Number of Online Controls 1		Number of Time/Area Diagrams 0					
Number of Offline Controls 0		Number of Real Time Controls 0					
Synthetic Rainfall Details							
Rainfall Model FSR		Ratio R 0.400					
Region England and Wales Cv (Summer) 0.750							
M5-60 (mm) 18.700		Cv (Winter) 0.840					
Margin for Flood Risk Warning (mm) 300.0							
Analysis Timestep 2.5		Second Increment (Extended)					
DTS Status OFF							
DVD Status ON							
Inertia Status ON							
Profile(s) Summer and Winter							
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080							
Return Period(s) (years) 100							
Climate Change (%) 40							
Water Surcharged							
PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)		
1.000	Permeable paving 5	60 minute 100 year Winter I+40%	52.222	52.187	0.537		
2.000	rwf 5	720 minute 100 year Winter I+40%	51.900	51.922	0.475		
1.001	Soakaway 5	60 minute 100 year Winter I+40%	52.352	52.164	2.514		
Pipe							
PN	US/MH Name	Flooded Volume (m³)	Flow / Cap. (l/s)	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Discharge Vol (m³)	Pipe Flow (l/s)
1.000	Permeable paving 5	0.000	0.33	0.2	1.177	5.267	12.674
2.000	rwf 5	22.174	0.06			22.178	0.274
1.001	Soakaway 5	0.000	0.00	0.1	0.637	8.894	0.000
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Storage Structures for Surface Network 7

Porous Car Park Manhole: Permeable paving 5, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.02000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	13.9	Slope (1:X)	0.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	51.500	Cap Volume Depth (m)	0.350

Lined Soakaway Manhole: Additional soakaway 5A, DS/PN: 3.000

Infiltration Coefficient Base (m/hr)	0.02000	Ring Diameter (m)	1.20
Infiltration Coefficient Side (m/hr)	0.02000	Pit Multiplier	2.2
Safety Factor	1.5	Number Required	1
Porosity	0.30	Cap Volume Depth (m)	2.000
Invert Level (m)	49.500	Cap Infiltration Depth (m)	0.000

Lined Soakaway Manhole: Soakaway 5, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.02000	Ring Diameter (m)	1.20
Infiltration Coefficient Side (m/hr)	0.02000	Pit Multiplier	2.2
Safety Factor	1.5	Number Required	1
Porosity	0.30	Cap Volume Depth (m)	2.000
Invert Level (m)	49.500	Cap Infiltration Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 7								
Simulation Criteria								
Areal Reduction Factor 1.000		Additional Flow - % of Total Flow 0.000						
Hot Start (mins) 0		MADD Factor * 10m³/ha Storage 2.000						
Hot Start Level (mm) 0		Inlet Coeffiecient 0.800						
Manhole Headloss Coeff (Global) 0.500		Flow per Person per Day (l/per/day) 0.000						
Foul Sewage per hectare (l/s) 0.000								
Number of Input Hydrographs 0		Number of Storage Structures 3						
Number of Online Controls 1		Number of Time/Area Diagrams 0						
Number of Offline Controls 0		Number of Real Time Controls 0						
Synthetic Rainfall Details								
Rainfall Model		FSR		Ratio R 0.400				
Region England and Wales Cv (Summer) 0.750								
M5-60 (mm)		18.700 Cv (Winter) 0.840						
Margin for Flood Risk Warning (mm)				300.0				
Analysis Timestep 2.5 Second Increment (Extended)								
DTS Status				OFF				
DVD Status				ON				
Inertia Status				ON				
Profile(s)				Summer and Winter				
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080						
Return Period(s) (years)				10				
Climate Change (%)				40				
Water Surcharged								
PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)			
1.000	Permeable paving 5	720 minute 10 year Winter I+40%	52.222	51.629	-0.021			
2.000	rw 5	720 minute 10 year Winter I+40%	51.900	51.630	0.182			
3.000	Additional soakaway 5A	720 minute 10 year Winter I+40%	52.450	51.628	1.978			
1.001	Soakaway 5	720 minute 10 year Winter I+40%	52.352	51.629	1.979			
Flooded								
PN	US/MH Name	Volume (m³)	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)
1.000	Permeable paving 5	0.000	0.04	0.2	4.468	1.940	17.503	1.2
2.000	rw 5	0.000	0.05			0.002	6.243	0.4
3.000	Additional soakaway 5A	0.000	0.00	0.1	6.797	8.805	-11.959	0.0
1.001	Soakaway 5	0.000	0.00	0.1	6.816	8.456	0.000	0.0
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 7								
Simulation Criteria								
Areal Reduction Factor 1.000		Additional Flow - % of Total Flow 0.000						
Hot Start (mins) 0		MADD Factor * 10m³/ha Storage 2.000						
Hot Start Level (mm) 0		Inlet Coeffiecient 0.800						
Manhole Headloss Coeff (Global) 0.500		Flow per Person per Day (l/per/day) 0.000						
Foul Sewage per hectare (l/s) 0.000								
Number of Input Hydrographs 0		Number of Storage Structures 3						
Number of Online Controls 1		Number of Time/Area Diagrams 0						
Number of Offline Controls 0		Number of Real Time Controls 0						
Synthetic Rainfall Details								
Rainfall Model		FSR		Ratio R 0.400				
Region England and Wales Cv (Summer) 0.750								
M5-60 (mm)		18.700 Cv (Winter) 0.840						
Margin for Flood Risk Warning (mm)				300.0				
Analysis Timestep 2.5 Second Increment (Extended)								
DTS Status				OFF				
DVD Status				ON				
Inertia Status				ON				
Profile(s)				Summer and Winter				
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080						
Return Period(s) (years)				30				
Climate Change (%)				40				
Water Surcharged								
PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)			
1.000	Permeable paving 5	600 minute 30 year Winter I+40%	52.222	51.905	0.255			
2.000	rw 5	600 minute 30 year Winter I+40%	51.900	51.899	0.452			
3.000	Additional soakaway 5A	600 minute 30 year Winter I+40%	52.450	51.903	2.253			
1.001	Soakaway 5	600 minute 30 year Winter I+40%	52.352	51.904	2.254			
Flooded								
PN	US/MH Name	Volume (m³)	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)
1.000	Permeable paving 5	0.000	0.05	0.2	7.566	5.260	19.089	1.8
2.000	rw 5	0.000	0.07			0.004	7.559	0.5
3.000	Additional soakaway 5A	0.000	0.00	0.1	6.222	9.198	-13.485	0.0
1.001	Soakaway 5	0.000	0.00	0.1	6.238	8.768	0.000	0.0
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 7

