

MONSON

Structural Engineering
Roads & Car Parks
Traffic & Flood Risk Assessments
Water & Drainage Engineering
Technical Audits & Assessments

**133 Baston Road
Hayes
Bromley
BR2 7AB**

**Proposed Residential
Redevelopment**

Drainage Strategy Report

Issue	A
Date	29 Sep 2023
Author	C. Maheshe
Verified by	G. Leslie
Job No.	23172



Registered No. FS 37624

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1.00 Introduction

- 1.01 Monson Engineering has been instructed to prepare a drainage strategy for the proposed redevelopment of the site at 133 Baston Road in Hayes, Bromley.
- 1.02 The proposal consists of the demolition of the existing buildings and the erection of 5 dwellings.
- 1.03 The site which has an existing access from Baston Road B265 is bounded by an open greenfield land to the north and east, and by dwellings to the west and by Baston Road to the south (*Figure 1*). The approximate National Grid Reference is TQ 40848 65730 (540848E, 165730N).



Figure 1: Application Site (Google)

- 1.04 Development proposal can be found in **Appendix A**.

2.00 Existing Drainage

- 2.01 A topographical survey for the site (**Appendix B**) shows a number of drainage manholes towards Thames Water (**Appendix C**) public foul water sewer underneath Baston Road. This suggests that the existing building(s) possibly discharge into this sewer; although it is unclear whether these drains serve both surface and foul water drainage.
- 2.02 There is a number of impermeable areas which include No. 133 building and some other buildings, as well as a swimming pool and a tarmac court to the north. Any surface water runoff will infiltrate the ground in the grass areas or will flow north as the site slopes down to the north.
- 2.03 HRWallingford Greenfield Runoff Rates tool (**Appendix D**) gives the soil index as 1 which suggests a permeable soil. In addition, the SPR/SPRHOST is less than 0.3 which suggests groundwater to be low enough for infiltration systems.

3.00 Geology

3.01 British Geological Survey (BGS) mapping (*Figure 2*) shows that the site is underlain by Harwich Formation – Sand and Gravel, with no superficial deposits.



Geology

Bedrock geology

Harwich Formation - Sand and gravel. Sedimentary bedrock formed between 56 and 47.8 million years ago during the Palaeogene period.

Figure 2: BGS Bedrock Geology

3.02 BGS describes the lithology of this bedrock as “*In the south of the London Basin, it typically comprises glauconitic silty or sandy clays, silts and fine- to coarse-grained glauconitic sands, some gravelly, varying to flint gravel beds*”.

3.03 Soilscape mapping (*Figure 3*) indicates that the site is ‘freely draining’ which is consistent with the geology and infiltration drainage proposed at the Baston House School to the east.

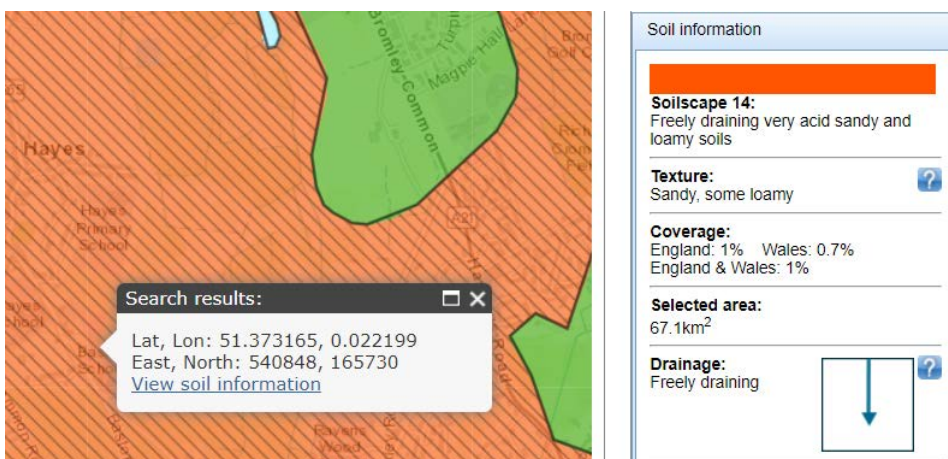


Figure 3: Soilscape Map

4.00 Drainage Strategy

- 4.01 Policy SI 13 ‘Sustainable Drainage’ of the London Plan 2021 gives a hierarchy for the disposal of rainwater sustainably.
- 4.02 Our proposed surface water drainage recommends a number of SuDS systems to provide treatment and minimise flood risk downstream of the site.
- 4.03 Water conservation measures such as water butts could be used to water proposed rain gardens. These SuDS features (Figure 4-6) will slow down peak flow rates while providing runoff treatment and amenity value to the users of the proposed dwellings.

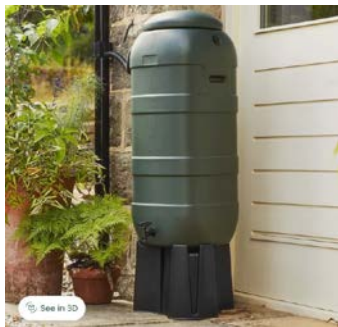


Figure 4: Water Butt



Figure 5: Rain Garden



Figure 6: Block Pavement

- 4.04 It is recommended to carry out a full site investigation, to include a number of representative soakage tests in accordance to Digest 365 published by the Building Research Establishment, also known as BRE365 soakage test.
- 4.05 Based on desktop study, similar drainage proposals in the vicinity of the application site and the geology, it is highly likely that infiltration is the most sustainable method for surface water disposal at this site.

5.00 Drainage Proposals

- 5.01 For the consideration of surface water runoff, the main contributing areas will be the proposed roofs, parking spaces/drives and the access road.
- 5.02 Runoff from the five dwellings roofs will be drained into an individual 4.0m x 2.0m x 0.8m soakaway in their respective rear gardens. These will be constructed 5 metres away from any foundation structures.
- 5.03 The existing and proposed access road will drain into a soakaway along the proposed access via catchpit chambers. Inlet structures such as gullies and channel drains will be designed at detailed design stage to take runoff from the access road and drain it into the 34.0m x 2.0m x 1.2m soakaway.
- 5.04 Parking drives have been designed as permeable pavements. Using the largest drive, a 450mm deep permeable pavement has been designed to accommodate storm that falls directly on it.
- 5.05 Microdrainage Source Control calculations demonstrate the adequacy of these soakaways and permeable pavement to store up to the 1 in 100 year storm, allowing for 40% increase in rainfall intensity due to climate change without flooding on or off site.
- 5.06 An infiltration rate used for the Baston House School to the east has been used for this preliminary hydraulic design. This value of 2.7×10^{-5} m/s will need to be confirmed using a site-specific BRE365 soakage testing, location and depth subject to detailed design.
- 5.07 Foul water will be discharged to the nearest public foul water sewer on Baston Road. Given the existing levels, this will need to be pumped to a break chamber to the south and then drained by gravity to the public foul water sewer. A section 106 Agreement to connect will have to be applied for to Thames Water.
- 5.08 Proposed drainage layout as discussed, as well as Microdrainage calculations can be found in **Appendix E**.

