BANNERS GATE

CIVIL, STRUCTURAL AND
TRANSPORTATION ENGINEERS

Hayfield Homes

Berry Hill Road, Adderbury

Flood Risk Assessment - Addendum

August 2022

HAYFIELD HOMES

Revision Schedule

Berry Hill Road, Adderbury
Flood Risk Assessment - Addendum
22021_FRA-A

Rev	Date	Details	Prepared by	Reviewed by	Approved by
00	08/03/2022	Draft	**Scott Marshall** BSc (Hons), MCIWEM	**David Allbright** Associate Director	**Steve Foxall** Managing Director
01	23/03/2022	Final	**Scott Marshall** BSc (Hons), MCIWEM	**David Allbright** Associate Director	**Steve Foxall** Managing Director
02	31/08/2022	-	**Scott Marshall** BSc (Hons), MCIWEM	**David Allbright** Associate Director	**Steve Foxall** Managing Director

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1 INTRODUCTION

1.1 Background Information

1.1.1 Banners Gate was commissioned, in February 2022, by Hayfield Homes to prepare an Addendum to a Flood Risk Assessment[1] undertaken in support of an Outline Planning application[2] for land to the north of Berry Hill Road in Adderbury, Oxfordshire.

National Grid Reference	SP468347
Post Code	OX17 3HF

Table 1.1: Approximate Site Location

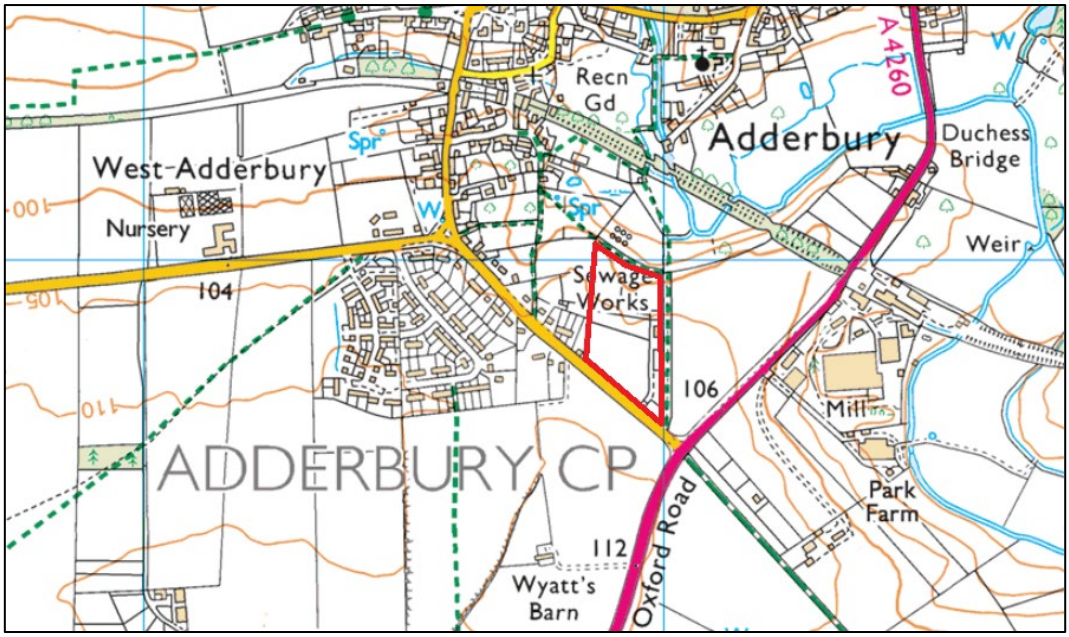

Figure 1.1: Site Location

1.1.2 The proposed development was granted Outline Planning Permission, on Appeal[3], for up to 40 dwellings in September 2021.

1.1.3 This revision 01 Addendum has been prepared to support a Reserved Matters application.

1.1.4 A subsequent revision will be used to support a Discharge of Conditions application for the following conditions in due course:

(11) No development shall commence until have [sic] *been submitted to and approved in writing by the local planning authority a detailed scheme for the surface water and foul sewage drainage of the development. The surface water drainage scheme as approved shall be carried out prior to the commencement of any building works on the site. The approved foul sewage drainage scheme shall be implemented prior to the first occupation of each building to which the scheme relates. The drainage works shall be laid out and constructed in accordance with the current edition of the Water UK Sewers for Adoption Design and Construction Guide for Developers.*

(12) No development shall commence until there shall have been submitted to and approved in writing by the local planning authority full details of the construction of the surface water mitigation proposals, including any balancing pond if required, and implementation schedule. The works shall be carried out as approved and retained thereafter.

[1] Betts Hydro Consulting Engineers Report Reference: HYD250_Berry.Hill. Road Revision 1.1 dated 05 October 2017
[2] Cherwell District Council Application Reference Number: 19/00963/OUT
[3] Appeal Reference: APP/C3105/W/20/3255419

1.2 Summary of 2017 Flood Risk Assessment

1.2.1 The Betts Hydro Consulting Engineers Flood Risk Assessment, prepared for Hollins Strategic Land, concluded the 4-hectare Site is located wholly within Food Zone 1 and is at a low risk of flooding from all sources.

1.2.2 Greenfield runoff rates, for a reduced developable area of 1.97-hectares, were summarised in a Table with supporting calculations provided within an Appendix.

Return Period	Greenfield Runoff (l/s)
Q1	0.6
Qbar	0.7
Q30	1.7
Q100	2.4

Table 1.2: Greenfield Runoff Rates (2017 FRA)

1.2.3 Notably, the calculations specified a soil index of 0.15 suggesting the site is underlain by well-draining soils. Indeed, desktop studies indicated freely draining soils and so the use of infiltration techniques was promoted as the primary method of surface water disposal, although in the absence of site-specific testing an alternative solution[4] was also described for robustness.

1.2.4 Consideration was given to the inclusion of "domestic soakaways and an appropriate highways infiltration system".

1.2.5 Foul water flows were to be directed to the 375mm diameter public foul water sewer to the east of the Site.

1.3 Summary of 2019 Drainage Strategy

1.3.1 Ironside Farrar produced a Drainage Strategy[5] for Hollins Strategic Land in November 2019 to provide additional information sought by Oxfordshire County Council as the Lead Local Flood Authority.

1.3.2 Infiltration testing, in accordance with BRE Digest 365, was carried out at the three locations shown in Figure 1.3.1.

1.3.3 The trial pits were excavated to depths of between 1.5m and 2.1m below ground level in September 2019. Topsoil was underlain by very sandy clay with increasing gravel content by depth in SA101 and SA103.

1.3.4 Test results indicated poor drainage conditions in the north (SA102) and good drainage conditions in the south (SA101 and SA103).

Location	Infiltration Rate (m/s)	BRE 365 Compliant
SA101	1.30×10^{-4}	Yes
SA102	2.76×10^{-6}	No
SA103	1.48×10^{-4}	Yes

Table 1.3: Lowest Infiltration Rate (2019)

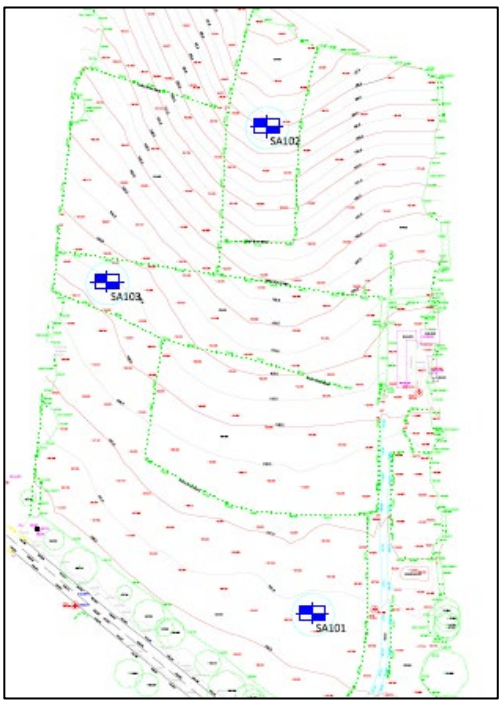

Figure 1.3.1: Infiltration Test Locations (2019)

[4] Discharge to the off-site Sor Brook at 5l/s.
[5] Report Reference: 30394/SRG

1.3.5 The following primary SuDS elements were proposed:

- Individual soakaways to each property.
- Permeable surfacing to each property.
- Adopted site access roads to be provided with permeable surfacing.

1.3.6 Additionally, it was proposed that the highway corridor would fall towards a series of swales, to intercept any overland flows, connected to an infiltration basin located to the north of the developable area.

Figure 1.3.2: Ironside Farrar Preliminary Drainage Layout (Drawing No: 30394/102)

2 FLOOD RISK

2.1 River (fluvial) Flooding

2.1.1 The Environment Agency's Flood Map for Planning (Rivers and Sea) is shown in the following figure. The map shows the Site to be situated entirely within Flood Zone 1.

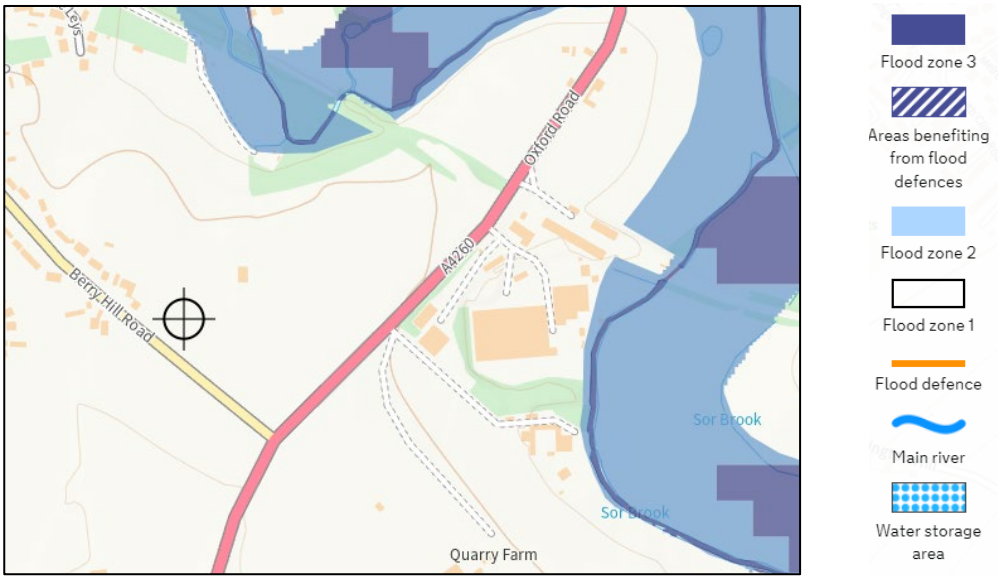

Figure 2.1: Environment Agency Flood Map for Planning (Rivers and Sea)

2.2 Surface Water (pluvial) Flooding

2.2.1 The 'Flood Risk from Surface Water' map, shown in the following figure, shows the Site to be at very low risk of surface water flooding.

Figure 2.2: Flood Risk from Surface Water Map

2.3 Reservoir Flooding

2.3.1 The 'Flood Risk from Reservoirs' map, shown in the following figure, shows the Site is not at risk of Reservoir flooding.

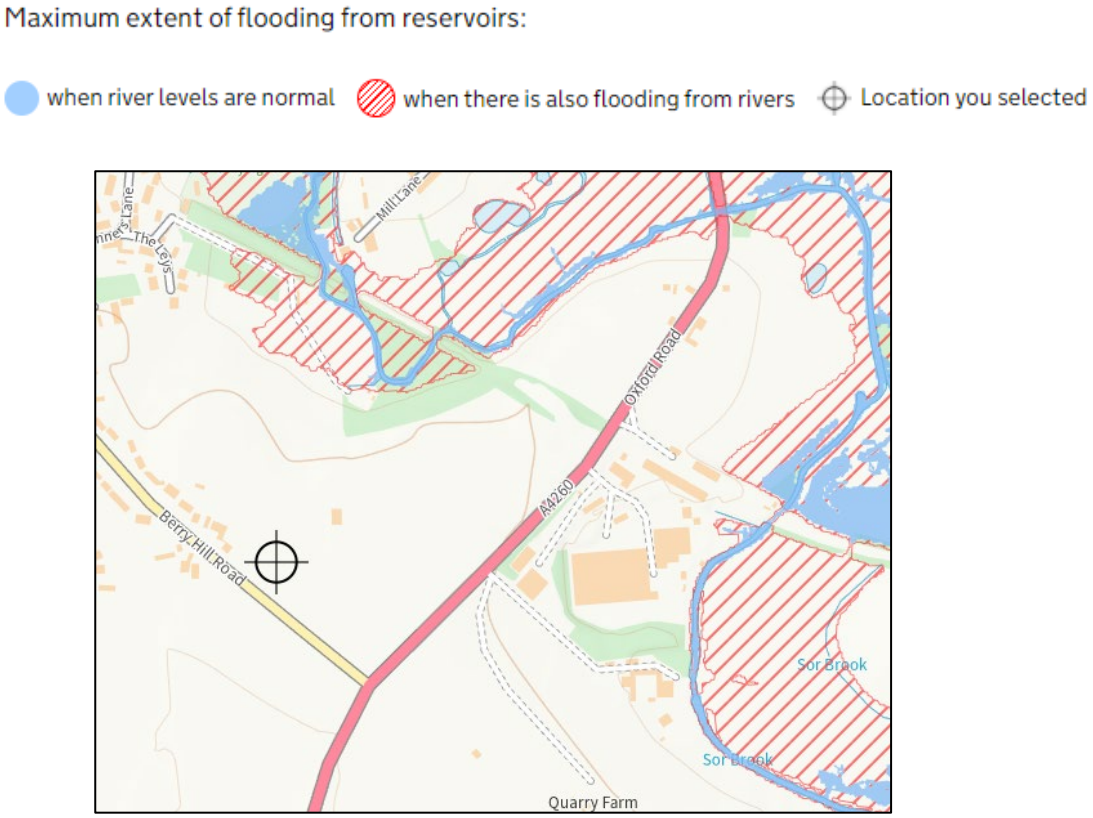

Figure 2.3: Flood Risk from Reservoirs Map

2.4 Flood Risk from other Sources

Source	Flood Risk			
	Very Low	Low	Medium	High
Groundwater	x			
Sea (tidal & coastal)	x			
Sewer	x			

Table 2.4: Flood Risk from other Sources

3 DEVELOPMENT PROPOSALS

3.1 Layout

3.1.1 A development of 40 dwellings is proposed as illustrated on the drawing extract[6] below.

Figure 3.1: Proposed Layout

Land Use	Area (hectares)
Permeable	0.5
Pervious Paving	0.3
Impermeable	0.8
Developable	1.6
Undeveloped (inc. SuDS)	2.4

Table 3.1: Proposed Land Use

[6] Pagasus Design Site Layout Drawing Number: P21-2984 01 [Appendix III]

4 SURFACE WATER DRAINAGE

4.1 Introduction

4.1.1 The Lead Local Flood Authority raised no objections against the Outline Planning application, but recommended the following conditions:

SuDS

No development shall take place until a detailed design and associated management and maintenance plan of surface water drainage for the site using sustainable drainage methods has been submitted to and approved in writing by the Local Planning Authority.