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 Coeffiecient 0.800

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

Number of Input Hydrographs 0

Number of Storage Structures 3

Number of Online Controls 1

Number of Time/Area Diagrams 0

Number of Offline Controls 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model

Region England and Wales Cv (Summer)

M5-60 (mm)

FSR

Cv (Summer)

18.700 Cv (Winter)

Ratio R 0.400

0.750

0.840

Margin for Flood Risk Warning (mm)

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status

DVD Status

Inertia Status

300.0

OFF

ON

ON

Profile(s)

Duration(s) (mins)

Return Period(s) (years)

Climate Change (%)

Summer and Winter

15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

100

40

PN

US/MH Name

Event

US/CL (m)

Water Level (m)

Surcharged Depth (m)

1.000

Permeable paving 5

180 minute 100 year Winter I+40%

52.222

51.965

0.315

2.000

rw 5

600 minute 100 year Winter I+40%

51.900

51.911

0.464

3.000

Additional soakaway 5A

180 minute 100 year Winter I+40%

52.450

51.958

2.308

1.001

Soakaway 5

180 minute 100 year Winter I+40%

52.352

51.959

2.309

PN

US/MH Name

Flooded Volume (m³)

Flow / Cap.

Infil. Flow (l/s)

Infil. Vol (m³)

Maximum Vol (m³)

Discharge Vol (m³)

Pipe Flow (l/s)

1.000

Permeable paving 5

0.000

0.18

0.2

3.411

5.262

17.309

6.1

2.000

rw 5

10.689

0.09

10.693

9.580

0.6

3.000

Additional soakaway 5A

0.000

0.00

0.1

1.884

9.276

-11.075

0.0

1.001

Soakaway 5

0.000

0.00

0.1

1.894

8.830

0.000

0.0

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 7		

Soakaway 6

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STORM SEWER DESIGN by the Modified Rational Method

Pipe Sizes STANDARD Manhole Sizes STANDARD

Designed with Level Soffits

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
1.000	4.332	0.300	14.4	0.014	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	7.268	0.143	50.9	0.013	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	5.750	0.025	230.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

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	5.03	53.000	0.014	0.0	0.0	0.0	2.66	47.1	1.9
2.000	50.00	5.11	52.843	0.013	0.0	0.0	0.0	1.08	8.5	1.7
1.001	50.00	5.26	51.000	0.027	0.0	0.0	0.0	0.66	11.6	3.6