6.00 Maintenance of Block Pavement

- 6.01 The private drives have been designed as permeable pavement.
- 6.02 All maintenance operations are to be carried out in accordance with the manufacturer’s recommendations and maintenance schedules.
- 6.03 Typical maintenance of permeable block paving can be found in *Table 1*.

Table 1: Maintenance schedule for permeable paving (Appointed management company)

SCHEDULE	ACTION	FREQUENCY
Routine visual inspection	Visually inspect the paving for ponding during heavy rainfall or following heavy rainfall.	Once a year
Remedial maintenance for ponding	Brush / vacuum joints Replace any lost jointing material	As required
Structural Maintenance	Replace damaged blocks Repair any rutting	As required
Maintenance for aesthetics of the joints	Brush / vacuum joints as required Replace any lost jointing material	Recommended once a year
Maintenance for aesthetics of the paving blocks	Brush with soapy water Light pressure wash	As required
Weed control	Treat with weedkiller	As required
Maintenance during the winter months	De-icing salts	As required during winter
WARNING !	Do not replace the jointing grit with kiln dried sand as this will block the joints and prevent infiltration. Do not store materials which may clog up the permeable joints such as soil and mulch on top of the paving.	

7.00 Maintenance of Rain Gardens

7.01 Rain gardens are typically small systems that serve part of a single property (roof or driveway). They are likely to be less engineered than full bioretention components. They usually have a simple inflow where rainwater enters the garden, and they have a maximum depth of standing water of 150 mm. They can have an above-ground overflow where excess water exits, although in some instances a simple underdrain may be more effective than providing a small control structure.

7.02 Typical maintenance plan can be found in Table 2.

Table 2: Maintenance schedule for Rain Gardens (Homeowners on private land)

Maintenance Activities	Frequency of Maintenance
- Litter / trash removal	As per landscaper’s recommendations. Visual inspection can expose areas needing maintenance
- Inlet / outlet cleaning	
- Vegetation management	

8.00 Maintenance of the Water Butt

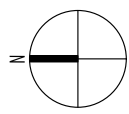
8.01 Water butts are the most common means of harvesting rainwater, although they are primarily designed for small scale use such as in gardens. Therefore, the relative cost, maintenance and performance of water butts when compared to other larger rainwater harvesting systems are significantly less.

8.02 Typical water butt maintenance can be found in Table 3.

Table 3: Management and Maintenance of Water Butts (By homeowners)

Maintenance Activities	Frequency of Maintenance
<ul style="list-style-type: none"> - Inspection and cleaning of sedimentation at the base of the tank - Cleaning out of house guttering - Inspection and repair of the inlet and outlet mechanisms - Cleaning of the tank, inlets, outlets, filters and removal of debris 	Ongoing monitoring and maintenance
<ul style="list-style-type: none"> - Inspection of the tank for debris, leaks, or other damage 	Maintenance following storms
<ul style="list-style-type: none"> - Replacement of any filters 	Occasional maintenance (when required)

APPENDIX A : PROPOSED DEVELOPMENT



Revisions	Notes

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Client	South East Living Group	Project Number	134
Project	133 Baston Road Bromley BR2 7BS		
Drawing Title	Site Layout	Status	Planning
		Scale	1:500(A3)
		Drawing Number	134-S00

DOMINIC LAMB ARCHITECTS		
6a Markings Place, 100 Tower Bridge Road, London SE1 3JH		
t: +44 (0)20 7613 2200		
l: lamb@domlamb.com		
Drawn	Checked	
DL	DL	
Date		Sept 2023
Revision		

APPENDIX B : TOPOGRAPHICAL SURVEY

Tree Schedule		
1	Ash	d=0.5
2	Hazel	d=0.15
3	Hazel	d=0.15
4	Unknown	multibole
5	Maple	d=0.25
6	Fruit	d=0.15
7	Fruit	d=0.15
8	Fruit	d=0.15
9	Maple	d=0.25
10	Fruit	d=0.2
11	Fruit	d=0.2
12	Fruit	d=0.2
13	Fruit	d=0.2
14	Cherry	d=0.4
15	Fruit	d=0.2
16	Cypress	d=0.2
17	Oak	d=0.1
18	Unknown	multibole
19	Ash	d=0.2
20	Sycamore	d=0.3
21	Cypress	d=0.15
22	Hawthorn	d=0.1
23	Maple	multibole
24	Maple	d=0.25
25	Maple	d=0.25
26	Maple	d=0.25
27	Maple	d=0.3
28	Maple	d=0.3
29	Oak	d=0.1
30	Silver birch	d=2x0.12
31	Maple	d=0.3
32	Lime	d=0.6
33	Ash	d=0.25
34	Unknown	multibole
35	Cherry	d=2x0.05
36	Hawthorn	d=0.3
37	Hawthorn	d=0.3
38	Holly	d=0.3

Survey control		
Sh	Easting	Northing
H1	540833.906	165633.202
H2	540802.164	165670.159
H3	540815.428	165673.999
H4	540837.455	165658.253
H5	540824.375	165706.204
H6	540832.519	165715.898
H7	540844.217	165714.711
H8	540842.826	165707.967
H9	540847.069	165729.269
H10	540859.492	165734.315
H11	540834.796	165750.394
H12	540820.050	165734.538
H13	540812.405	165726.916
H14	540820.992	165719.067
H15	540874.331	165758.773
H16	540877.243	165692.321
H17	540822.660	165795.103
H18	540844.489	165779.084
H19	540854.137	165746.561
H20	540842.417	165762.995
H21	540839.765	165756.772
H22	540847.780	165742.555

Any setting-out should be undertaken using these control stations and any setting-out using GPS should be transformed to this control.