The approved drainage system shall be implemented in accordance with the approved detailed design prior to the use of the building commencing.

The detailed design must address:

- *Provision of evidence that green space on site has been used to its full potential to incorporate SuDS.*
- *Provision of evidence demonstrating safe ingress/egress.*
- *Provision of evidence demonstrating exceedance events and where surface water flows will be routed or held temporarily on site.*
- *Detail of any phasing plan including how surface water will be managed during construction*

Detailed Design and subsequent construction to be in line with Drainage Strategy document reference 30394/SRG dated November 2019.

Completion and Maintenance of Sustainable Drainage

Shown on Approved Plans.

No building or use hereby permitted shall be occupied or the use commenced until the sustainable drainage scheme for this site has been completed in accordance with the submitted details. The sustainable drainage scheme shall be managed and maintained thereafter in accordance with the agreed management and maintenance plan.

Outline Design Infiltration Condition

The development hereby permitted shall not commence until full Detailed Design details of the proposal, implementation, maintenance and management of a surface water drainage scheme have been submitted to and approved in writing by the local planning authority. Those details shall include:

- *a) Information about the design storm period and intensity (1 in 30 & 1 in 100 (+40% allowance for climate change), discharge rates and volumes (both pre and post development), temporary storage facilities, means of access for maintenance, the methods employed to delay and control surface water discharged from the site, and the measures taken to prevent flooding and pollution of the receiving groundwater and/or surface waters;*
- *b) Any works required off-site to ensure adequate discharge of surface water without causing flooding or pollution (which should include refurbishment of existing culverts and headwalls or removal of unused culverts where relevant);*
- *c) Flood water exceedance routes, both on and off site;*
- *d) A timetable for implementation;*
- *e) Site investigation and test results to confirm infiltrations rates; and*
- *f) A management and maintenance plan, in perpetuity, for the lifetime of the development which shall include the arrangements for adoption by an appropriate public body or statutory undertaker, management and maintenance by a Residents' Management Company or any other arrangements to secure the operation of the surface water drainage scheme throughout its lifetime.*

Detailed Comments

Full Detailed Design to be submitted, including completed OCC Flows and Volumes Pro-Forma to enable audit of the submitted calculation files.

4.2 Surface Water Strategy

4.2.1 Generally, the surface water strategy remains in accordance with that described within the Ironside Farrar Drainage Strategy (2019), although the proposed eastern swale has been omitted due to a planning requirement to create an undeveloped buffer along the western boundary.

4.2.1 Additional infiltration testing, in accordance with BRE Digest 365, was carried out at three locations 'SA201 – SA203' as shown in Figure 4.2, in April 2022[7].

4.2.2 Trial pits were excavated to between 2.2-2.5m below ground; it is anticipated the tests were appropriately conducted within the underlying bedrock.

Location	Infiltration Rate (m/s)
SA201	$1.2x10^{-5}$
SA202	$2.3x10^{-4}$
SA203	$4.9x10^{-4}$

Table 4.2: Lowest Infiltration Rate (2022)

4.2.3 It is recommended any further testing targets and penetrates the bedrock by at least 1m.

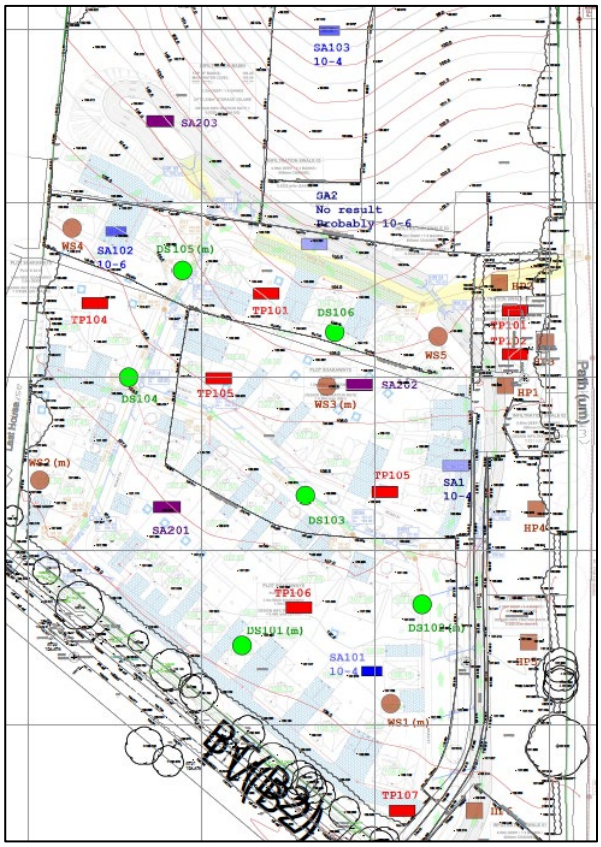

Figure 4.2: Infiltration Test Locations (2022)

4.3 Urban Creep Allowance

4.3.1 In accordance with the requirements of the 'Local Standards and guidance for Surface Water Drainage on Major Development in Oxfordshire' a 10% urban creep allowance is to be applied. It is recommended this is applied to impermeable areas within the property curtilage only.

4.4 Preliminary Drainage Layout & Details

4.4.1 The following drainage information is included within the referenced Appendix to support the Reserved Matters application:

- Drainage Strategy Plan [Appendix III]
- Drainage Calculations [Appendix II]
  - Greenfield Runoff Calculations
  - Storm Network 1 (highway drainage)
    - Results (2-year, 30-year, 100 year + 40% climate change)
  - Soakaway 20 - Typical Plot Soakaways (plots 1-21)
    - Results (2-year, 10-year, 100 year + 40% climate change)
  - Soakaway 31 - Typical Plot Soakaways (plots 22-31)
    - Results (2-year, 10-year, 100 year + 40% climate change)
  - Soakaway 33 - Typical Plot Soakaways (plots 32-40)
    - Results (2-year, 10-year, 100 year + 40% climate change)
  - Porous Paving - Typical Example
    - Results (2-year, 10-year, 100 year + 40% climate change)

[7] JNP Group Project No: M43979

4.5 Water Quality

4.5.1 In accordance with Table 26.2 of CIRIA Report C753 'The SuDS Manual' the pollution hazard level for the proposed development is 'Low' and therefore a simple index approach has been applied to ensure minimum water quality requirements are achieved.

4.5.2 The pollution hazard indices for the proposed development are summarised in the following table.

Land Use	Total Suspended Solids	Metals	Hydrocarbons
Roofs	0.2	0.2	0.05
Driveways/road	0.5	0.4	0.4

Table 4.5.1: Pollution Hazard Indices
(CIRIA Report C753 Table 26.2)

4.5.3 The indicative SuDS mitigation indices for discharges to groundwater for the features proposed are summarised in the following table.

Component	Total Suspended Solids	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7
Basin	0.6	0.5	0.6

Table 4.5.2: Indicative SuDS Mitigation Indices for Discharges to Groundwater
(CIRIA Report C753 Table 26.4)

4.6 Maintenance & Management

4.6.1 A Private Management Company is to be appointed, by the developer, to manage and maintain the drainage networks, except for the road drainage which is expected to be adopted by the Highway Authority.

5 FOUL WATER DRAINAGE

5.1 Introduction

5.1.1 Thames Water raised no objections against the Outline Planning application.

5.2 Third-party Permissions

5.2.1 The public sewerage is located on third-party land.

5.2.2 It is recommended that discussions are held with the relevant landowner(s) to establish if they would grant the necessary rights to construct a foul water sewer within their land by private negotiation.

5.2.3 Alternatively, a foul sewer could be requisitioned under Section 98 of the Water Industry Act.

6 CONCLUSIONS & RECOMMENDATIONS

1. Discussions should be held with the third-party landowner(s) to the east to establish if they would grant the necessary rights to construct foul water drainage within their land. If so, the topographical survey should be extended as appropriate, ensuring that cover and invert levels of the manholes immediately upstream and downstream of the proposed point of connection are confirmed.
2. If third-party negotiations fail, a sewer requisition application should be made to Thames Water at the appropriate time.
3. The following information should be prepared to support a future discharge of conditions application:
    - Oxfordshire County Council – SuDS Flows and Volumes – LLFA Technical Assessment Pro-forma.
    - Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire - Appendix D: Information required for Full Applications

APPENDIX I – SUPPORTING INFORMATION

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SOIL INFILTRATION TEST

Project:
Berry Hill Road, Adderbury

Project No:
M43979

Test Location: SA201 Test No: 1 Date: 26 Apr 2022

Water level during test

Time mins	Depth m bgl
0	1.500
6	1.600
12	1.650
29	1.800
40	1.870
60	2.000
90	2.100
120	2.150
154	2.200
190	2.250
230	2.300
280	2.350
375	2.430

Trial pit dimensions

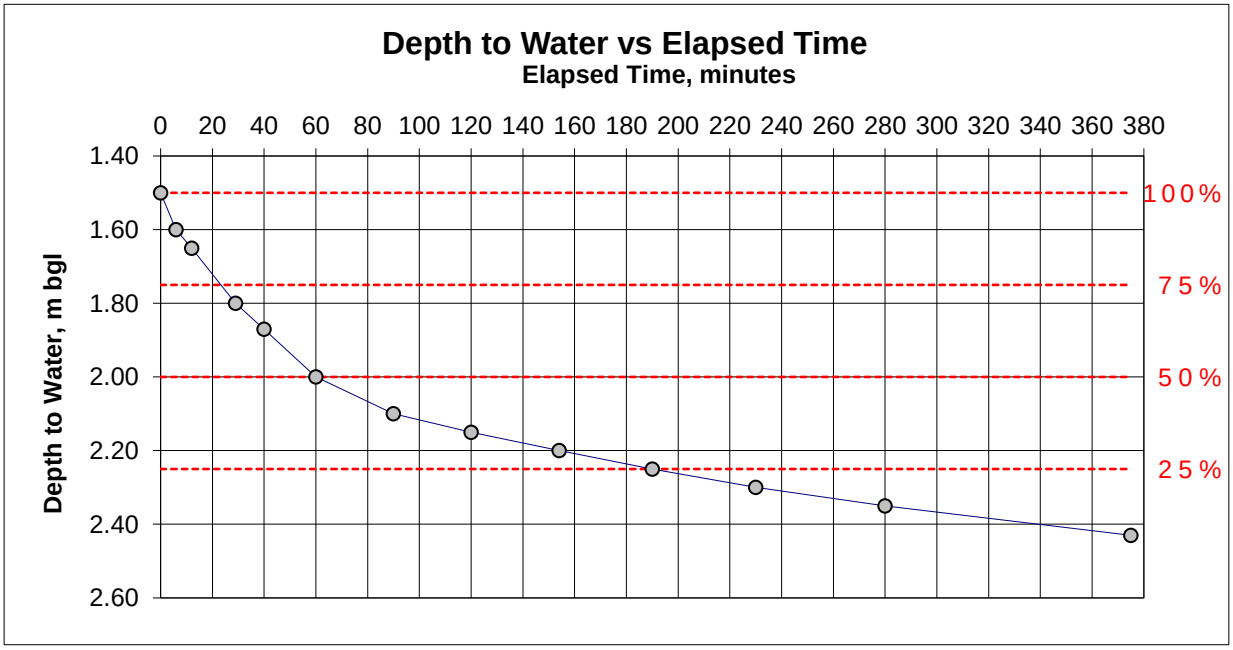
depth (m)	2.50
length (m)	2.30
width (m)	0.60

$$f = \frac{V_{p75-25}}{a_{s50} \times t_{p75-25}}$$

f = soil infiltration rate
V_{p75-25} = volume of water from 75% to 25% effective depth
a_{s50} = internal surface area at 50% effective depth
t_{p75-25} = time for the water level to fall from 75% to 25% effective dep

time at 75% effective depth (mins) 21
time at 25% effective depth (mins) 190
(from graph)

Calculated Soil Infiltration Rate = 1.6E-05 m/sec



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SOIL INFILTRATION TEST

Project:

ill Road, Adderbury

Project No:

M43979

Test Location: SA201 Test No: 2 Date: 27 Apr 2022

Water level during test

Time mins	Depth m bgl
0	1.500
5	1.650
15	1.780
31	1.900
49	1.970
64	2.010
82	2.040
119	2.100
154	2.150
190	2.200
223	2.250
250	2.280
375	2.400