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127 Hampton Road Bristol BS6 6JE																																														
Date 31/05/2022 12:31 File Soakaway 6.mdx	Designed by Sam Parsons Checked by																																													
Innovyze	Network 2020.1.3																																													
Storage Structures for Surface Network 3 Porous Car Park Manhole: Permeable paving 6, DS/PN: 1.000 <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.02000</td><td>Width (m)</td><td>5.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Length (m)</td><td>10.0</td></tr><tr><td>Max Percolation (l/s)</td><td>13.9</td><td>Slope (1:X)</td><td>0.0</td></tr><tr><td>Safety Factor</td><td>1.5</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Porosity</td><td>0.30</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Invert Level (m)</td><td>53.000</td><td>Cap Volume Depth (m)</td><td>0.350</td></tr></table> Lined Soakaway Manhole: Soakaway 6, DS/PN: 1.001 <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.02000</td><td>Ring Diameter (m)</td><td>1.20</td></tr><tr><td>Infiltration Coefficient Side (m/hr)</td><td>0.02000</td><td>Pit Multiplier</td><td>2.2</td></tr><tr><td>Safety Factor</td><td>1.5</td><td>Number Required</td><td>1</td></tr><tr><td>Porosity</td><td>0.30</td><td>Cap Volume Depth (m)</td><td>2.000</td></tr><tr><td>Invert Level (m)</td><td>51.000</td><td>Cap Infiltration Depth (m)</td><td>0.000</td></tr></table>			Infiltration Coefficient Base (m/hr)	0.02000	Width (m)	5.0	Membrane Percolation (mm/hr)	1000	Length (m)	10.0	Max Percolation (l/s)	13.9	Slope (1:X)	0.0	Safety Factor	1.5	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	53.000	Cap Volume Depth (m)	0.350	Infiltration Coefficient Base (m/hr)	0.02000	Ring Diameter (m)	1.20	Infiltration Coefficient Side (m/hr)	0.02000	Pit Multiplier	2.2	Safety Factor	1.5	Number Required	1	Porosity	0.30	Cap Volume Depth (m)	2.000	Invert Level (m)	51.000	Cap Infiltration Depth (m)	0.000
Infiltration Coefficient Base (m/hr)	0.02000	Width (m)	5.0																																											
Membrane Percolation (mm/hr)	1000	Length (m)	10.0																																											
Max Percolation (l/s)	13.9	Slope (1:X)	0.0																																											
Safety Factor	1.5	Depression Storage (mm)	5																																											
Porosity	0.30	Evaporation (mm/day)	3																																											
Invert Level (m)	53.000	Cap Volume Depth (m)	0.350																																											
Infiltration Coefficient Base (m/hr)	0.02000	Ring Diameter (m)	1.20																																											
Infiltration Coefficient Side (m/hr)	0.02000	Pit Multiplier	2.2																																											
Safety Factor	1.5	Number Required	1																																											
Porosity	0.30	Cap Volume Depth (m)	2.000																																											
Invert Level (m)	51.000	Cap Infiltration Depth (m)	0.000																																											
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Micro Drainage

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

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 Storage Structures 2

Number of Online Controls 1

Number of Time/Area Diagrams 0

Number of Offline Controls 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR

Ratio R 0.400

Region England and Wales Cv (Summer) 0.750

M5-60 (mm) 18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status OFF

DVD Status ON

Inertia Status ON

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years) 10

Climate Change (%) 40

PN

US/MH

US/CL

Water Level

Surcharged Depth

Flooded Volume

Name

Event

(m)

(m)

(m)

(m³)

1.000

Permeable paving

6

720 minute

10 year

Winter I+40%

53.657

53.036

-0.114

0.000

2.000

rw

6

720 minute

10 year

Winter I+40%

53.325

53.037

0.094

0.000

1.001

Soakaway

6

720 minute

10 year

Winter I+40%

53.856

53.036

1.886

0.000

PN

US/MH

Flow /

Infil.

Infil.

Maximum

Discharge

Pipe Flow

Status

Name

Cap.