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Topographical Survey Legend	
Hedge	Telephone line
Undergrowth	Power line
Tree	Banking
Bush	Contour line
Building	Survey Station
Glass Building	Gate
Open Building	Level
Ordnance Survey Benchmark	
Foul Drainage	
Storm Drainage	

Abbreviations	
Animal Set	Sett
Air Valve	AV
Borehole	BH
Bus Stop	BS
Cover Level	CL
Earth Rod	ER
Electricity Pole	EP
Fire Hydrant	FH
Inspection Cover	IC
Invert Level	IL
Lamp Post	LP
Manhole	MH
Marker	MK
Name Plate	NRP
Power Pole	PP
Rain water Pipe	RWP
Road Sign	RS
Rodding Eye	RE
Reinforced Steel Joint	RSJ
Soil Vent Pipe	SVP
Stop Valve	SV
Survey Station	STN
Telegraph Pole	TP
Tree Stump	Stump
Trail Hole	TH
Unable To Lift	UTL
Vent Pipe	VP
Water Valve	WV



Notes
All trees are identified where possible. Species, spread, height and girth are indicative only.
Drainage has been surveyed where found, and traced where possible.
Eaves and ridge heights of surrounding buildings have been surveyed where possible.

HOOK SURVEY

Land & Building Surveyors
www.hooksurvey.com

Project: No.133 and adjoining land, Baston Road, Hayes, Bromley BR2 7BS

Client: S E Living Group

Drawing title: Topographical Survey

Job No: S23/9422	Dwg No: S23/9422/01	Revision:
Scale: 1:200	Date: June 2023	Drawn by: W.M.

Grid & Levels related to:
Ordnance survey coordinate system using GPS related to the Leica Smartnet RTK network. Based around 3 survey stations with a scale factor of 1.000, only the fixed survey stations H1, H2 and H5 are true Ordnance Survey positions.

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APPENDIX C : THAMES WATER SEWER RECORDS

Asset location search



Property Searches

South East Living
Cobden Court,2 Cobden Court

BROMLEY
BR2 9JF

Search address supplied 133
Baston Road
Hayes
Bromley
Kent
BR2 7AB

Your reference 133 Baston Road

Our reference ALS/ALS Standard/2023_4770658

Search date 11 January 2023

Knowledge of features below the surface is essential for every development

The benefits of this knowledge not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility of any development.

Did you know that Thames Water Property Searches can also provide a variety of utility searches including a more comprehensive view of utility providers' assets (across up to 35-45 different providers), as well as more focused searches relating to specific major utility companies such as National Grid (gas and electric).

Contact us to find out more.



Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13



searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk



0800 009 4540

Search address supplied: 133, Baston Road, Hayes, Bromley, Kent, BR2 7AB

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This search provides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0800 009 4540, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk

Web: www.thameswater-propertysearches.co.uk

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0800 316 9800. The Customer Centre can also arrange for a full flow and pressure test to be carried out for a fee.

Asset location search



Property Searches

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

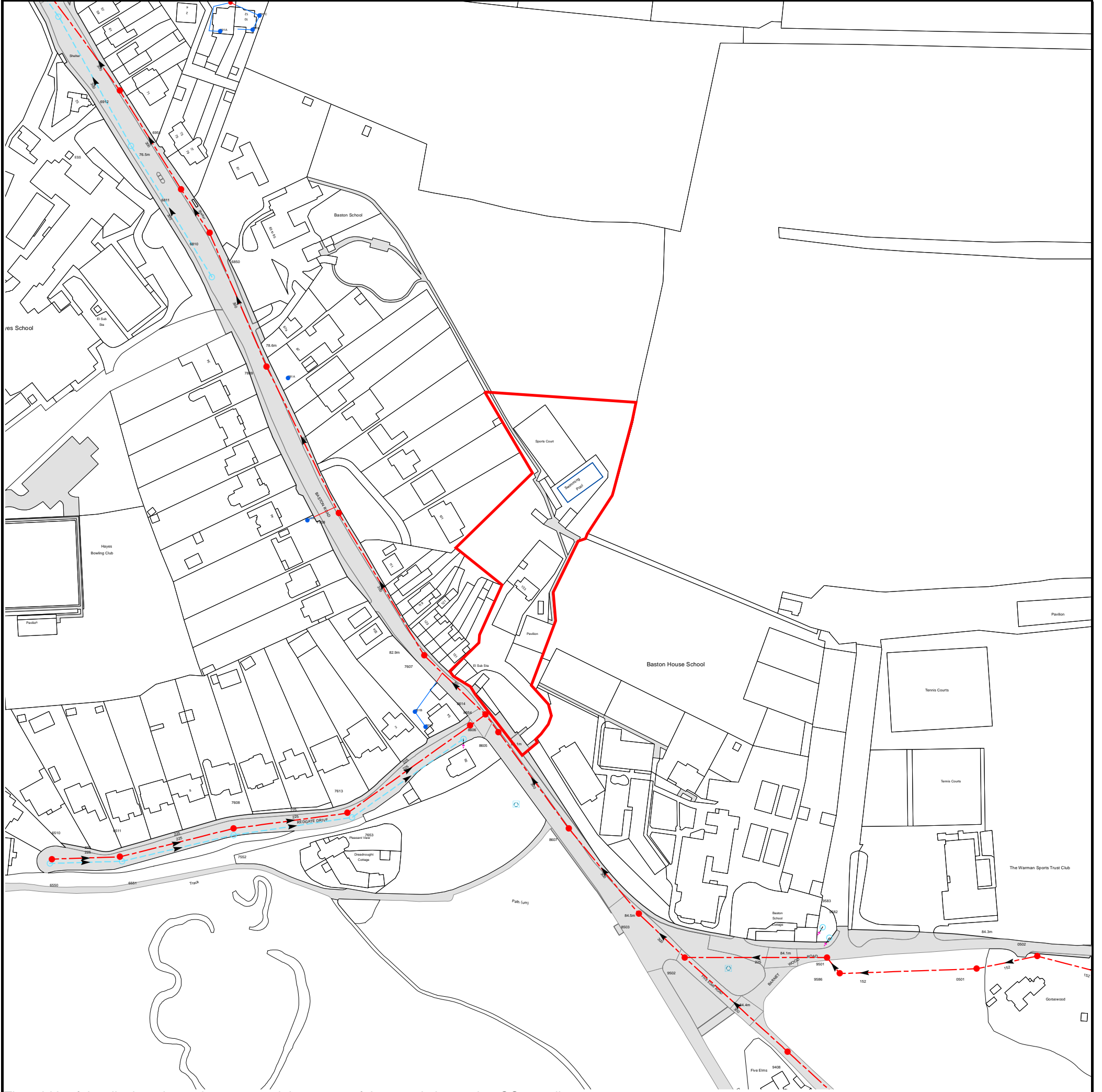
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2023 4770658