Trial pit dimensions

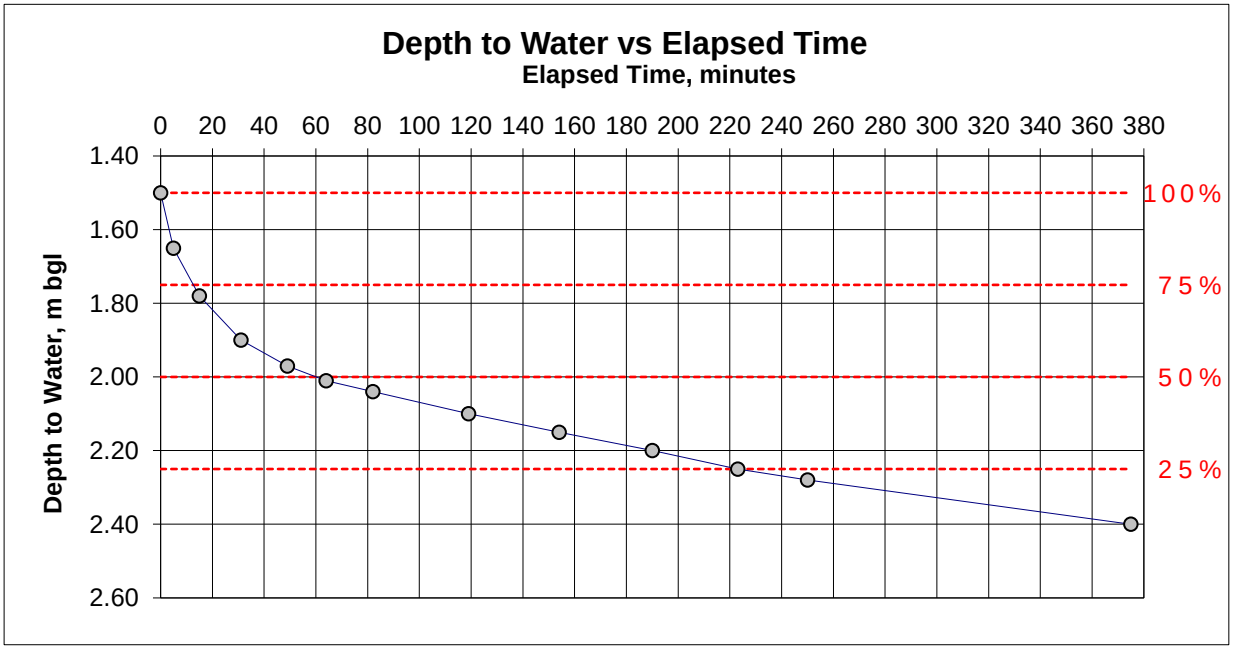
depth (m)	2.50
length (m)	2.30
width (m)	0.60

$$f = \frac{V_{p75-25}}{a_{s50} \times t_{p75-25}}$$

f = soil infiltration rate
V_{p75-25} = volume of water from 75% to 25% effective depth
a_{s50} = internal surface area at 50% effective depth
t_{p75-25} = time for the water level to fall from 75% to 25% effective dep

time at 75% effective depth (mins) 14
time at 25% effective depth (mins) 223
(from graph)

Calculated Soil Infiltration Rate = 1.3E-05 m/sec



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SOIL INFILTRATION TEST

Project:
Berry Hill Road, Adderbury

Project No:
M43979

Test Location: SA201 Test No: 3 Date: 27 Apr 2022

Water level during test

Time mins	Depth m bgl
0	1.500
6	1.600
16	1.770
30	1.880
45	1.940
60	1.980
95	2.040
120	2.080
165	2.160
195	2.200
230	2.250
260	2.280
360	2.390

Trial pit dimensions

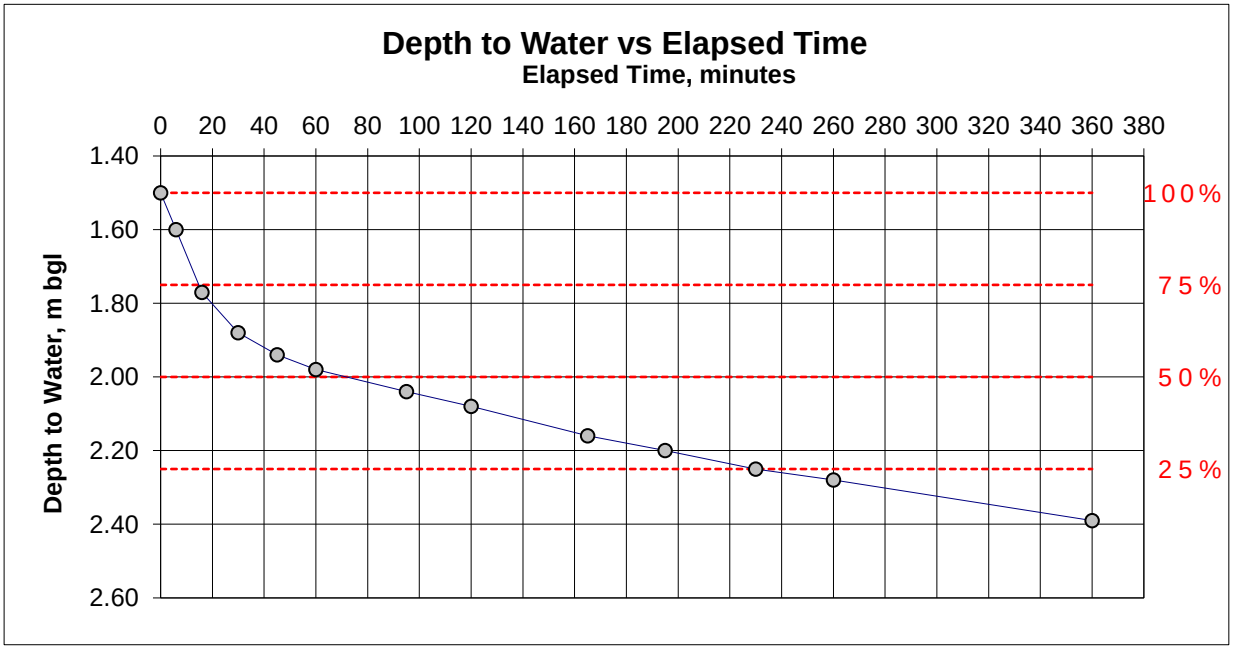
depth (m)	2.50
length (m)	2.30
width (m)	0.60

$$f = \frac{V_{p75-25}}{a_{s50} \times t_{p75-25}}$$

f = soil infiltration rate
V_{p75-25} = volume of water from 75% to 25% effective depth
a_{s50} = internal surface area at 50% effective depth
t_{p75-25} = time for the water level to fall from 75% to 25% effective dep

time at 75% effective depth (mins) 15
time at 25% effective depth (mins) 230
(from graph)

Calculated Soil Infiltration Rate = 1.2E-05 m/sec



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SOIL INFILTRATION TEST

Project:
Berry Hill Road, Adderbury

Proje t No:
M43979

Test Location: SA202 Test No: 1 Date: 26 Apr 2022

Water level during test

Time mins	Depth m bgl
0	1.400
2	1.700
4	1.800
6	1.900
9	2.050
13	2.200
16	2.300
21	2.400

Trial pit dimensions

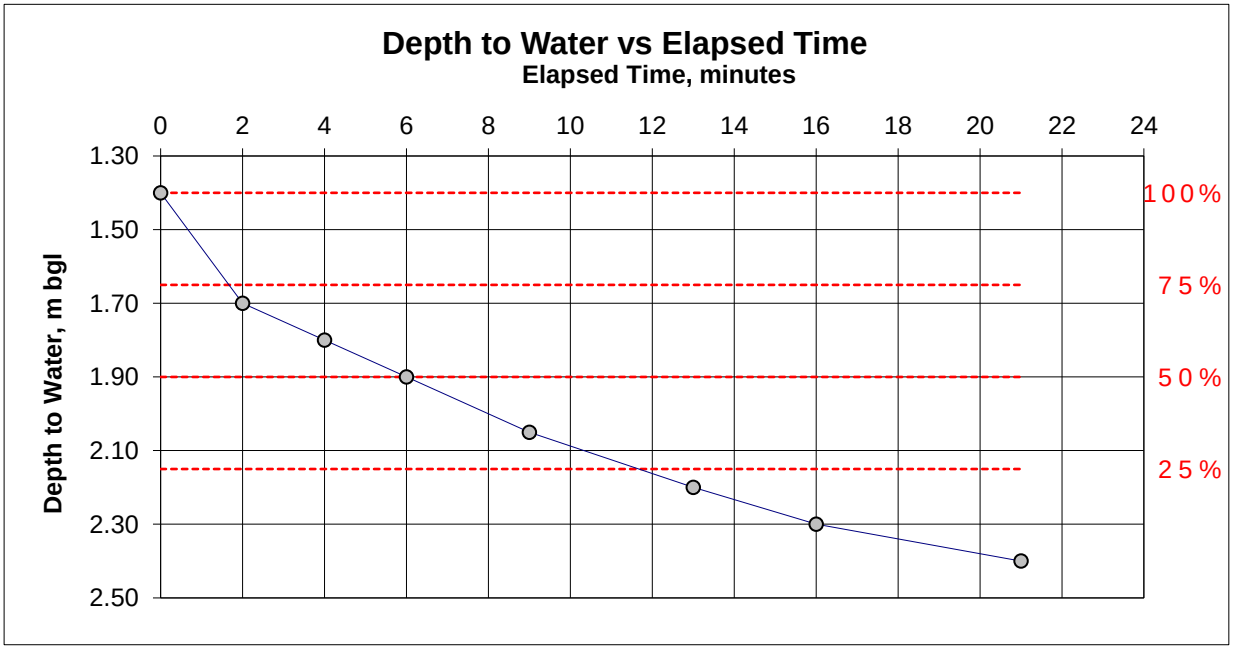
depth (m)	2.40
length (m)	2.30
width (m)	0.60

$$f = \frac{V_{p75-25}}{a_{s50} \times t_{p75-25}}$$

f = soil infiltration rate
V_{p75-25} = volume of water from 75% to 25% effective depth
a_{s50} = internal surface area at 50% effective depth
t_{p75-25} = time for the water level to fall from 75% to 25% effective dep

time at 75% effective depth (mins) 1.75
time at 25% effective depth (mins) 11.5
(from graph)

Calculated Soil Infiltration Rate = 2.8E-04 m/sec



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SOIL INFILTRATION TEST

Project:
Berry Hill Road, Adderbury

Project No:
M43979

Test Location: SA202 Test No: 2 Date: 26 Apr 2022

Water level during test

Time mins	Depth m bgl
0	1.400
2	1.630
4	1.740
8	1.950
10	2.030
12	2.100
15	2.180
17	2.240
19	2.300
24	2.400

Trial pit dimensions

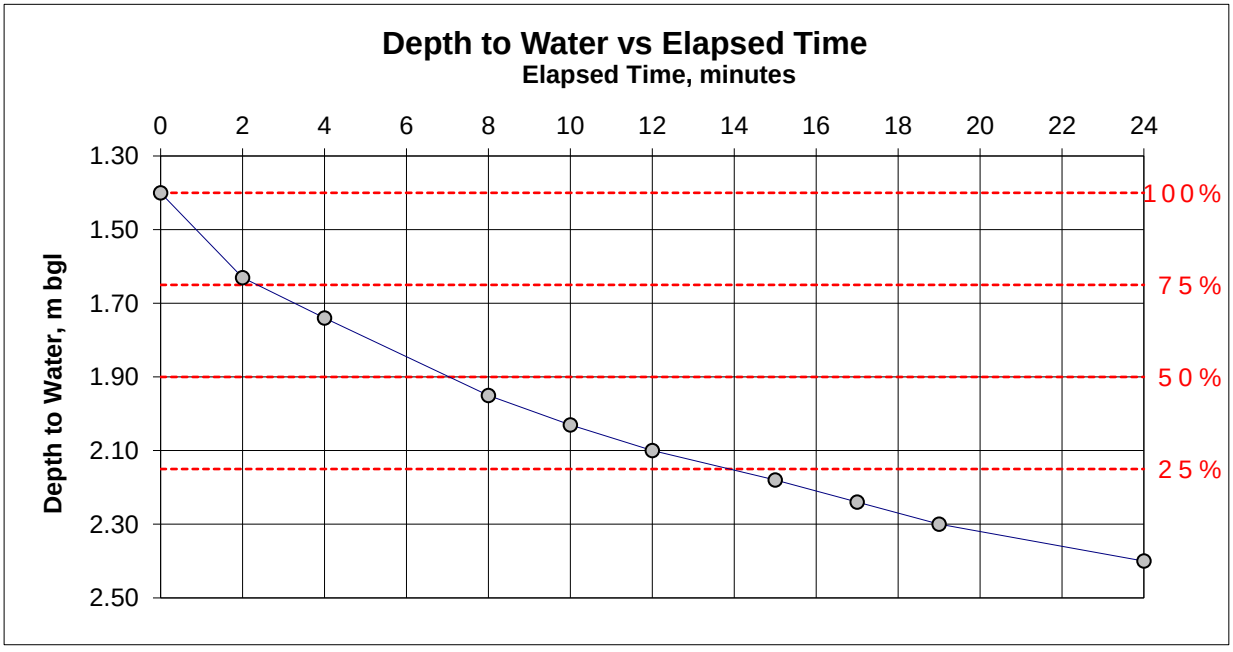
depth (m)	2.40
length (m)	2.30
width (m)	0.60

$$f = \frac{V_{p75-25}}{a_{s50} \times t_{p75-25}}$$

f = soil infiltration rate
V_{p75-25} = volume of water from 75% to 25% effective depth
a_{s50} = internal surface area at 50% effective depth
t_{p75-25} = time for the water level to fall from 75% to 25% effective dep

time at 75% effective depth (mins)	2.25
time at 25% effective depth (mins)	13.75
(from graph)	

Calculated Soil Infiltration Rate = 2.3E-04 m/sec



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SOIL INFILTRATION TEST

Project:

Barry Hill Road, Adderbury

Project No:

M43979

Test Location: SA202 Test No: 3 Date: 26 Apr 2022

Water level during test

Time mins	Depth m bgl
0	1.400
1	1.600
2	1.700
4	1.800
6	1.900
7	1.950
11	2.100
15	2.200
18	2.290
23	2.400