Flow (l/s)

Vol (m³)

Vol (m³)

Vol (m³)

(l/s)

1.000

Permeable paving

6

0.01

0.1

1.690

0.546

4.973

0.4

OK

2.000

rw

6

0.05

0.001

6.243

0.4

FLOOD RISK

1.001

Soakaway

6

0.00

0.1

6.686

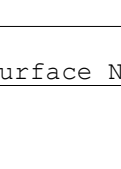
8.166

0.000

0.0

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m ³ /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 Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.700	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	30
Climate Change (%)	40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)
1.000	Permeable paving	6 600 minute 30 year Winter I+40%	53.657	53.148	-0.002	0.000
2.000	rwf	6 600 minute 30 year Winter I+40%	53.325	53.149	0.206	0.000
1.001	Soakaway	6 600 minute 30 year Winter I+40%	53.856	53.148	1.998	0.000

PN	US/MH Name	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m ³)	Maximum Discharge Vol (m ³)	Pipe Flow (l/s)	Status
1.000	Permeable paving	6 0.02	0.2	4.117	2.225	4.004	OK
2.000	rwf	6 0.07			0.002	7.559	FLOOD RISK
1.001	Soakaway	6 0.00	0.1	5.975	8.301	0.000	SURCHARGED

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3								
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 Storage Structures 2						
Number of Online Controls 1		Number of Time/Area Diagrams 0						
Number of Offline Controls 0		Number of Real Time Controls 0						
Synthetic Rainfall Details								
Rainfall Model		FSR		Ratio R 0.400				
Region England and Wales Cv (Summer) 0.750								
M5-60 (mm)		18.700 Cv (Winter) 0.840						
Margin for Flood Risk Warning (mm)				300.0				
Analysis Timestep 2.5 Second Increment (Extended)								
DTS Status				OFF				
DVD Status				ON				
Inertia Status				ON				
Profile(s)				Summer and Winter				
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080						
Return Period(s) (years)				100				
Climate Change (%)				40				
Water Surcharged								
PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)			
1.000	Permeable paving 6	480 minute 100 year Winter I+40%	53.657	53.324	0.174			
2.000	rwf 6	480 minute 100 year Winter I+40%	53.325	53.324	0.381			
1.001	Soakaway 6	480 minute 100 year Winter I+40%	53.856	53.324	2.174			
Pipe								
PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Discharge Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)
1.000	Permeable paving 6	0.000	0.02	0.2	6.663	4.867	3.411	0.8
2.000	rwf 6	0.000	0.10			0.004	9.302	0.8
1.001	Soakaway 6	0.000	0.00	0.1	5.122	8.504	0.000	0.0
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3														
<table><thead><tr><th>PN</th><th>US/MH Name</th><th>Status</th></tr></thead><tbody><tr><td>1.000</td><td>Permeable paving 6</td><td>SURCHARGED</td></tr><tr><td>2.000</td><td>rwp 6</td><td>FLOOD RISK</td></tr><tr><td>1.001</td><td>Soakaway 6</td><td>SURCHARGED</td></tr></tbody></table>			PN	US/MH Name	Status	1.000	Permeable paving 6	SURCHARGED	2.000	rwp 6	FLOOD RISK	1.001	Soakaway 6	SURCHARGED
PN	US/MH Name	Status												
1.000	Permeable paving 6	SURCHARGED												
2.000	rwp 6	FLOOD RISK												
1.001	Soakaway 6	SURCHARGED												
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Soakaway 7

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STORM SEWER DESIGN by the Modified Rational Method

Pipe Sizes STANDARD Manhole Sizes STANDARD

Designed with Level Soffits

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
1.000	5.152	0.300	17.2	0.011	5.00	0.0	0.600	o	150	Pipe/Conduit		
2.000	6.621	0.139	47.7	0.013	5.00	0.0	0.600	o	100	Pipe/Conduit		
1.001	4.699	0.025	187.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		

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	5.04	53.900	0.011	0.0	0.0	0.0	2.44	43.2	1.5
2.000	50.00	5.10	53.739	0.013	0.0	0.0	0.0	1.12	8.8	1.7
1.001	50.00	5.21	51.900	0.024	0.0	0.0	0.0	0.73	12.9	3.2

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Storage Structures for Surface Network 2

Porous Car Park Manhole: Permeable paving 7, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.02000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	13.9	Slope (1:X)	0.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	53.900	Cap Volume Depth (m)	0.350