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 540848,165730

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

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NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available
















Manhole Reference	Manhole Cover Level	Manhole Invert Level
9581	n/a	n/a
9408	n/a	n/a
9583	n/a	n/a
9501	n/a	n/a
9582	n/a	n/a
9586	n/a	n/a
0501	n/a	n/a
0502	n/a	n/a
9502	n/a	n/a
8503	n/a	n/a
8607	n/a	n/a
7653	n/a	n/a
7613	n/a	n/a
8681	n/a	n/a
8654	n/a	n/a
8605	n/a	n/a
761A	n/a	n/a
8614	n/a	n/a
8606	n/a	n/a
761B	n/a	n/a
7607	n/a	n/a
7708	n/a	n/a
7809	n/a	n/a
6850	n/a	n/a
6810	n/a	n/a
6811	n/a	n/a
6951	n/a	n/a
6912	n/a	n/a
691A	n/a	n/a
791B	n/a	n/a
6952	n/a	n/a
791C	n/a	n/a
791D	n/a	n/a
6550	n/a	n/a
6510	n/a	n/a
6511	n/a	n/a
6551	n/a	n/a
7608	n/a	n/a
7552	n/a	n/a
781A	n/a	n/a
771A	n/a	n/a

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Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

-  **Foul Sewer:** A sewer designed to convey waste water from domestic and industrial sources to a treatment works.
-  **Surface Water Sewer:** A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.
-  **Combined Sewer:** A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.
-  Storm Sewer
-  Sludge Sewer
-  Foul Trunk Sewer
-  Surface Trunk Sewer
-  Combined Trunk Sewer
-  Foul Rising Main
-  Surface Water Rising Main
-  Combined Rising Main
-  Vacuum
-  Thames Water Proposed
-  Vent Pipe
-  Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

-  Sewer
-  Culverted Watercourse
-  Proposed
-  Decommissioned Sewer
-  Content of this drainage network is currently unknown
-  Ownership of this drainage network is currently unknown

Notes:

- 1) All levels associated with the plans are to Ordnance Datum Newlyn.
- 2) All measurements on the plan are metric.
- 3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the direction of flow.
- 4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

-  Air Valve
-  Meter
-  Dam Chase
-  Vent
-  Fitting

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

-  Ancillary
-  Drop Pipe
-  Control Valve
-  Weir



End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol. Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

-  Inlet
-  Outfall
-  Undefined End




Other Symbols

Symbols used on maps which do not fall under other general categories.





-  Change of Characteristic Indicator
-  Public / Private Pumping Station
-  Invert Level
-  Summit

Areas

Lines denoting areas of underground surveys, etc.

-  Agreement
-  Chamber
-  Operational Site

Ducts or Crossings

-  Casement
 -  Conduit Bridge
 -  Subway
 -  Tunnel
- Ducts may contain high voltage cables. Please check with Thames Water.

5) 'na' or 'of' on a manhole indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology, please contact Property Searches on 0800 009 4540.



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 540848, 165730.








The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

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Asset Location Search - Water Key

Water Pipes (Operated & Maintained by Thames Water)

-  **Distribution Main:** The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.
-  **Trunk Main:** A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.
-  **Supply Main:** A supply main indicates that the water main is used as a supply for a single property or group of properties.
-  **Fire Main:** Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.
-  **Metered Pipe:** A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.
-  **Transmission Tunnel:** A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.
-  **Proposed Main:** A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Valves

-  General Purpose Valve
-  Air Valve
-  Pressure Control Valve
-  Customer Valve

Hydrants

-  Single Hydrant

Meters

-  Meter

End Items



Symbol indicating what happens at the end of a water main.

-  Blank Flange
-  Capped End
-  Emptying Pit
-  Undefined End
-  Manifold
-  Customer Supply
-  Fire Supply



Operational Sites

-  Booster Station
-  Other
-  Other (Proposed)
-  Pumping Station
-  Service Reservoir
-  Shaft Inspection
-  Treatment Works
-  Unknown
-  Water Tower

Other Symbols

-  Data Logger
-  **Casement:** Ducts may contain high voltage cables. Please check with Thames Water.

Other Water Pipes (Not Operated or Maintained by Thames Water)

-  **Other Water Company Main:** Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.
-  **Private Main:** Indicates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL's terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	BACS Payment	Telephone Banking	Cheque
Call 0800 009 4540 quoting your invoice number starting CBA or ADS / OSS	A remittance advice must be sent to: Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW. or email ps.billing@thameswater. co.uk	By calling your bank and quoting: and your invoice number	Made payable to ' Thames Water Utilities Ltd ' Write your Thames Water account number on the back. Send to: Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW or by DX to 151280 Slough 13

Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.

APPENDIX D : HRWALLINGFORD GREENFIELD RUNOFF RATES

Calculated by: Christian Maheshe

Site name: 133 Baston Road

Site location: Bromley

Site Details

Latitude: 51.37336° N

Longitude: 0.02240° E

Reference: 4293380185

Date: Sep 28 2023 13:41

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 0.5345

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Notes

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

Soil characteristics

	Default	Edited
SOIL type:	1	1
HOST class:	N/A	N/A
SPR/SPRHOST:	0.1	0.1

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

Hydrological characteristics

	Default	Edited
SAAR (mm):	717	717
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