Trial pit dimensions

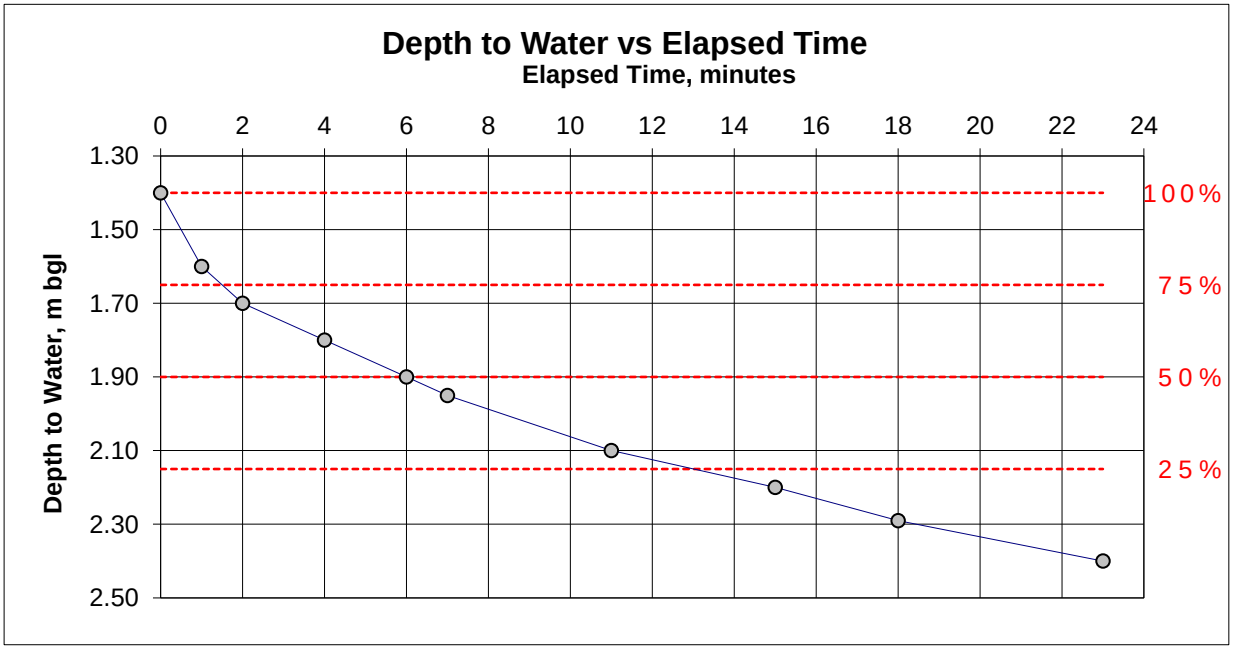
depth (m)	2.40
length (m)	2.30
width (m)	0.60

$$f = \frac{V_{p75-25}}{a_{s50} \times t_{p75-25}}$$

f = soil infiltration rate
V_{p75-25} = volume of water from 75% to 25% effective depth
a_{s50} = internal surface area at 50% effective depth
t_{p75-25} = time for the water level to fall from 75% to 25% effective dep

time at 75% effective depth (mins) 1.5
time at 25% effective depth (mins) 13
(from graph)

Calculated Soil Infiltration Rate = 2.3E-04 m/sec



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SOIL INFILTRATION TEST

Project:
Berry Hill Road, Adderbury

Proj t No:
M43979

Test Location: SA203 Test No: 1 Date: 26 Apr 2022

Water level during test

Time mins	Depth m bgl
0	1.200
2	1.500
3	1.600
5	1.800
8	2.000
10	2.100
13	2.200

Trial pit dimensions

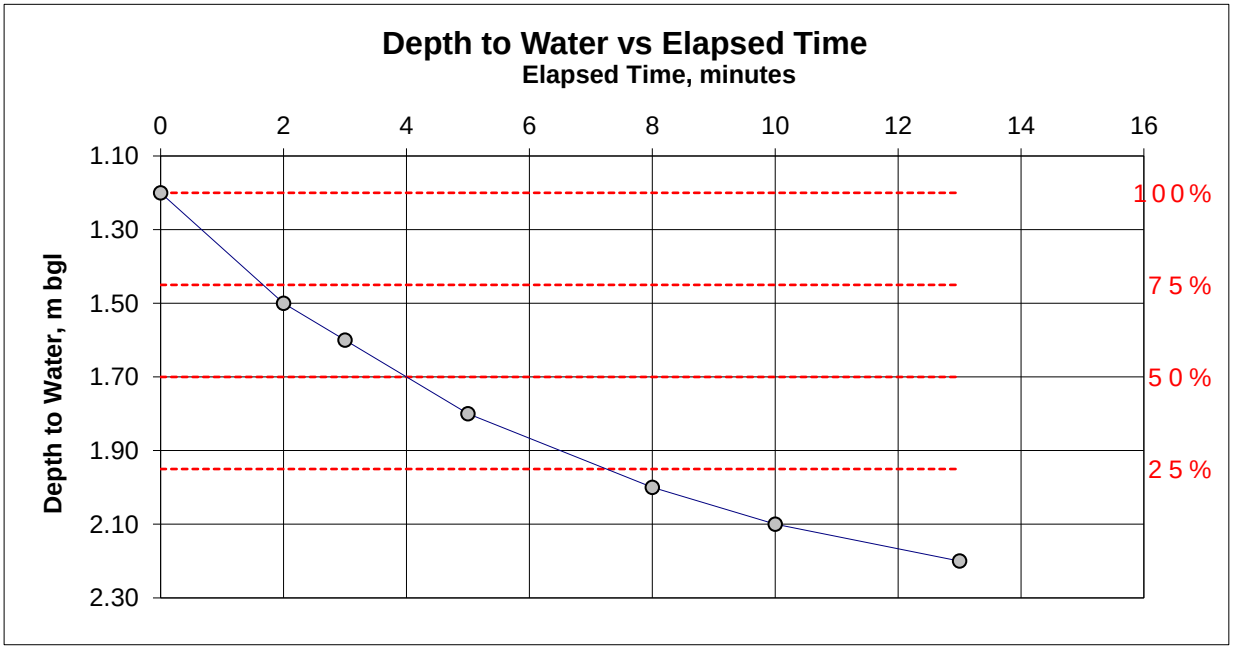
depth (m)	2.20
length (m)	2.30
width (m)	0.60

$$f = \frac{V_{p75-25}}{a_{s50} \times t_{p75-25}}$$

f = soil infiltration rate
V_{p75-25} = volume of water from 75% to 25% effective depth
a_{s50} = internal surface area at 50% effective depth
t_{p75-25} = time for the water level to fall from 75% to 25% effective dep

time at 75% effective depth (mins) 1.75
time at 25% effective depth (mins) 7.25
(from graph)

Calculated Soil Infiltration Rate = 4.9E-04 m/sec



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CONSULTING ENGINEERS

DRAFT

SOIL INFILTRATION TEST

Project:
Berry Hill Road, Adderbury

Project No:
M43979

Test Location: SA203 Test No: 2 Date: 26 Apr 2022

Water level during test

Time mins	Depth m bgl
0	1.200
1	1.500
2	1.700
4	1.900
7	2.100
10	2.200

Trial pit dimensions

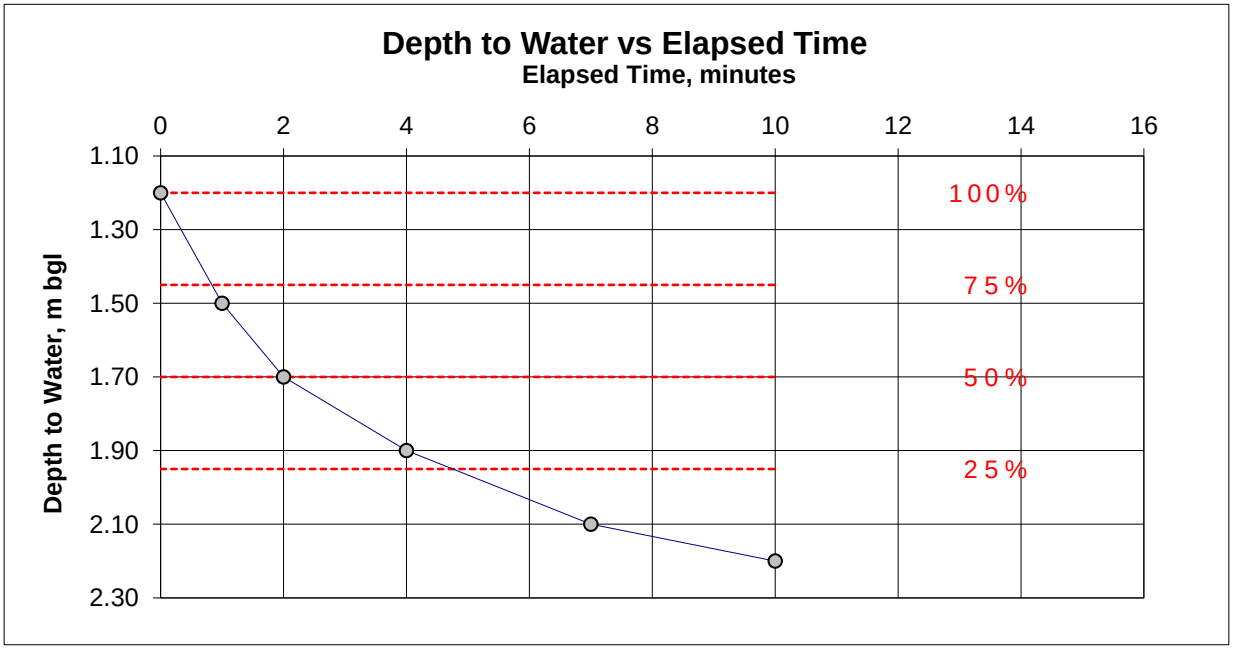
depth (m)	2.20
length (m)	2.30
width (m)	0.60

$$f = \frac{V_{p75-25}}{a_{s50} \times t_{p75-25}}$$

f = soil infiltration rate
V_{p75-25} = volume of water from 75% to 25% effective depth
a_{s50} = internal surface area at 50% effective depth
t_{p75-25} = time for the water level to fall from 75% to 25% effective dep

time at 75% effective depth (mins) 0.9
time at 25% effective depth (mins) 4.7
(from graph)

Calculated Soil Infiltration Rate = 7.1E-04 m/sec



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SOIL INFILTRATION TEST

Project: Berry Hill Road, Adderbury

Project No: M43979

Test Location: SA203 Test No: 3 Date: 27 Apr 2022

Water level during test

Time mins	Depth m bgl
0	1.200
1	1.500
2	1.700
5	1.900
7	2.000
9	2.100
11	2.180
13	2.200

Trial pit dimensions

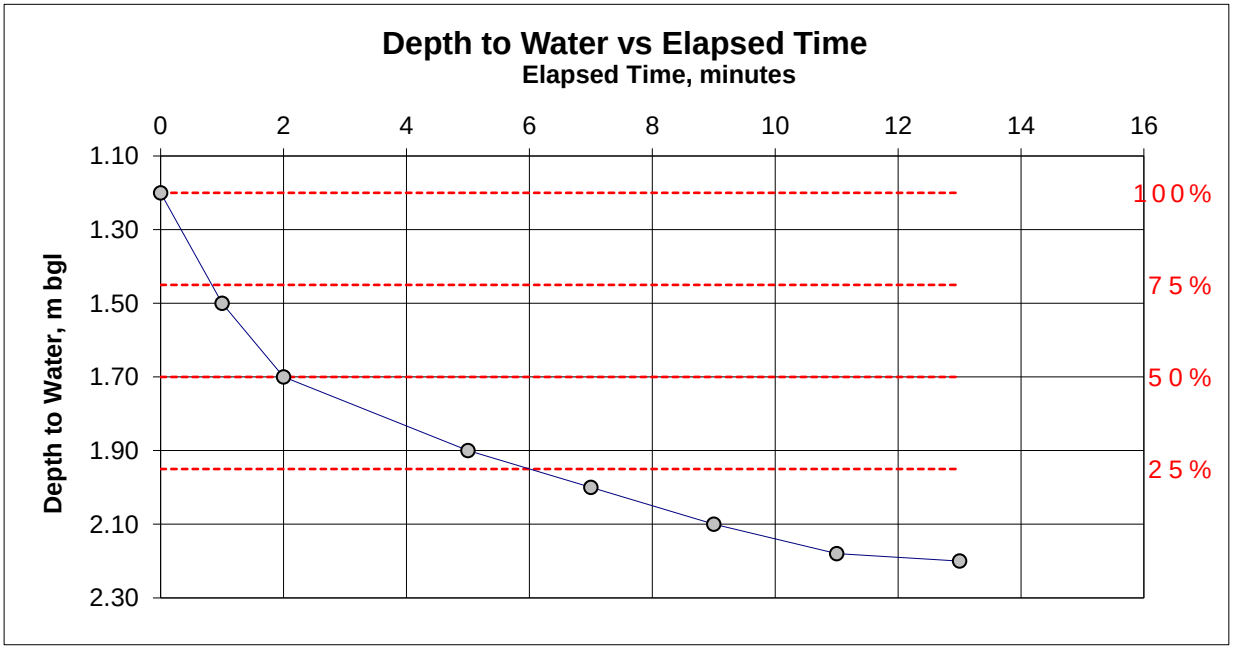
depth (m)	2.20
length (m)	2.30
width (m)	0.60

$$f = \frac{V_{p75-25}}{a_{s50} \times t_{p75-25}}$$

f = soil infiltration rate
V_{p75-25} = volume of water from 75% to 25% effective depth
a_{s50} = internal surface area at 50% effective depth
t_{p75-25} = time for the water level to fall from 75% to 25% effective dep

time at 75% effective depth (mins) 0.8
time at 25% effective depth (mins) 6
(from graph)

Calculated Soil Infiltration Rate = 5.2E-04 m/sec



SuDS Flows and Volumes - LLFA Technical Assessment Pro-forma

This form identifies the information required by Oxfordshire County Council LLFA to enable technical assessment of flows and volumes determined as part of drainage I SuDS *calculations.*

*Note : * means delete as appropriate; Numbers in brackets refer to accompanying notes.*

SITE DETAILS

1.1 Planning application reference

1.2 Site name

1.3 Total application site area (1 .....m² ha

1.4 Is the site located in a CDA or LFRZ Y/N

1.5 Is the site located in a SPZ Y/N

VOLUME AND FLOW DESIGN INPUTS

2.1 Site area which is positively drained by SuDS (2 m²

2.2 Impermeable area drained pre development (3 m²

2.3 Impermeable area drained post development (3) m²

2.4 Additional impermeable area (2.3 minus 2.2) m²

2.5 Predevelopment use (4 Greenfield / Brownfield / Mixed*

2.6 Method of discharge (5 Infiltration / waterbody / storm sewer/ combined sewer*

2.7 Infiltration rate (where applicable) .....m/hr

2.8 Influencing factors on infiltration

2.9 Depth to highest known ground water table.....mAOD

2.10 Coefficient of runoff (Cv) (6

2.11 Justification for Cv used

2.12 FEH rainfall data used (Note that FSR is no longer the preferred rainfall calculation method) Y/N

2.13 Will storage be subject to surcharge by elevated water levels in watercourse/ sewer Y/N

2.14 Invert level at outlet (invert level of final flow control) .....mAOD

2.15 Design level used for surcharge water level at point of discharge(14) .....mAOD

SuDS Flows and Volumes - LLFA Technical Assessment Pro-forma

CALCULATION OUTPUTS

Sections 3 and 4 refer to site where storage is provided by attenuation and I or partial infiltration. Where all flows are infiltrated to ground omit Sections 3 -5 and complete Section 6.