Lined Soakaway Manhole: Soakaway 7, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.02000	Ring Diameter (m)	1.20
Infiltration Coefficient Side (m/hr)	0.02000	Pit Multiplier	2.2
Safety Factor	1.5	Number Required	1
Porosity	0.30	Cap Volume Depth (m)	2.000
Invert Level (m)	51.900	Cap Infiltration Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 2								
Simulation Criteria								
Areal Reduction Factor		1.000		Additional Flow - % of Total Flow		0.000		
Hot Start (mins)		0		MADD Factor * 10m³/ha Storage		2.000		
Hot Start Level (mm)		0		Inlet Coeffiecient		0.800		
Manhole Headloss Coeff (Global)		0.500		Flow per Person per Day (l/per/day)		0.000		
Foul Sewage per hectare (l/s)		0.000						
Number of Input Hydrographs		0		Number of Storage Structures		2		
Number of Online Controls		1		Number of Time/Area Diagrams		0		
Number of Offline Controls		0		Number of Real Time Controls		0		
Synthetic Rainfall Details								
Rainfall Model		FSR		Ratio R		0.400		
Region England and Wales		Cv (Summer)		0.750				
M5-60 (mm)		18.700		Cv (Winter)		0.840		
Margin for Flood Risk Warning (mm)		300.0						
Analysis Timestep		2.5 Second Increment (Extended)						
DTS Status		OFF						
DVD Status		ON						
Inertia Status		ON						
Profile(s)		Summer and Winter						
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080						
Return Period(s) (years)		30						
Climate Change (%)		40						
Water Surcharged Flooded								
PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)	Volume (m³)		
1.000	Permeable paving	7 600 minute 30 year Winter I+40%	54.562	53.979	-0.071	0.000		
2.000	rwp	7 600 minute 30 year Winter I+40%	54.150	53.980	0.141	0.000		
1.001	Soakaway	7 600 minute 30 year Winter I+40%	54.807	53.979	1.929	0.000		
Pipe								
PN	US/MH Name	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	Permeable paving	7 0.01	0.2	2.850	1.180	3.476	0.4	OK
2.000	rwp	7 0.07			0.002	7.577	0.5	FLOOD RISK
1.001	Soakaway	7 0.00	0.1	5.807	8.224	0.000	0.0	SURCHARGED
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 2

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 Coeffiecient 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 0

Number of Storage Structures 2

Number of Time/Area Diagrams 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model

Region England and Wales

M5-60 (mm)

FSR

Cv (Summer) 0.750

18.700 Cv (Winter) 0.840

Ratio R 0.400

Margin for Flood Risk Warning (mm) 300.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status OFF

DVD Status ON

Inertia Status ON

Profile(s)

Duration(s) (mins)

Return Period(s) (years)

Climate Change (%)

Summer and Winter

15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

30

40

PN

US/MH Name

Event

US/CL (m)

Water Level (m)

Surcharged Depth (m)

Flooded Volume (m³)

1.000

Permeable paving

7 600 minute 30 year Winter I+40%

54.562

53.979

-0.071

0.000

2.000

rwp

7 600 minute 30 year Winter I+40%

54.150

53.980

0.141

0.000

1.001

Soakaway

7 600 minute 30 year Winter I+40%

54.807

53.979

1.929

0.000

PN

US/MH Name

Flow / Cap.

Infil. Flow (l/s)

Infil. Vol (m³)

Maximum Vol (m³)

Discharge Vol (m³)

Pipe Flow (l/s)

Status

1.000

Permeable paving

7 0.01

0.2

2.850

1.180

3.476

0.4

OK

2.000

rwp

7 0.07

0.002

7.577

0.5

FLOOD RISK

1.001

Soakaway

7 0.00

0.1

5.807

8.224

0.000

0.0

SURCHARGED

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 2								
Simulation Criteria								
Areal Reduction Factor 1.000		Additional Flow - % of Total Flow 0.000						
Hot Start (mins) 0		MADD Factor * 10m³/ha Storage 2.000						
Hot Start Level (mm) 0		Inlet 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 Storage Structures 2						
Number of Online Controls 1		Number of Time/Area Diagrams 0						
Number of Offline Controls 0		Number of Real Time Controls 0						
Synthetic Rainfall Details								
Rainfall Model		FSR		Ratio R 0.400				
Region England and Wales		Cv (Summer) 0.750						
M5-60 (mm)		18.700 Cv (Winter) 0.840						
Margin for Flood Risk Warning (mm)				300.0				
Analysis Timestep 2.5		Second Increment (Extended)						
DTS Status				OFF				
DVD Status				ON				
Inertia Status				ON				
Profile(s)				Summer and Winter				
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080						
Return Period(s) (years)				100				
Climate Change (%)				40				
Water Surcharged								
PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)			
1.000	Permeable paving	7 480 minute 100 year Winter I+40%	54.562	54.148	0.098			
2.000	rwp	7 480 minute 100 year Winter I+40%	54.150	54.149	0.310			
1.001	Soakaway	7 600 minute 100 year Winter I+40%	54.807	54.148	2.098			
Pipe								
PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)
1.000	Permeable paving	7 0.000	0.02	0.2	5.206	3.727	2.657	0.7
2.000	rwp	7 0.000	0.10			0.003	9.345	0.8
1.001	Soakaway	7 0.000	0.00	0.1	6.204	8.428	0.000	0.0
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127 Hampton Road Bristol BS6 6JE		
Date 31/05/2022 12:35 File Soakaway 7.mdx	Designed by Sam Parsons Checked by	
Innovyze	Network 2020.1.3	
Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 2		