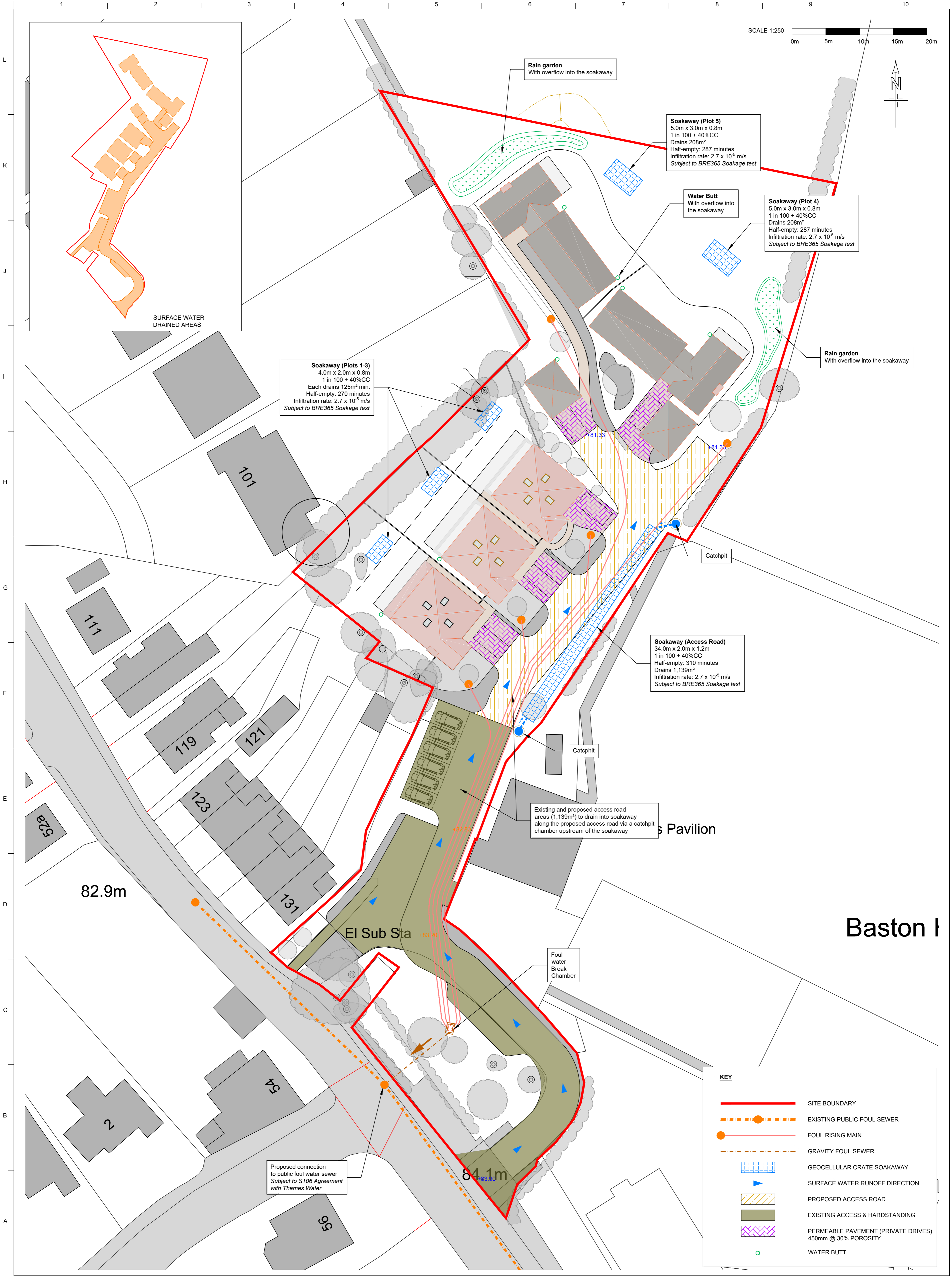
Greenfield runoff rates

Default Edited

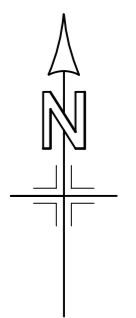
Q_{BAR} (l/s):	0.09	0.09
1 in 1 year (l/s):	0.08	0.08
1 in 30 years (l/s):	0.21	0.21
1 in 100 year (l/s):	0.29	0.29
1 in 200 years (l/s):	0.35	0.35

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

APPENDIX E : DRAINAGE PROPOSAL & MICRODRAINAGE CALCULATIONS



SCALE 1:250
0m 5m 10m 15m 20m



SURFACE WATER
DRAINED AREAS

Rain garden
With overflow into the soakaway

Soakaway (Plot 5)
5.0m x 3.0m x 0.8m
1 in 100 + 40%CC
Drains 208m²
Half-empty: 287 minutes
Infiltration rate: 2.7 x 10⁻⁵ m/s
Subject to BRE365 Soakage test

Water Butt
With overflow into
the soakaway

Soakaway (Plot 4)
5.0m x 3.0m x 0.8m
1 in 100 + 40%CC
Drains 208m²
Half-empty: 287 minutes
Infiltration rate: 2.7 x 10⁻⁵ m/s
Subject to BRE365 Soakage test

Rain garden
With overflow into the soakaway

Soakaway (Plots 1-3)
4.0m x 2.0m x 0.8m
1 in 100 + 40%CC
Each drains 125m² min.
Half-empty: 270 minutes
Infiltration rate: 2.7 x 10⁻⁵ m/s
Subject to BRE365 Soakage test

Soakaway (Access Road)
34.0m x 2.0m x 1.2m
1 in 100 + 40%CC
Half-empty: 310 minutes
Drains 1,139m²
Infiltration rate: 2.7 x 10⁻⁵ m/s
Subject to BRE365 Soakage test

Existing and proposed access road
areas (1,139m²) to drain into soakaway
along the proposed access road via a catchpit
chamber upstream of the soakaway

Pavilion

El Sub Sta

Foul water
Break
Chamber

Baston Road

KEY	
	SITE BOUNDARY
	EXISTING PUBLIC FOUL SEWER
	FOUL RISING MAIN
	GRAVITY FOUL SEWER
	GEOCELLULAR CRATE SOAKAWAY
	SURFACE WATER RUNOFF DIRECTION
	PROPOSED ACCESS ROAD
	EXISTING ACCESS & HARDSTANDING
	PERMEABLE PAVEMENT (PRIVATE DRIVES) 450mm @ 30% POROSITY
	WATER BUTT

Notes:
1. This drawing to be read in conjunction with all other relevant Monson drawings and specifications, any discrepancies to be reported to Monson prior to any fabrication or work commencing on site.
2. Do not scale this drawing, use figured dimensions only.
3. All dimensions in millimetres, all levels in metres.