3.0 Defining rate of runoff from the site

3.2 Max. discharge for 1 in 1 year rainfall .....l/s/ha, ...l/s for the site

3.2 Max. discharge for Qmed rainfall .....l/s/ha, ...l/s for the site

3.3 Max. discharge for 1 in 30 year rainfall .....l/s/ha, ...l/s for the site

3.4 Max. discharge for 1 in 100 year rainfall .....l/s/ha, ...l/s for the site

3.5 Max. discharge for 1 in 100 year plus 40%CC .....l/s/ha, ...l/s for the site

4.0 Attenuation storage to manage peak runoff rates from the site

4.1 Storage - 1 in 1 year .....m^3 .....m^3/m^2 (of developed impermeable area)

4.2 Storage -1in 30 year (7 .....m^3 .....m^3/m^2

4.3 Storage -1in 100 year (8) .....m^3 .....m3/m2

4.4 Storage - 1 in 100 year plus 40%CC (9) .....m3 .....m3/m2

5.0 Controlling volume of runoff from the site

5.1 Pre development runoff volume(10) ..... m^3 for the site

5.2 Post development runoff volume (unmitigated) (10) ..... m^3 for the site

5.3 Volume to be controlled/does not leave site (5.2-5.1)..... m^3 for the site

5.4 Volume control provided by

Interception losses(11)	.....m3
Rain harvesting(12)	.....m3
Infiltration (even at very low rates)	.....m3
Separate area designated as long term storage(13)	.....m3

5.5 Total volume control (sum of inputs for 5.4) m3 (15)

6.0 Site storage volumes (full infiltration only)

6.1 Storage - 1in 30 year (7 .....m^3 .....m^3/m^2 (of developed impermeable area)

6.2 Storage - 1 in 100 year plus CC (9 .....m3 .....m3/m2

SuDS Flows and Volumes - LLFA Technical Assessment Pro-forma

Notes

1. All area with the proposed application site boundary to be included.
2. The site area which is positively drained includes all green areas which drain to the SuDS system and area of surface SuDS features. It excludes large open green spaces which do not drain to the SuDS system.
3. Impermeable area should be measured pre and post development. Impermeable surfaces includes, roofs, pavements, driveways and paths where runoff is conveyed to the drainage system.
4. Predevelopment use may impact on the allowable discharge rate. The LLFA will seek for reduction in flow rates to GF status in all instances. The design statement and drawings explain/ demonstrate how flows will be managed from the site.
5. Runoff may be discharge via one or a number of means.
6. Sewers for Adoption 6th Edition recommends a Cv of 100% when designing drainage for impermeable area (assumes no loss of runoff from impermeable surfaces) and 0% for permeable areas. Where lower Cv's are used the application should justify the selection of Cv.
7. Storage for the 1 in 30 year must be fully contained within the SuDS components. Note that standing water within SuDS components such as ponds, basins and swales is not classified as flooding. Storage should be calculated for the critical duration rainfall event.
8. Runoff generated from rainfall events up to the 1 in 100 year will not be allowed to leave the site in an uncontrolled way. Temporary flooding of specified areas to shallow depths (150-300mm) may be permitted in agreement with the LLFA.
9. Climate change is specified as 40% increase to rainfall intensity, unless otherwise agreed with the LLFA / EA.
10. To be determined using the 100 year return period 6 hour duration rainfall event.
11. Where Source Control is provided Interception losses will occur. An allowance of 5mm rainfall depth can be subtracted from the net inflow to the storage calculation where interception losses are demonstrated. The Applicant should demonstrate use of subcatchments and source control techniques.
12. Please refer to Rain harvesting BS for guidance on available storage.
13. Flow diverted to Long term storage areas should be infiltrated to the ground, or where this is not possible, discharged to the receiving water at slow flow rates (maximum 2 l/s/ha). LT storage would not be allowed to empty directly back into attenuation storage and would be expected to drain away over 5-10 days. Typically LT storage may be provided on multi-functional open space or sacrificial car parking areas.
14. Careful consideration should be used for calculations where flow control / storage is likely to be influenced by surcharged sewer or peak levels within a watercourse. Storm sewers are designed for pipe full capacity for 1 in 1 to 1 in 5 year return period. Beyond this, the pipe network will usually be in conditions of surcharge. Where information cannot be gathered from Thames Water, engineering judgement should be used to evaluate potential impact (using sensitivity analysis for example).
15. In controlling the volume of runoff the total volume from mitigation measures should be greater than or equal to the additional volume generated.

Design and Credit to: McCloy Consulting Ltd

APPENDIX D: INFORMATION REQUIRED FOR FULL APPLICATIONS

The following information should be provided for every drainage strategy submitted to the LLFA for consideration as part of any **Full application**.

Detail required for Full Applications	Provided?
Non-technical summary Non-technical summary of the proposed drainage strategy.	
Description of the type of development Description of the type of development proposed and where it will be located. Include whether it is new development, an extension to existing development or change of use etc. State the area of the development site itself, how much of the site is currently hard standing, the proposed area to be hard standing post-development, and any proposed areas of public open space. Note that in calculations proposed values of impermeable area should include a 10% allowance for Urban Creep, as taken from CIRIA C753 (version 6) paragraph 24.7.2.	
Location plan Location plan at an appropriate scale should be provided with the application, showing site outline and other adjacent land under the applicant's control.	
Topography plan Topographical survey of the site, including cross-sections of any adjacent watercourses for appropriate distance upstream and downstream of discharge point if appropriate.	
Layout Plan Proposed layout of the development, clearly identifying areas of impermeable surfacing, public open space, natural features such as watercourses, and allocated areas for surface water storage.	
Ground Investigation which should account for: • The presence of constraints that must be considered prior to planning infiltration SuDS; • The drainage potential of the ground; • Potential for ground instability when water is infiltrated; and • Potential for deterioration in groundwater quality as a result of infiltration.	
Assessment of all existing flooding risks to the site An assessment should be made of the risk to the site from all sources of flooding: • **Surface water –** the Environment Agency's Surface Water flood map can be used to assess the level of surface water flood risk to the site. If this map is disputed or considered inaccurate, the developer would need to model the expected flows across the site and use the results to determine the level of risk to the site. • **Groundwater** – typically a geotechnical report is required to cover this. • **Canals** – normally a letter from the Canal and River Trust stating that there is no risk, otherwise modelling of potential overtopping or breach. • **Reservoirs** –the Environment Agency inundation maps can be used to determine local level of risk. If the mapped inundation extent is disputed, the Environment Agency may require further modelling by developer. • **Sewer –** typically a letter or model report from the Water Company. • **Fluvial (main river or ordinary watercourse)** - the Environment Agency have published flood mapping for watercourses with a catchment greater than 3km^2. They can be contacted to obtain models or data associated with this mapping. The Environment Agency will advise	

Detail required for Full Applications	Provided?
on whether flood risk associated with Main River has been assessed appropriately. If only approximate modelling is available for an ordinary watercourse and it is felt to be inaccurate or is disputed, the developer will be required to model such flooding accurately to ensure their development is safe. In some small catchments, the Environment Agency's Surface Water flood map may be considered as a suitable proxy where there is no fluvial floodplain mapping.	
Explanation of how each of these flood risks will be fully mitigated This could require detailed modelling of some sources where significant risk is shown on high level datasets. It might mean applying the sequential approach by avoiding building on one part of the site where there is known flooding. Examples of mitigation measures (note: this list in not exhaustive): • Setting minimum floor levels of the development; • Utilising the sequential approach by locating more sensitive development out of the floodplain that affects the site; • Works to improve/divert infrastructure to eliminate risk; • Proposals to route flood flows through a development so they do not adversely affect the development; • Avoiding the use of below-ground development or basements adjacent to areas of flood risk unless they are designed for flood storage; • Setting residential development 150mm above the adjacent ground level.	
Detailed Drainage Plans Showing the layout of the proposed drainage network, the location of storage within the proposed development and how these relate to submitted calculations, including any chamber, pipe numbers, direction of flow, invert and cover levels, gradients diameters and dimensions that are referenced in Micro Drainage (or similar) reports. The methods of flow control must be detailed, as should non-conventional elements such as ponds, swales, permeable paving etc.	
Full explanation of the forms of SuDS used on the site Including reasons for the use of these features, what flood mitigation, water quality, environmental and social benefits they might achieve. If no SuDS methods are proposed then justification and evidence will need to be provided as to why they are not appropriate for the site. Modelling of the proposed SuDS system for the site, showing the behaviour of the site for the main rainfall events described below ensuring: • Typical operation of the system for low rainfall and first-flush events, with indication of how treatment of surface water will be achieved. • No above ground flooding for any conventional element of the system for the 3.3% (1in30) event. • No flooding from the system to property or critical/sensitive infrastructure for the 1% (1in100) plus climate change event.	
Explanation of how the drainage discharge hierarchy has been followed, providing evidence why any are inappropriate: • Firstly, to infiltration/soakaway • Secondly, to a watercourse or highway ditch (with permission) • Thirdly, to a surface water sewer or highway drain (with permission) • Lastly, to a combined sewer (with permission)	
Evidence that the site has an agreed point of discharge • If a significant portion of surface water is to be infiltrated on site, provide a BRE365 infiltration assessment to prove that this will work effectively.	

Detail required for Full Applications	Provided?
• If discharge is to an ordinary watercourse, evidence will need to be provided to ensure that the system can accept the proposed flows to an acceptable downstream point without increasing risk to others. If the watercourse is not within the boundary of the site, evidence will be required that the developer has a right to cross 3rd party land. The drainage calculations will need to include an analysis of the effects on the drainage system if the outfall is likely to be surcharged during flooding events. • If discharge is to a surface water or combined sewer, or highways ditch or drain, letter of confirmation from the Water Company or responsible body will be required, stating their required discharge maximum rates and confirmation that there is adequate capacity in the existing system. This information is generally provided by going through the relevant water company's "Pre-Planning Service". This is a formal process that all developers are expected to go through to inform their planning applications. There is normally an associated cost for this service and a minimum timescale of 15 working days to obtain a response. The advice is then usually valid for a one year period. This process will provide assurance that there are no capacity issues with third party assets, as we as the LLFA are not able to make this type of assumption on behalf of a Water and Sewerage provider. • Thames Water: https://my.thameswater.co.uk/dynamic/cps/rde/xchg/corp/hs.xsl/18710.htm • Anglian Water: http://www.anglianwater.co.uk/developers/pre-planning-service-.aspx • Severn Trent Water: https://www.stwater.co.uk/developers/application-forms-and-guidance-notes/ (> application forms > Development enquiry application form)	
Calculations of current runoff from site Calculated runoff rates for the existing site for the following rainfall events: QBAR, 3.3% (1in30), 1% (1in100) and, 1% (1in100) plus climate change. A range of rainfall events should be assessed and the critical duration rainfall event selected for each case. For greenfield sites, the methodology in the EA/Defra document "Preliminary Rainfall Runoff Management for Development (W5- 074/A/TR1)" should be used as the basis for calculations. For brownfield sites, clearly state the existing impermeable area and determine the capacity of any existing drainage system.	
Calculations of proposed discharge from site All hydraulic calculations must be produced using approved software and should model the full drainage system. Provide a supporting explanation of methodology. Please note that it is not considered appropriate to use the Modified Rational Method for design calculations other than initial design estimates (i.e. at Outline planning) or for very simple sites (i.e. Minor developments). Clearly state the proposed impermeable area of the development and how this compares to the existing site. In all calculations, proposed values of impermeable area should include a 10% allowance for Urban Creep, as taken from CIRIA C753 (version 6) paragraph 24.7.2. Use the calculation of current runoff to decide discharge rates on the following basis: • Greenfield sites should discharge at a maximum of the equivalent rate so that the site behaves like the original greenfield across the range of events. • Brownfield sites are strongly encouraged to discharge at the greenfield rate wherever possible. As a minimum, brownfield sites should reduce the discharge by 40% to account for the impacts of climate change. • Developers have the option to limit discharge for all events to the QBAR flow rate; or install a complex discharge control which reflects the original discharge or run-off rates from the site across the range of storm events. E.g. QBAR, 3.3% (1in30), 1% (1in100), 1% (1in100) plus climate change and provide Long Term Storage for all runoff volume greater than the greenfield volume (as set out in 'Calculation of Storage Volume' below). Using complex	