APPENDIX D

DRAINAGE MAINTENANCE PLAN

TECHNICAL NOTE

Project: TE1565 Residential Units at Lowfield Road, Reading, RG4 6NL
Client: Reading Borough Council

Date: July 2022
Author: R Spriggs (01225 303523)

Title: Drainage Maintenance Plan

Introduction

1. This Technical Note describes the maintenance measures that should routinely be undertaken to ensure that the drainage system remain functional and serviceable for the life of the development. For specific equipment from suppliers e.g. manholes, controls, covers, geotextile, finished materials etc, the manufacturers O&M should be referred to.
2. The maintenance schedule set out in this Technical Note broadly follows the recommendations in the SuDS Manual (CIRIA C753 2015) and the sustainable drainage community guidelines (www.susdrain.org).

Maintenance schedule

3. The maintenance schedule is set out in Appendix A of this Technical Note.
4. It should be noted that maintenance is subject to the requirements of the Construction (Design & Management) Regulations 2015. The Regulations place a number of specific duties on Clients, the extent of which varies with the type of project involved. For most projects the client will be required to appoint a Principal Designer who should ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. The information will be required as part of the H&S file (CIRIA pp267).

Responsibility

5. The maintenance of the drainage will be the responsibility of the following:
 - a. General plumbing, foul and surface water issues up to the gully/ manhole: Property Services Repair Team, Reading Borough Council, 19 Bennet Road, Reading, RG2 0QX.
 - b. Below ground drainage: Highways & Drainage Team, Reading Borough Council, 19 Bennet Road, Reading, RG2 0QX.
-

Appendix A

Drainage Maintenance Schedule

Maintenance Schedule – Lowfield Road, Caversham

Structure	Construction Phase	Operational Phase				Remedial (As required)
		Regular	Frequency	Occasional	Frequency	
Pipelines (FW and SW)	Temporary protection as required	Inspection : walk-round and lift MHs	6 monthly	Clean Gullies, Silt Traps & MH catchpits	Annually	Structural/hydraulic repair
		Inspect covers for cracking, poor fit or debris around frame recesses	6 monthly			
Soakaways	Temporary protection as required	Monitoring: Inspect silt traps and note rate of sediment accumulation	Monthly (year 1) then annually	Remove sediment and debris on floor of inspection chamber and inside of concrete manhole rings	As required based on inspections	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs Replacement of clogged geotextile (will require reconstruction of soakaway)
		Monitoring: check soakaway to ensure emptying is occurring	Annually			
		Inspection; sediment and debris on floor of inspection chamber and inside of concrete manhole rings	Annually			
		Cleaning gutter and any filters on downpipes	Annually			
		Trimming any roots that may be causing blockages	Annually			
Permeable Parking Areas (loose gravel)	Protect from damage due to site works	Initial Inspection	monthly (for 3 months)	Stabilise and mow contributing neighbouring area	As required	Remediate any slumped landscaping
		Inspection for evidence of poor operation and weed growth	3 monthly (and after storm)	Removal of weeds or management using glyphosate applied directly to the weeds rather than sprayed	As required/ annually	Remedial works to any depressions or rutting
		Inspect for silt accumulation and clean stone if required	Annually	Cut dead or overhanging vegetation, clear silt, jet wash outfalls	2 yearly or earlier if required	Replace upper structure and replace with clean gravel/ stone

		Sweep any loose gravel from road and replace in bays	3 monthly			
		Remove debris, weeds as necessary, cut and clear overhanging vegetation, clear outfalls & chambers	Annually			
General		Re-assess maintenance schedule in light of experience	Annually			
		Save record of inspection for future reference	all inspections			
		First operational year - double up inspections	all inspections			

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