Issue	By	Date	Original Issue	Amendments
A	...	28/09/2023	Original Issue	


MONSON
Broadway Chambers, High Street, Crowborough, East Sussex TN6 1DF
Tel: (01892) 601370
E-mail: enquiries@monson.co.uk

Project:
133 Baston Road
Hayes
Bromley
BR2 7AB

Description:
Proposed Drainage Layout
Surface Water &
Foul Water Drainage

Original Drawing:	Prepared	CM	Approved	GL
Origin:	Crowborough		Size	A1
Current Issue:	Approved	GL	Date	28/09/2023
Drawing Status:	PRELIMINARY			

Scale:	1:250	Dwg No:	23172/100	Issue:	A
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Monson Engineering		Page 1
Broadway Chambers High Street Crowborough East Essex TN6 1DF	133 Baston Road, BR2 7AB Plots 1 - 3 1 in 100 + 40%CC	
Date 29/09/2023 File 23172 - HOUSE 4,5 (28.09...	Designed by CM Checked by	
Micro Drainage	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 270 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
15 min Summer	80.559	0.419	0.2	3.2	O K
30 min Summer	80.681	0.541	0.2	4.1	O K
60 min Summer	80.789	0.649	0.2	4.9	O K
120 min Summer	80.864	0.724	0.2	5.5	O K
180 min Summer	80.877	0.737	0.2	5.6	O K
240 min Summer	80.871	0.731	0.2	5.6	O K
360 min Summer	80.852	0.712	0.2	5.4	O K
480 min Summer	80.830	0.690	0.2	5.2	O K
600 min Summer	80.805	0.665	0.2	5.1	O K
720 min Summer	80.781	0.641	0.2	4.9	O K
960 min Summer	80.736	0.596	0.2	4.5	O K
1440 min Summer	80.655	0.515	0.2	3.9	O K
2160 min Summer	80.555	0.415	0.2	3.2	O K
2880 min Summer	80.474	0.334	0.2	2.5	O K
4320 min Summer	80.355	0.215	0.1	1.6	O K
5760 min Summer	80.274	0.134	0.1	1.0	O K
7200 min Summer	80.221	0.081	0.1	0.6	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
15 min Summer	138.153	0.0	25
30 min Summer	90.705	0.0	39
60 min Summer	56.713	0.0	68
120 min Summer	34.246	0.0	124
180 min Summer	25.149	0.0	180
240 min Summer	20.078	0.0	208
360 min Summer	14.585	0.0	270
480 min Summer	11.622	0.0	338
600 min Summer	9.738	0.0	408
720 min Summer	8.424	0.0	476
960 min Summer	6.697	0.0	614
1440 min Summer	4.839	0.0	882
2160 min Summer	3.490	0.0	1276
2880 min Summer	2.766	0.0	1648
4320 min Summer	1.989	0.0	2380
5760 min Summer	1.573	0.0	3064
7200 min Summer	1.311	0.0	3752

Monson Engineering		Page 2
Broadway Chambers High Street Crowborough East Essex TN6 1DF	133 Baston Road, BR2 7AB Plots 1 - 3 1 in 100 + 40%CC	
Date 29/09/2023 File 23172 - HOUSE 4,5 (28.09...	Designed by CM Checked by	
Micro Drainage	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Summer	80.193	0.053	0.1	0.4	O K
10080 min Summer	80.185	0.045	0.1	0.3	O K
15 min Winter	80.611	0.471	0.2	3.6	O K
30 min Winter	80.749	0.609	0.2	4.6	O K
60 min Winter	80.875	0.735	0.2	5.6	O K
120 min Winter	81.136	0.996	0.2	6.3	Flood Risk
180 min Winter	81.309	1.169	0.2	6.5	Flood Risk
240 min Winter	81.267	1.127	0.2	6.4	Flood Risk
360 min Winter	81.065	0.925	0.2	6.2	Flood Risk
480 min Winter	80.927	0.787	0.2	6.0	O K
600 min Winter	80.893	0.753	0.2	5.7	O K
720 min Winter	80.859	0.719	0.2	5.5	O K
960 min Winter	80.793	0.653	0.2	5.0	O K
1440 min Winter	80.677	0.537	0.2	4.1	O K
2160 min Winter	80.537	0.397	0.2	3.0	O K
2880 min Winter	80.430	0.290	0.2	2.2	O K
4320 min Winter	80.280	0.140	0.1	1.1	O K
5760 min Winter	80.196	0.056	0.1	0.4	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
8640 min Summer	1.129	0.0	4408
10080 min Summer	0.994	0.0	5136
15 min Winter	138.153	0.0	25
30 min Winter	90.705	0.0	39
60 min Winter	56.713	0.0	66
120 min Winter	34.246	0.0	122
180 min Winter	25.149	0.0	178
240 min Winter	20.078	0.0	230
360 min Winter	14.585	0.0	286
480 min Winter	11.622	0.0	362
600 min Winter	9.738	0.0	438
720 min Winter	8.424	0.0	514
960 min Winter	6.697	0.0	662
1440 min Winter	4.839	0.0	944
2160 min Winter	3.490	0.0	1344
2880 min Winter	2.766	0.0	1732
4320 min Winter	1.989	0.0	2432
5760 min Winter	1.573	0.0	3008

Monson Engineering		Page 3
Broadway Chambers High Street Crowborough East Essex TN6 1DF	133 Baston Road, BR2 7AB Plots 1 - 3 1 in 100 + 40%CC	
Date 29/09/2023	Designed by CM	
File 23172 - HOUSE 4,5 (28.09...	Checked by	
Micro Drainage	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
7200 min Winter	80.183	0.043	0.1	0.3	O K
8640 min Winter	80.177	0.037	0.1	0.3	O K
10080 min Winter	80.173	0.033	0.1	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
7200 min Winter	1.311	0.0	3672
8640 min Winter	1.129	0.0	4408
10080 min Winter	0.994	0.0	5144

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Micro Drainage	Source Control 2020.1	


Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.013

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From:	To:	From:	To:	From:	To:
	(ha)		(ha)		(ha)
0	4 0.004	4	8 0.004	8	12 0.004

Monson Engineering		Page 5
Broadway Chambers High Street Crowborough East Essex TN6 1DF	133 Baston Road, BR2 7AB Plots 1 - 3 1 in 100 + 40%CC	
Date 29/09/2023 File 23172 - HOUSE 4,5 (28.09...	Designed by CM Checked by	
Micro Drainage	Source Control 2020.1	


Model Details

Storage is Online Cover Level (m) 81.340

Cellular Storage Structure

Invert Level (m) 80.140 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.09720 Porosity 0.95
 Infiltration Coefficient Side (m/hr) 0.09720

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	8.0	8.0	0.801	0.0	17.6
0.800	8.0	17.6			