Detail required for Full Applications	Provided?
controls is more expensive but reduces the amount of attenuation storage required on the site and is probably worth doing on larger sites. • It is understood that some guidance recommends minimum discharge rates of 5 l/s, to minimise use of small orifice openings that could be at risk of blockages. However, appropriate consideration of filtration features to remove suspended matter and suitable maintenance regimes should minimise this risk and therefore the minimum limit of 5l/s does not apply in Oxfordshire. • Due to the additional datasets that have been added to the Flood Estimation Handbook (FEH) since design rainfall events were developed originally in the Flood Studies Report (FSR) (NERC, 1975), rainfall depths obtained using FEH show significant differences from those obtained from FSR in some parts of the country. Within Oxfordshire, rainfall depths are often greater using more up to date FEH datasets than those using FSR, therefore for various storm events, greater run-off is produced, and additional attenuation is likely to be required. As FEH rainfall data is more up to date, calculations should use FEH data for surface water drainage design, except where the critical storm duration is less than 60 minutes, as it is recognised that FEH data is less robust for short duration storms. If FEH rainfall data is not used as described above, then sensitivity testing to assess the implications of FEH2013 rainfall must be provided. This should demonstrate that the development proposals remain safe and do not increase flood risk to third parties. • Based on the existing and proposed discharge cases calculated as above, the applicant should now have detailed calculations of storage volume required on site for the 1% (1in100) plus climate change case. • When running calculations, the LLFA expect Cv values should be set to 0.95 for roofed areas and 0.9 for paved areas. Default software values should not be used for storage estimate calculations. It is the designer's responsibility to justify why Cv values of less than 0.9 are deemed appropriate	
Calculations of storage volume All hydraulic calculations must be produced using approved software. Calculations of storage volume that will be required on site for the 1% (1in100) plus climate change case, bearing in mind the controlled discharge rate. Where appropriate this should specify the volumes of both attenuation storage and Long-Term storage. See also note above about use of FEH rainfall data. Plans should be provided clearly identifying where this storage will be provided, and the water level within each element for the design storm events. Storage elements should be designed to empty sufficiently within 24 hours to be able to accommodate 80% of the 10% (1in10) storm runoff.	
Infiltration design Where any discharge to ground by infiltration is proposed, details of the infiltration system will be required. Full infiltration testing results are required along with a summary of the infiltration rate taken for each infiltration element. Infiltration elements should be designed to half empty within 24 hours to be able to accommodate further rainfall events.	
Residual Risk As well as the consideration of the modelled events above, there should be a qualitative examination of what would happen if any part of the system fails, demonstrate that flood water will have flow routes through the site without endangering property and where possible maintaining emergency access/egress routes.	
Landscaping Proposals, where relevant, for integrating the drainage system into the landscape or required publicly accessible open space and providing habitat and social enhancement.	

Designing for exceedance For events with a return-period in excess of 3.3% (1in30), surface flooding of open spaces such as landscaped areas or car parks is acceptable for short periods, but the layout and landscaping of the site should aim to route water away from any vulnerable property, and avoid creating hazards to	

Detail required for Full Applications	Provided?
access and egress routes (further guidance in CIRIA publication C635 Designing for exceedance in urban drainage - good practice). No flooding of property should occur as a result of a 1% (1in100) storm event (including an appropriate allowance for climate change). In principle, a well-designed surface water drainage system should ensure that there is little or no residual risk of property flooding occurring during events well in excess of the return-period for which the sewer system itself is designed. This is called designing for exceedance. The CIRIA publication `Designing for exceedance in urban drainage-good practice' can be accessed via the following link: http://www.ciria.com/suds/ciria_publications.htm. If the drainage system has been designed to allow flooding on site is during the 1% (1in100) storm event (including an appropriate allowance for climate change), provide a plan clearly identifying where this flooding will occur. Any flooding of the site should be assessed to ascertain if is safe for the sites users. The depth and rate of flow of the flood water should be compared to Table 4 of "Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose" May 2008 www.sciencesearch.defra.gov.uk/Document.aspx?Document=FD2321_7400_PR.pdf.	
Hydraulic calculations of the full drainage system All hydraulic calculations must be produced using approved software. All elements of the drainage system should be included in the model, with an explanation provided for any assumptions made in the modelling. 'Source control' modelling is not appropriate for a Full planning application. The model results should be provided for critical storm durations of each element of the system and should demonstrate that all the criteria above are met and that there is no surcharging of the system for the QBAR rainfall, no flooding of the surface of the site for the 3.3% (1in30) rainfall, and flooding only in safe areas for the 1% (1in100) plus climate change. See also note above about use of FEH rainfall data.	
Explanation of who will maintain and fund the maintenance of the proposed system over the lifetime of the development and evidence that access will be physically possible to carry out that maintenance, without entering others land. Ideally, SuDS features should be located within public space and a maintenance manual be produced to pass to the future maintainer. Full details will be required at Discharge of Conditions. **SuDS As Built and Maintenance Details** Prior to first occupation, a record of the installed SuDS and site wide drainage scheme shall be submitted to and approved in writing by the Local Planning Authority for deposit with the Lead Local Flood Authority Asset Register. The details shall include: (a) As built plans in both .pdf, CAD and .shp file format; (b) Photographs to document each key stage of the drainage system when installed on site; (c) Photographs to document the completed installation of the drainage structures on site; (d) The name and contact details of any appointed management company information.	

Phasing Explanation of how the site will adequately consider flood risk at all stages of the development. Avoiding interim developed phases that are unprotected. Phases can only progress if adequate flood mitigation measures are in place for that particular phase. This should avoid one small phase of the site being allowed to discharge at the calculated rate for a larger part of the entire development. Adequate flood risk measures for each individual phase should be able to stand alone, (until the entire site is completed), without themselves being at flood risk and without increasing flood risk for other parties.	

APPENDIX II – CALCULATIONS

ReFH2 Rural Runoff Peak Flows

Input

Return Period (Years)	100	Area (ha)	1.000
FEH Rainfall Version	2013	SAAR (mm)	649
Site Location	GB 446938 234809 SP 46938 34809	BFIHOST	0.841
Data Type	Point	FARL	0.000
Season	Winter	SPRHOST	0.000
Country	England/Wales/Northern Ireland	URBEXT (2000)	0.0000

Results

Return Period (Years)	Rural (l/s)	Urban (l/s)
User	2.1	2.1
Q1	0.6	0.6
Q2	0.7	0.7
Q5	1.0	1.0
Q10	1.2	1.2
Q30	1.6	1.6
Q50	1.8	1.8
Q75	2.0	2.0
Q100	2.1	2.1
Q200	2.6	2.6
Q1000	3.9	3.9

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	30	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	1.800
CV	0.840	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	500.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
HD02	0.013	4.00	108.443	1350	1.443
HD04	0.065	4.00	108.246	1350	1.446
HD06	0.021	4.00	107.803	1350	1.453
HD08	0.046	4.00	107.689	1350	1.539
HD10	0.051	4.00	107.338	1350	1.538
HD12	0.024	4.00	106.788	1350	1.538
HD14	0.023	4.00	108.213	1350	1.463
HD16	0.037	4.00	107.608	1350	1.458
HD18	0.025	4.00	106.644	1350	1.594
HD20	0.015	4.00	105.893	1350	1.543
HD22	0.027	4.00	105.372	1350	1.522
HD24	0.084	4.00	103.966	1350	1.516
BASIN			103.200	100	0.900

Links

Name	US Node	DS Node	Length (m)	US IL (m)	DS IL (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	HD02	HD04	17.256	107.000	106.800	86.3	225	4.15	139.9
1.001	HD04	HD06	44.675	106.800	106.350	99.3	225	4.85	139.9
1.002	HD06	HD08	11.370	106.350	106.225	91.0	225	4.96	139.9
1.003	HD08	HD10	34.804	106.150	105.800	99.4	300	5.40	136.0
1.004	HD10	HD12	53.659	105.800	105.250	97.6	300	5.91	131.0
1.005	HD12	HD18	21.123	105.250	105.050	105.6	300	6.26	127.9
2.000	HD14	HD16	20.232	106.750	106.150	33.7	225	4.15	139.9
2.001	HD16	HD18	32.073	106.150	105.125	31.3	225	4.38	139.9
1.006	HD18	HD20	19.381	105.050	104.350	27.7	300	6.35	127.1
1.007	HD20	HD22	10.260	104.350	103.850	20.5	300	6.40	126.7
1.008	HD22	HD24	28.485	103.850	102.450	20.3	300	6.51	125.7
1.009	HD24	BASIN	15.121	102.450	102.300	100.8	300	6.55	125.4

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	Σ Area (ha)	Σ Add Inflow (l/s)
1.000	1.408	56.0	5.5	0.013	0.0
1.001	1.312	52.2	33.1	0.078	0.0
1.002	1.371	54.5	42.0	0.099	0.0
1.003	1.576	111.4	59.9	0.145	0.0
1.004	1.592	112.5	77.9	0.196	0.0
1.005	1.529	108.1	85.4	0.220	0.0
2.000	2.260	89.9	9.8	0.023	0.0
2.001	2.347	93.3	25.5	0.060	0.0
1.006	2.999	212.0	117.7	0.305	0.0
1.007	3.486	246.4	123.1	0.320	0.0
1.008	3.501	247.4	132.4	0.347	0.0
1.009	1.566	110.7	164.1	0.431	0.0

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Detailed	Additional Storage (m³/ha)	0.0
Summer CV	0.840	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.750	Drain Down Time (mins)	1440	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	40	0	0
30	0	0	0				

Node BASIN Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	1.76400	Safety Factor	10.0	Invert Level (m)	102.000
Side Inf Coefficient (m/hr)	1.76400	Porosity	1.00	Time to half empty (mins)	159

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	148.5	148.5	1.200	511.1	511.1

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.83%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	HD02	10	107.031	0.031	2.3	0.0443	0.0000	OK
15 minute summer	HD04	10	106.878	0.078	13.6	0.1112	0.0000	OK
15 minute summer	HD06	10	106.442	0.092	17.1	0.1317	0.0000	OK
15 minute summer	HD08	10	106.247	0.097	24.7	0.1382	0.0000	OK
15 minute summer	HD10	10	105.910	0.110	33.4	0.1579	0.0000	OK
15 minute summer	HD12	11	105.378	0.128	36.3	0.1825	0.0000	OK
15 minute summer	HD14	10	106.782	0.032	4.0	0.0462	0.0000	OK
15 minute summer	HD16	10	106.201	0.051	10.4	0.0735	0.0000	OK
15 minute summer	HD18	11	105.154	0.104	49.5	0.1487	0.0000	OK
15 minute summer	HD20	11	104.454	0.104	52.1	0.1482	0.0000	OK
15 minute summer	HD22	11	103.947	0.097	56.3	0.1384	0.0000	OK
15 minute summer	HD24	11	102.641	0.191	68.6	0.2727	0.0000	OK
120 minute summer	BASIN	82	102.167	-0.133	31.6	29.0103	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	HD02	1.000	HD04	2.3	0.312	0.041	0.1330
15 minute summer	HD04	1.001	HD06	13.5	0.990	0.260	0.6120
15 minute summer	HD06	1.002	HD08	16.7	1.157	0.307	0.1647
15 minute summer	HD08	1.003	HD10	24.5	1.137	0.219	0.7494
15 minute summer	HD10	1.004	HD12	32.3	1.262	0.287	1.3842
15 minute summer	HD12	1.005	HD18	36.6	1.459	0.338	0.5299
15 minute summer	HD14	2.000	HD16	4.0	0.797	0.044	0.1040
15 minute summer	HD16	2.001	HD18	10.3	1.541	0.111	0.2152
15 minute summer	HD18	1.006	HD20	50.0	2.313	0.236	0.4187
15 minute summer	HD20	1.007	HD22	52.4	2.547	0.213	0.2112
15 minute summer	HD22	1.008	HD24	56.5	1.696	0.228	0.9517
15 minute summer	HD24	1.009	BASIN	69.2	1.567	0.626	0.6677
120 minute summer	BASIN	Infiltration		9.1			

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.83%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	HD02	10	107.048	0.048	5.7	0.0690	0.0000	OK
15 minute summer	HD04	10	106.934	0.134	34.3	0.1920	0.0000	OK
15 minute summer	HD06	10	106.520	0.170	43.6	0.2426	0.0000	OK
15 minute summer	HD08	10	106.319	0.169	63.1	0.2415	0.0000	OK
15 minute summer	HD10	10	105.999	0.199	85.1	0.2843	0.0000	OK
15 minute summer	HD12	11	105.483	0.233	93.8	0.3340	0.0000	OK
15 minute summer	HD14	10	106.801	0.051	10.1	0.0726	0.0000	OK
15 minute summer	HD16	9	106.232	0.082	26.4	0.1174	0.0000	OK
15 minute summer	HD18	10	105.234	0.184	127.4	0.2627	0.0000	OK
15 minute summer	HD20	11	104.536	0.186	132.3	0.2657	0.0000	OK
15 minute summer	HD22	11	104.033	0.183	143.0	0.2613	0.0000	OK
15 minute summer	HD24	11	103.136	0.686	176.4	0.9820	0.0000	SURCHARGED
60 minute summer	BASIN	57	102.407	0.107	111.6	85.5470	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	HD02	1.000	HD04	5.7	0.378	0.102	0.2666
15 minute summer	HD04	1.001	HD06	34.4	1.207	0.659	1.2684
15 minute summer	HD06	1.002	HD08	42.9	1.430	0.788	0.3410
15 minute summer	HD08	1.003	HD10	62.7	1.387	0.563	1.5721
15 minute summer	HD10	1.004	HD12	83.2	1.542	0.739	2.8873
15 minute summer	HD12	1.005	HD18	93.4	1.792	0.864	1.0978
15 minute summer	HD14	2.000	HD16	10.1	1.040	0.112	0.1989
15 minute summer	HD16	2.001	HD18	26.4	1.893	0.283	0.5117
15 minute summer	HD18	1.006	HD20	126.9	2.793	0.599	0.8811
15 minute summer	HD20	1.007	HD22	133.2	3.023	0.541	0.4651
15 minute summer	HD22	1.008	HD24	144.6	2.256	0.584	1.6423
15 minute summer	HD24	1.009	BASIN	177.5	2.521	1.604	1.0540
60 minute summer	BASIN	Infiltration		12.8			

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.83%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	HD02	11	107.612	0.612	12.9	0.8760	0.0000	SURCHARGED
15 minute summer	HD04	11	107.624	0.824	59.2	1.1785	0.0000	SURCHARGED
15 minute summer	HD06	11	107.272	0.922	63.6	1.3191	0.0000	SURCHARGED
15 minute summer	HD08	11	107.105	0.955	99.0	1.3666	0.0000	SURCHARGED
15 minute summer	HD10	11	106.890	1.090	131.3	1.5595	0.0000	SURCHARGED
15 minute summer	HD12	11	106.292	1.042	127.1	1.4912	0.0000	SURCHARGED
15 minute summer	HD14	10	106.819	0.069	18.3	0.0981	0.0000	OK
15 minute summer	HD16	11	106.269	0.119	47.7	0.1700	0.0000	OK
15 minute summer	HD18	11	105.952	0.902	187.3	1.2908	0.0000	SURCHARGED
15 minute summer	HD20	11	105.306	0.956	190.4	1.3680	0.0000	SURCHARGED
15 minute summer	HD22	11	104.853	1.003	198.5	1.4350	0.0000	SURCHARGED
15 minute summer	HD24	11	103.710	1.260	252.6	1.8034	0.0000	FLOOD RISK
120 minute summer	BASIN	98	102.688	0.388	131.8	173.7317	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	HD02	1.000	HD04	14.8	0.398	0.265	0.6863
15 minute summer	HD04	1.001	HD06	46.9	1.278	0.900	1.7768
15 minute summer	HD06	1.002	HD08	62.6	1.574	1.147	0.4522
15 minute summer	HD08	1.003	HD10	90.8	1.387	0.815	2.4509
15 minute summer	HD10	1.004	HD12	108.7	1.544	0.966	3.7786
15 minute summer	HD12	1.005	HD18	122.8	1.873	1.136	1.4875
15 minute summer	HD14	2.000	HD16	18.3	1.222	0.204	0.3140
15 minute summer	HD16	2.001	HD18	45.9	1.973	0.492	0.9785
15 minute summer	HD18	1.006	HD20	178.5	2.756	0.842	1.3648
15 minute summer	HD20	1.007	HD22	185.7	3.065	0.754	0.7225
15 minute summer	HD22	1.008	HD24	201.4	2.860	0.814	2.0059
15 minute summer	HD24	1.009	BASIN	253.0	3.594	2.287	1.0540
120 minute summer	BASIN	Infiltration		17.1			

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	10	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	1.800
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	500.0		

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	RE	IC	12.000	0.600	107.300	107.150	0.150	80.0	100	4.22	109.8
1.002	IC	CP	12.000	0.600	107.150	107.000	0.150	80.0	100	4.61	109.8
1.003	CP	SA 20	8.000	0.600	106.950	106.850	0.100	80.0	150	4.09	109.8

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.861	6.8	1.6	0.350	0.500	0.004	0.0	33	0.705
1.002	0.861	6.8	3.2	0.500	0.650	0.008	0.0	48	0.846
1.003	1.125	19.9	5.2	0.650	0.750	0.013	0.0	52	0.944

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
RE	446967.787	234860.263	107.750	0.450	300		0	1.000	107.300	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
IC	446975.932	234849.976	107.750	0.600	525	1	1.000	107.150	100
						0	1.002	107.150	100
CP	446957.628	234848.872	107.750	0.800	525	1	1.002	107.000	100
						0	1.003	106.950	150
SA 20	446953.398	234845.328	107.750	0.900	100	1	1.003	106.850	150

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Detailed	Additional Storage (m³/ha)	0.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	1440	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	10	0	0	0

Node SA 20 Lined Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.46800	Invert Level (m)	106.250	Pit Length (m)	2.400
Side Inf Coefficient (m/hr)	0.46800	Time to half empty (mins)	40	Depth (m)	
Safety Factor	2.0	Ring Diameter (m)	1.500	Inf Depth (m)	1.200
Porosity	0.30	Pit Width (m)	2.400	Number Required	1

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	RE	10	107.323	0.023	0.8	0.0016	0.0000	OK
15 minute summer	IC	10	107.184	0.034	1.6	0.0073	0.0000	OK
15 minute summer	CP	10	106.988	0.038	2.6	0.0082	0.0000	OK
30 minute summer	SA 20	25	106.504	-0.346	2.2	0.7537	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	RE	1.000	IC	0.8	0.441	0.118	0.0221
15 minute summer	IC	1.002	CP	1.6	0.691	0.231	0.0272
15 minute summer	CP	1.003	SA 20	2.5	0.754	0.128	0.0269
30 minute summer	SA 20	Infiltration		0.5			

Results for 10 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	RE	10	107.333	0.033	1.6	0.0023	0.0000	OK
15 minute summer	IC	10	107.200	0.050	3.2	0.0108	0.0000	OK
15 minute summer	CP	10	107.005	0.055	5.2	0.0119	0.0000	OK
30 minute summer	SA 20	26	106.835	-0.015	4.3	1.7341	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	RE	1.000	IC	1.6	0.525	0.236	0.0370
15 minute summer	IC	1.002	CP	3.2	0.829	0.467	0.0457
15 minute summer	CP	1.003	SA 20	5.1	0.910	0.258	0.0451
30 minute summer	SA 20	Infiltration		0.7			

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	10	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	1.800
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	500.0		

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	RE	IC	12.000	0.600	107.300	107.150	0.150	80.0	100	4.22	109.8
1.002	IC	CP	12.000	0.600	107.150	107.000	0.150	80.0	100	4.61	109.8
1.003	CP	SA 20	8.000	0.600	106.950	106.850	0.100	80.0	150	4.09	109.8

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.861	6.8	1.6	0.350	0.500	0.004	0.0	33	0.705
1.002	0.861	6.8	3.2	0.500	0.650	0.008	0.0	48	0.846
1.003	1.125	19.9	5.2	0.650	0.750	0.013	0.0	52	0.944

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
RE	446967.787	234860.263	107.750	0.450	300		0	1.000	107.300	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
IC	446975.932	234849.976	107.750	0.600	525	1	1.000	107.150	100
						0	1.002	107.150	100
CP	446957.628	234848.872	107.750	0.800	525	1	1.002	107.000	100
						0	1.003	106.950	150
SA 20	446953.398	234845.328	107.750	0.900	100	1	1.003	106.850	150

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Detailed	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	1440	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node SA 20 Lined Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.46800	Invert Level (m)	106.250	Pit Length (m)	2.400
Side Inf Coefficient (m/hr)	0.46800	Time to half empty (mins)	40	Depth (m)	
Safety Factor	2.0	Ring Diameter (m)	1.500	Inf Depth (m)	1.200
Porosity	0.30	Pit Width (m)	2.400	Number Required	1

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.40%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	RE	47	107.530	0.230	2.4	0.0571	0.0000	FLOOD RISK
60 minute summer	IC	47	107.530	0.379	4.8	0.1328	0.0000	FLOOD RISK
60 minute summer	CP	48	107.527	0.577	7.8	0.1968	0.0000	FLOOD RISK
60 minute summer	SA 20	48	107.527	0.677	6.3	3.7000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
60 minute summer	RE	1.000	IC	2.4	0.582	0.351	0.0939
60 minute summer	IC	1.002	CP	4.8	0.890	0.715	0.0939
60 minute summer	CP	1.003	SA 20	6.3	0.913	0.316	0.1408
60 minute summer	SA 20	Infiltration		1.1			

Design Settings

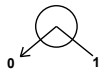
Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	10	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	1.800
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	500.0		

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	RE	IC 01	12.000	0.600	105.450	105.300	0.150	80.0	100	4.22	109.8
1.001	IC 01	IC 02	12.000	0.600	105.300	105.150	0.150	80.0	100	4.43	109.8
1.002	IC 02	CP	12.000	0.600	105.100	104.950	0.150	80.0	150	4.61	109.8
1.003	CP	SA 31	4.800	0.600	104.950	104.900	0.050	96.0	150	4.09	109.8

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.861	6.8	1.6	0.300	0.450	0.004	0.0	33	0.705
1.001	0.861	6.8	3.2	0.450	0.600	0.008	0.0	48	0.846
1.002	1.125	19.9	4.8	0.600	0.700	0.012	0.0	50	0.927
1.003	1.026	18.1	7.9	0.700	0.750	0.020	0.0	69	0.992

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
RE	446967.787	234860.263	105.850	0.400	300				
						0	1.000	105.450	100
IC 01	446975.932	234849.976	105.850	0.550	525	1	1.000	105.300	100
									
						0	1.001	105.300	100
IC 02	446966.238	234841.923	105.850	0.750	525	1	1.001	105.150	100
									
						0	1.002	105.100	150
CP	446957.628	234848.872	105.800	0.850	525	1	1.002	104.950	150
									
						0	1.003	104.950	150
SA 31	446953.398	234845.328	105.800	0.900	100	1	1.003	104.900	150
									

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Detailed	Additional Storage (m³/ha)	0.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	1440	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	10	0	0	0

Node SA 31 Lined Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.50400	Invert Level (m)	103.800	Pit Length (m)	2.400
Side Inf Coefficient (m/hr)	0.50400	Time to half empty (mins)	43	Depth (m)	
Safety Factor	2.0	Ring Diameter (m)	1.500	Inf Depth (m)	1.700
Porosity	0.30	Pit Width (m)	2.400	Number Required	1

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	RE	10	105.473	0.023	0.8	0.0016	0.0000	OK
15 minute summer	IC 01	10	105.334	0.034	1.6	0.0073	0.0000	OK
15 minute summer	IC 02	10	105.135	0.035	2.4	0.0075	0.0000	OK
15 minute summer	CP	10	105.002	0.052	4.0	0.0112	0.0000	OK
120 minute summer	SA 31	76	104.226	-0.674	1.8	1.2617	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	RE	1.000	IC 01	0.8	0.441	0.118	0.0221
15 minute summer	IC 01	1.001	IC 02	1.6	0.691	0.231	0.0272
15 minute summer	IC 02	1.002	CP	2.3	0.559	0.118	0.0507
15 minute summer	CP	1.003	SA 31	4.0	0.783	0.220	0.0244
120 minute summer	SA 31	Infiltration		0.7			

Results for 10 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	RE	10	105.483	0.033	1.6	0.0023	0.0000	OK
15 minute summer	IC 01	10	105.350	0.050	3.2	0.0108	0.0000	OK
15 minute summer	IC 02	10	105.150	0.050	4.8	0.0107	0.0000	OK
15 minute summer	CP	10	105.027	0.077	7.9	0.0166	0.0000	OK
30 minute summer	SA 31	27	104.744	-0.156	6.7	2.7985	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	RE	1.000	IC 01	1.6	0.525	0.236	0.0370
15 minute summer	IC 01	1.001	IC 02	3.2	0.829	0.467	0.0457
15 minute summer	IC 02	1.002	CP	4.7	0.671	0.238	0.0849
15 minute summer	CP	1.003	SA 31	7.9	0.928	0.433	0.0406
30 minute summer	SA 31	Infiltration		1.0			

Design Settings

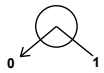
Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	10	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	1.800
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	500.0		

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	RE	IC 01	12.000	0.600	105.450	105.300	0.150	80.0	100	4.22	109.8
1.001	IC 01	IC 02	12.000	0.600	105.300	105.150	0.150	80.0	100	4.43	109.8
1.002	IC 02	CP	12.000	0.600	105.100	104.950	0.150	80.0	150	4.61	109.8
1.003	CP	SA 31	4.800	0.600	104.950	104.900	0.050	96.0	150	4.09	109.8

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.861	6.8	1.6	0.300	0.450	0.004	0.0	33	0.705
1.001	0.861	6.8	3.2	0.450	0.600	0.008	0.0	48	0.846
1.002	1.125	19.9	4.8	0.600	0.700	0.012	0.0	50	0.927
1.003	1.026	18.1	7.9	0.700	0.750	0.020	0.0	69	0.992

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
RE	446967.787	234860.263	105.850	0.400	300				
						0	1.000	105.450	100
IC 01	446975.932	234849.976	105.850	0.550	525	1	1.000	105.300	100
									
						0	1.001	105.300	100
IC 02	446966.238	234841.923	105.850	0.750	525	1	1.001	105.150	100
									
						0	1.002	105.100	150
CP	446957.628	234848.872	105.800	0.850	525	1	1.002	104.950	150
									
						0	1.003	104.950	150
SA 31	446953.398	234845.328	105.800	0.900	100	1	1.003	104.900	150
									

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Detailed	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	1440	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node SA 31 Lined Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.50400	Invert Level (m)	103.800	Pit Length (m)	2.400
Side Inf Coefficient (m/hr)	0.50400	Time to half empty (mins)	43	Depth (m)	
Safety Factor	2.0	Ring Diameter (m)	1.500	Inf Depth (m)	1.700
Porosity	0.30	Pit Width (m)	2.400	Number Required	1

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	RE	49	105.779	0.329	2.4	0.0893	0.0000	FLOOD RISK
60 minute summer	IC 01	49	105.779	0.479	4.8	0.1733	0.0000	FLOOD RISK
60 minute summer	IC 02	48	105.777	0.677	7.1	0.2187	0.0000	FLOOD RISK
60 minute summer	CP	48	105.777	0.827	11.2	0.3349	0.0000	FLOOD RISK
60 minute summer	SA 31	48	105.776	0.876	9.5	5.5365	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
60 minute summer	RE	1.000	IC 01	2.4	0.568	0.351	0.0939
60 minute summer	IC 01	1.001	IC 02	4.7	0.904	0.691	0.0939
60 minute summer	IC 02	1.002	CP	6.6	0.704	0.330	0.2113
60 minute summer	CP	1.003	SA 31	9.5	0.969	0.527	0.0845
60 minute summer	SA 31	Infiltration		1.5			

Design Settings

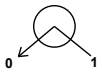
Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	10	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	1.800
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	500.0		