Monson Engineering		Page 1
Broadway Chambers High Street Crowborough East Essex TN6 1DF	133 Baston Road, BR2 7AB SW Hydraulic Calculations 1 in 100 + 40%CC	
Date 29/09/2023 File 23172 - HOUSE 1,2,3 (28....	Designed by CM Checked by	
Micro Drainage	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 310 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
15 min Summer	80.081	0.431	1.3	27.8	O K
30 min Summer	80.207	0.557	1.5	36.0	O K
60 min Summer	80.323	0.673	1.6	43.5	O K
120 min Summer	80.409	0.759	1.7	49.0	O K
180 min Summer	80.431	0.781	1.7	50.5	O K
240 min Summer	80.428	0.778	1.7	50.2	O K
360 min Summer	80.410	0.760	1.7	49.1	O K
480 min Summer	80.388	0.738	1.6	47.7	O K
600 min Summer	80.365	0.715	1.6	46.2	O K
720 min Summer	80.342	0.692	1.6	44.7	O K
960 min Summer	80.298	0.648	1.5	41.9	O K
1440 min Summer	80.219	0.569	1.5	36.7	O K
2160 min Summer	80.116	0.466	1.4	30.1	O K
2880 min Summer	80.031	0.381	1.3	24.6	O K
4320 min Summer	79.899	0.249	1.2	16.1	O K
5760 min Summer	79.808	0.158	1.1	10.2	O K
7200 min Summer	79.746	0.096	1.0	6.2	O K
8640 min Summer	79.710	0.060	1.0	3.9	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
15 min Summer	138.153	0.0	26
30 min Summer	90.705	0.0	40
60 min Summer	56.713	0.0	68
120 min Summer	34.246	0.0	124
180 min Summer	25.149	0.0	182
240 min Summer	20.078	0.0	230
360 min Summer	14.585	0.0	288
480 min Summer	11.622	0.0	352
600 min Summer	9.738	0.0	420
720 min Summer	8.424	0.0	490
960 min Summer	6.697	0.0	626
1440 min Summer	4.839	0.0	900
2160 min Summer	3.490	0.0	1300
2880 min Summer	2.766	0.0	1676
4320 min Summer	1.989	0.0	2420
5760 min Summer	1.573	0.0	3112
7200 min Summer	1.311	0.0	3816
8640 min Summer	1.129	0.0	4416

Monson Engineering		Page 2
Broadway Chambers High Street Crowborough East Essex TN6 1DF	133 Baston Road, BR2 7AB SW Hydraulic Calculations 1 in 100 + 40%CC	
Date 29/09/2023	Designed by CM	
File 23172 - HOUSE 1,2,3 (28....	Checked by	
Micro Drainage	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
10080 min Summer	79.697	0.047	0.9	3.1	O K
15 min Winter	80.134	0.484	1.4	31.3	O K
30 min Winter	80.278	0.628	1.5	40.6	O K
60 min Winter	80.411	0.761	1.7	49.2	O K
120 min Winter	80.514	0.864	1.8	55.8	O K
180 min Winter	80.546	0.896	1.8	57.9	O K
240 min Winter	80.548	0.898	1.8	58.0	O K
360 min Winter	80.524	0.874	1.8	56.5	O K
480 min Winter	80.499	0.849	1.7	54.9	O K
600 min Winter	80.469	0.819	1.7	52.9	O K
720 min Winter	80.438	0.788	1.7	50.9	O K
960 min Winter	80.374	0.724	1.6	46.8	O K
1440 min Winter	80.258	0.608	1.5	39.3	O K
2160 min Winter	80.112	0.462	1.4	29.8	O K
2880 min Winter	79.994	0.344	1.3	22.2	O K
4320 min Winter	79.823	0.173	1.1	11.1	O K
5760 min Winter	79.719	0.069	1.0	4.5	O K
7200 min Winter	79.695	0.045	0.9	2.9	O K
8640 min Winter	79.689	0.039	0.7	2.5	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
10080 min Summer	0.994	0.0	5136
15 min Winter	138.153	0.0	25
30 min Winter	90.705	0.0	39
60 min Winter	56.713	0.0	68
120 min Winter	34.246	0.0	122
180 min Winter	25.149	0.0	178
240 min Winter	20.078	0.0	234
360 min Winter	14.585	0.0	300
480 min Winter	11.622	0.0	374
600 min Winter	9.738	0.0	450
720 min Winter	8.424	0.0	528
960 min Winter	6.697	0.0	678
1440 min Winter	4.839	0.0	968
2160 min Winter	3.490	0.0	1376
2880 min Winter	2.766	0.0	1764
4320 min Winter	1.989	0.0	2476
5760 min Winter	1.573	0.0	3112
7200 min Winter	1.311	0.0	3616
8640 min Winter	1.129	0.0	4408

Monson Engineering		Page 3
Broadway Chambers High Street Crowborough East Essex TN6 1DF	133 Baston Road, BR2 7AB SW Hydraulic Calculations 1 in 100 + 40%CC	
Date 29/09/2023	Designed by CM	
File 23172 - HOUSE 1,2,3 (28....	Checked by	
Micro Drainage	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
10080 min Winter	79.684	0.034		0.7 2.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
10080 min Winter	0.994	0.0	5136

Monson Engineering		Page 4
Broadway Chambers High Street Crowborough East Essex TN6 1DF	133 Baston Road, BR2 7AB SW Hydraulic Calculations 1 in 100 + 40%CC	
Date 29/09/2023 File 23172 - HOUSE 1,2,3 (28....	Designed by CM Checked by	
Micro Drainage	Source Control 2020.1	


Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.113

Time (mins) Area			Time (mins) Area			Time (mins) Area		
From:	To:	(ha)	From:	To:	(ha)	From:	To:	(ha)
0	4	0.038	4	8	0.038	8	12	0.038

Monson Engineering		Page 5
Broadway Chambers High Street Crowborough East Essex TN6 1DF	133 Baston Road, BR2 7AB SW Hydraulic Calculations 1 in 100 + 40%CC	
Date 29/09/2023	Designed by CM	
File 23172 - HOUSE 1,2,3 (28....	Checked by	
Micro Drainage	Source Control 2020.1	


Model Details

Storage is Online Cover Level (m) 81.500

Cellular Storage Structure

Invert Level (m) 79.650 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.09720 Porosity 0.95
 Infiltration Coefficient Side (m/hr) 0.09720