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	RE	IC 01	12.000	0.600	105.250	105.100	0.150	80.0	100	4.22	109.8
1.001	IC 01	IC 02	12.000	0.600	105.100	104.950	0.150	80.0	100	4.43	109.8
1.002	IC 02	CP	12.000	0.600	104.900	104.750	0.150	80.0	150	4.61	109.8
1.003	CP	SA 31	4.800	0.600	104.750	104.700	0.050	96.0	150	4.09	109.8

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.861	6.8	1.6	0.300	0.450	0.004	0.0	33	0.705
1.001	0.861	6.8	3.2	0.450	0.600	0.008	0.0	48	0.846
1.002	1.125	19.9	4.8	0.600	0.700	0.012	0.0	50	0.927
1.003	1.026	18.1	7.9	0.700	0.750	0.020	0.0	69	0.992

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
RE	446967.787	234860.263	105.650	0.400	300				
						0	1.000	105.250	100
IC 01	446975.932	234849.976	105.650	0.550	525	1	1.000	105.100	100
									
						0	1.001	105.100	100
IC 02	446966.238	234841.923	105.650	0.750	525	1	1.001	104.950	100
									
						0	1.002	104.900	150
CP	446957.628	234848.872	105.600	0.850	525	1	1.002	104.750	150
									
						0	1.003	104.750	150
SA 31	446953.398	234845.328	105.600	0.900	100	1	1.003	104.700	150
									

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Detailed	Additional Storage (m³/ha)	0.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	1440	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	10	0	0	0

Node SA 31 Lined Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.53280	Invert Level (m)	103.600	Pit Length (m)	2.400
Side Inf Coefficient (m/hr)	0.53280	Time to half empty (mins)	41	Depth (m)	
Safety Factor	2.0	Ring Diameter (m)	1.500	Inf Depth (m)	1.700
Porosity	0.30	Pit Width (m)	2.400	Number Required	1

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	RE	10	105.273	0.023	0.8	0.0016	0.0000	OK
15 minute summer	IC 01	10	105.134	0.034	1.6	0.0073	0.0000	OK
15 minute summer	IC 02	10	104.935	0.035	2.4	0.0075	0.0000	OK
15 minute summer	CP	10	104.802	0.052	4.0	0.0112	0.0000	OK
30 minute summer	SA 31	25	104.011	-0.689	3.4	1.2180	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	RE	1.000	IC 01	0.8	0.441	0.118	0.0221
15 minute summer	IC 01	1.001	IC 02	1.6	0.691	0.231	0.0272
15 minute summer	IC 02	1.002	CP	2.3	0.559	0.118	0.0507
15 minute summer	CP	1.003	SA 31	4.0	0.783	0.220	0.0244
30 minute summer	SA 31	Infiltration		0.7			

Results for 10 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	RE	10	105.283	0.033	1.6	0.0023	0.0000	OK
15 minute summer	IC 01	10	105.150	0.050	3.2	0.0108	0.0000	OK
15 minute summer	IC 02	10	104.950	0.050	4.8	0.0107	0.0000	OK
15 minute summer	CP	10	104.827	0.077	7.9	0.0166	0.0000	OK
30 minute summer	SA 31	27	104.529	-0.171	6.7	2.7532	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	RE	1.000	IC 01	1.6	0.525	0.236	0.0370
15 minute summer	IC 01	1.001	IC 02	3.2	0.829	0.467	0.0457
15 minute summer	IC 02	1.002	CP	4.7	0.671	0.238	0.0849
15 minute summer	CP	1.003	SA 31	7.9	0.928	0.433	0.0406
30 minute summer	SA 31	Infiltration		1.1			

Design Settings

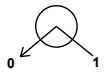
Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	10	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	1.800
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	500.0		

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	RE	IC 01	12.000	0.600	105.250	105.100	0.150	80.0	100	4.22	109.8
1.001	IC 01	IC 02	12.000	0.600	105.100	104.950	0.150	80.0	100	4.43	109.8
1.002	IC 02	CP	12.000	0.600	104.900	104.750	0.150	80.0	150	4.61	109.8
1.003	CP	SA 31	4.800	0.600	104.750	104.700	0.050	96.0	150	4.09	109.8

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.861	6.8	1.6	0.300	0.450	0.004	0.0	33	0.705
1.001	0.861	6.8	3.2	0.450	0.600	0.008	0.0	48	0.846
1.002	1.125	19.9	4.8	0.600	0.700	0.012	0.0	50	0.927
1.003	1.026	18.1	7.9	0.700	0.750	0.020	0.0	69	0.992

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
RE	446967.787	234860.263	105.650	0.400	300				
						0	1.000	105.250	100
IC 01	446975.932	234849.976	105.650	0.550	525	1	1.000	105.100	100
									
						0	1.001	105.100	100
IC 02	446966.238	234841.923	105.650	0.750	525	1	1.001	104.950	100
									
						0	1.002	104.900	150
CP	446957.628	234848.872	105.600	0.850	525	1	1.002	104.750	150
									
						0	1.003	104.750	150
SA 31	446953.398	234845.328	105.600	0.900	100	1	1.003	104.700	150
									

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Detailed	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	1440	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node SA 31 Lined Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.53280	Invert Level (m)	103.600	Pit Length (m)	2.400
Side Inf Coefficient (m/hr)	0.53280	Time to half empty (mins)	41	Depth (m)	
Safety Factor	2.0	Ring Diameter (m)	1.500	Inf Depth (m)	1.700
Porosity	0.30	Pit Width (m)	2.400	Number Required	1

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	RE	49	105.555	0.305	2.4	0.0828	0.0000	FLOOD RISK
60 minute summer	IC 01	48	105.555	0.455	4.8	0.1647	0.0000	FLOOD RISK
60 minute summer	IC 02	48	105.554	0.654	7.1	0.2112	0.0000	FLOOD RISK
60 minute summer	CP	48	105.554	0.804	11.2	0.3255	0.0000	FLOOD RISK
60 minute summer	SA 31	48	105.553	0.853	9.5	5.4951	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
60 minute summer	RE	1.000	IC 01	2.4	0.573	0.351	0.0939
60 minute summer	IC 01	1.001	IC 02	4.7	0.904	0.691	0.0939
60 minute summer	IC 02	1.002	CP	6.6	0.704	0.330	0.2113
60 minute summer	CP	1.003	SA 31	9.5	0.969	0.527	0.0845
60 minute summer	SA 31	Infiltration		1.6			

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	10	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	1.800
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	500.0		

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.003	CP	PP 22-31	8.000	0.600	105.400	105.300	0.100	80.0	100	4.09	109.8

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.003	0.861	6.8	2.0	0.500	0.550	0.005	0.0	37	0.748

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
CP	446957.628	234848.872	106.000	0.600	525	 0	1.003	105.400	100
PP 22-31	446953.398	234845.328	105.950	0.650	100	 1	1.003	105.300	100

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Detailed	Additional Storage (m³/ha)	0.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	1440	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	40	0	0
10	0	0	0				

Node PP 22-31 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.50400	Invert Level (m)	105.300	Slope (1:X)	20.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	13	Depth (m)	
Safety Factor	2.0	Width (m)	7.600	Inf Depth (m)	0.540
Porosity	0.30	Length (m)	50.000		

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	CP	21	105.540	0.140	0.9	0.0303	0.0000	SURCHARGED
30 minute summer	PP 22-31	21	105.540	0.240	5.6	1.3349	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	CP	1.003	PP 22-31	0.5	0.073	0.068	0.0626
30 minute summer	PP 22-31	Infiltration		2.6			

Results for 10 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	CP	22	105.674	0.274	1.7	0.0592	0.0000	SURCHARGED
30 minute summer	PP 22-31	22	105.674	0.373	11.4	3.2177	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	CP	1.003	PP 22-31	1.1	0.142	0.164	0.0626
30 minute summer	PP 22-31	Infiltration		4.0			

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	CP	23	105.947	0.547	4.1	0.1181	0.0000	FLOOD RISK
30 minute summer	PP 22-31	23	105.945	0.645	27.7	9.5392	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	CP	1.003	PP 22-31	3.1	0.397	0.459	0.0626
30 minute summer	PP 22-31	Infiltration		6.9			

APPENDIX III – DRAWINGS

KEY

- ACCESS TO DWELLINGS
- DENOTES LOCATION OF AFFORDABLE RENTED DWELLINGS
- DENOTES LOCATION OF AFFORDABLE SHARED OWNERSHIP DWELLINGS
- GARDEN GATE ACCESS
- V — VISITOR PARKING LOCATION

Crofton
Berry Cottage
Three Spires
Shaldon
Last House
Track
Path (um)
BERRY HILL ROAD
BERRY HILL ROAD (30MPH)
NEW 3M WIDE SHARED CYCLE/PED LINK
2.4x120M
R6.0M
1B x4
3B
A3+
A2+
EATN V2
EATN V1 (CT)
HANW
HANW (CT)
HENL
HENL (CT)
LAVI
FAIR
STR
BOUR
HAL
SALES OFFICE
V
SHED

N W E S

0 5 10 20m

BERRY HILL ROAD, ADDERBURY - **DRAFT SITE LAYOUT**

Pegasus Design

PLANNING | DESIGN | ENVIRONMENT | ECONOMICS | WWW.PEGASUSGROUP.CO.UK | TEAM/DRAWN BY: CU/ET | APPROVED BY P.M: ET | DATE: 31/08/22 | SCALE: 1:500 @A1 | DRWG: **P21-2984**_01 REV: V | CLIENT: **HAYFIED HOMES** |

GENERAL NOTES

- This drawing is to be read in conjunction with relevant architectural and engineering drawings.
- Any discrepancies between the details shown and actual on site conditions to be reported immediately to the engineer prior to commencement of works.
- This drawing is not intended to show details of ground conditions or ground contaminants. Each area of ground relied upon to support any structure depicted (including drainage) must be investigated by the Contractor any areas of formation for said structures which do not accord with the anticipated conditions as described in the site investigation report are to be immediately notified to the Engineer, where applicable. Any suspect fluid ground or ground contaminants on or within the ground should be further investigated by a suitable expert. Any earthworks shown indicate typical slopes for guidance only and should be investigated further by a suitable geotechnical expert.
- Where existing trees are shown to be retained they should be subject to a full Arboricultural inspection for safety. All trees are to be planted so as to ensure they are a minimum of 5 metres from buildings and 3 metres from drainage and services, where applicable. A foundation is to be provided to accommodate the proposed tree planting, where applicable.

DRAINAGE STRATEGY NOTES

- Proposed drainage, SuDS features and levels subject to detailed design.
- Sewer easements shown are indicative and subject to change following technical review from relevant drainage and / or highway authorities.
- Proposed finished floor levels subject to change by 300mm±.
- Drainage strategy illustrated is based on the 'Preliminary SW Drainage Layout' (30394/1) by 'IronsideFarrar' dated Octover 2019 with minor amendments to suit the current planning layout.
- Proposed Foul Water outfall is subject to third party land owners permission. S98 Sewer Requistion may be required.
- All proposed soakaways, including permeable paving, will require in-situ percolation testing to BRE 365 prior to detailed design to confirm indicative soakaway designs.

Drainage Strategy Legend

General

- Site Boundary
- FFL 00.00 — Proposed Finshed Floor Level
- Sewer Easement
- Flood Exceedance Routing Arrow
- SA201 — Soakaway Test Location & Reference

Proposed Adoptable Drainage

- S38 Highway Drainage
- HD02 CL:000.00 IL: 000.00 — S38 Highway Drainage MH Reference
- S38 Highway Gully & Connection
- S104 FW Sewer & MH
- F01 CL:000.00 IL: 000.00 — S104 FW MH Reference

Proposed Private Drainage

- Permeable Paving with Porous Sub-Base
- Proposed Plot Soakaway
- SW Plot Drainage
- FW Plot Drainage

Existing Drainage

- Existing FW Sewer & MH
- EXMH-0000 CL: 000.00 IL: 000.00 — Existing FW MH Reference

INFILTRATION BASIN

TOP OF BANKS:	103.20
MAX. WATER LEVEL:	102.69
BED LEVEL:	102.00

1.2m DEEP / 1:4 BANKS

UPTO 248m³ STORAGE VOLUME

DESIGN INFILTRATION RATE = 1.764 m/hr (SA203)

PLOTS 29, 33 & SHARED DRIVEWAY TO DRAIN TO COMMIUNAL SOAKAWAY

FOUL WATER OUTFALL

PROPOSED MANHOLE F17 AND 150Ø CONNECTION ON LINE OF EXISTING 375Ø THAMES WATER FW SEWER.

PROPOSED SEWER / MANHOLE OUTSIDE SITE BOUNDARY AND IS SUBJECT TO THIRD PARTY LAND OWNERS APPROVAL, SEWER REQUISITION MAY BE REQUIRED.

EXMH-0902 CL: 96.02 IL: 94.53

EXMH-0903 CL: 96.33 IL: 90.58

EX. 375Ø FW SEWER

EXMH-0901 CL: 100.68 IL: 96.97

EXMH-0801 CL: 104.30 IL: 102.39

EXMH-0701 CL: 106.60 IL: 104.06

EXMH-0601 CL: 107.51 IL: 104.55

Rev.	Description	Date	By
C	Permeable paving removed from adoptable sewer easement, note added and indicative SW drainage route added to plots 29 / 33 communal soakaway.	31/08/2022	OB
B	Updated to suit site re-plan.	26/08/2022	CS
A	Drainage strategy updated to reflect revised planning layout. Proposed basin and swale moved north to tie-in with revised highway layout and amended levels around plots 28-33. HD20 > HW05 & F17 > F21 amended. Porous paving removed from future S104 sewer easement and double gully to swale added.	21/03/2022	OB
-	First Issue	21/02/2022	OB

Drawing Status: **PLANNING**

Please note while these drawings may be used for tender purposes, drawings are subject to detailed design and planning approval as part of ongoing consultations and design checks. Amendments may therefore be requested.

Client: HAYFIELD

Project: Berry Hill Road, Adderbury, Oxfordshire

Title: Proposed Drainage Strategy Plan

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Scale	A1 @ 1:500	Drawn	OB
Date	February 2022	Checked	
File	22021 / dwgs / civils / current / planning	Drawing	22021-BGC-D / PL01 C