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	68.0	68.0	1.201	0.0	154.4
1.200	68.0	154.4			


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Broadway Chambers High Street Crowborough East Essex TN6 1DF	133 Baston Road, BR2 7AB Access Road Soakaway 1 in 100 + 40%CC	
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Micro Drainage	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 310 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
15 min Summer	80.081	0.431	1.3	27.8	O K
30 min Summer	80.207	0.557	1.5	36.0	O K
60 min Summer	80.323	0.673	1.6	43.5	O K
120 min Summer	80.409	0.759	1.7	49.0	O K
180 min Summer	80.431	0.781	1.7	50.5	O K
240 min Summer	80.428	0.778	1.7	50.2	O K
360 min Summer	80.410	0.760	1.7	49.1	O K
480 min Summer	80.388	0.738	1.6	47.7	O K
600 min Summer	80.365	0.715	1.6	46.2	O K
720 min Summer	80.342	0.692	1.6	44.7	O K
960 min Summer	80.298	0.648	1.5	41.9	O K
1440 min Summer	80.219	0.569	1.5	36.7	O K
2160 min Summer	80.116	0.466	1.4	30.1	O K
2880 min Summer	80.031	0.381	1.3	24.6	O K
4320 min Summer	79.899	0.249	1.2	16.1	O K
5760 min Summer	79.808	0.158	1.1	10.2	O K
7200 min Summer	79.746	0.096	1.0	6.2	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
15 min Summer	138.153	0.0	26
30 min Summer	90.705	0.0	40
60 min Summer	56.713	0.0	68
120 min Summer	34.246	0.0	124
180 min Summer	25.149	0.0	182
240 min Summer	20.078	0.0	230
360 min Summer	14.585	0.0	288
480 min Summer	11.622	0.0	352
600 min Summer	9.738	0.0	420
720 min Summer	8.424	0.0	490
960 min Summer	6.697	0.0	626
1440 min Summer	4.839	0.0	900
2160 min Summer	3.490	0.0	1300
2880 min Summer	2.766	0.0	1676
4320 min Summer	1.989	0.0	2420
5760 min Summer	1.573	0.0	3112
7200 min Summer	1.311	0.0	3816

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Micro Drainage	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
8640 min Summer	79.710	0.060	1.0	3.9	O K
10080 min Summer	79.697	0.047	0.9	3.1	O K
15 min Winter	80.134	0.484	1.4	31.3	O K
30 min Winter	80.278	0.628	1.5	40.6	O K
60 min Winter	80.411	0.761	1.7	49.2	O K
120 min Winter	80.514	0.864	1.8	55.8	O K
180 min Winter	80.546	0.896	1.8	57.9	O K
240 min Winter	80.548	0.898	1.8	58.0	O K
360 min Winter	80.524	0.874	1.8	56.5	O K
480 min Winter	80.499	0.849	1.7	54.9	O K
600 min Winter	80.469	0.819	1.7	52.9	O K
720 min Winter	80.438	0.788	1.7	50.9	O K
960 min Winter	80.374	0.724	1.6	46.8	O K
1440 min Winter	80.258	0.608	1.5	39.3	O K
2160 min Winter	80.112	0.462	1.4	29.8	O K
2880 min Winter	79.994	0.344	1.3	22.2	O K
4320 min Winter	79.823	0.173	1.1	11.1	O K
5760 min Winter	79.719	0.069	1.0	4.5	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
8640 min Summer	1.129	0.0	4416
10080 min Summer	0.994	0.0	5136
15 min Winter	138.153	0.0	25
30 min Winter	90.705	0.0	39
60 min Winter	56.713	0.0	68
120 min Winter	34.246	0.0	122
180 min Winter	25.149	0.0	178
240 min Winter	20.078	0.0	234
360 min Winter	14.585	0.0	300
480 min Winter	11.622	0.0	374
600 min Winter	9.738	0.0	450
720 min Winter	8.424	0.0	528
960 min Winter	6.697	0.0	678
1440 min Winter	4.839	0.0	968
2160 min Winter	3.490	0.0	1376
2880 min Winter	2.766	0.0	1764
4320 min Winter	1.989	0.0	2476
5760 min Winter	1.573	0.0	3112

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
7200 min Winter	79.695	0.045	0.9	2.9	O K
8640 min Winter	79.689	0.039	0.7	2.5	O K
10080 min Winter	79.684	0.034	0.7	2.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
7200 min Winter	1.311	0.0	3616
8640 min Winter	1.129	0.0	4408
10080 min Winter	0.994	0.0	5136

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Micro Drainage	Source Control 2020.1	


Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.113

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From:	To: (ha)	From:	To: (ha)	From:	To: (ha)
0	4 0.038	4	8 0.038	8	12 0.038

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Micro Drainage	Source Control 2020.1	


Model Details

Storage is Online Cover Level (m) 81.500

Cellular Storage Structure

Invert Level (m) 79.650 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.09720 Porosity 0.95
 Infiltration Coefficient Side (m/hr) 0.09720

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	68.0	68.0	1.201	0.0	154.4
1.200	68.0	154.4			


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Micro Drainage	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 13 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
15 min Summer	80.523	0.083	0.5	0.5	O K
30 min Summer	80.534	0.094	0.5	0.6	O K
60 min Summer	80.536	0.096	0.5	0.7	O K
120 min Summer	80.527	0.087	0.5	0.6	O K
180 min Summer	80.517	0.077	0.5	0.4	O K
240 min Summer	80.509	0.069	0.5	0.4	O K
360 min Summer	80.498	0.058	0.4	0.3	O K
480 min Summer	80.491	0.051	0.3	0.2	O K
600 min Summer	80.487	0.047	0.3	0.2	O K
720 min Summer	80.484	0.044	0.3	0.1	O K
960 min Summer	80.480	0.040	0.2	0.1	O K
1440 min Summer	80.474	0.034	0.2	0.1	O K
2160 min Summer	80.469	0.029	0.1	0.1	O K
2880 min Summer	80.466	0.026	0.1	0.0	O K
4320 min Summer	80.462	0.022	0.1	0.0	O K
5760 min Summer	80.459	0.019	0.1	0.0	O K
7200 min Summer	80.458	0.018	0.0	0.0	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
15 min Summer	138.153	0.0	20
30 min Summer	90.705	0.0	29
60 min Summer	56.713	0.0	46
120 min Summer	34.246	0.0	76
180 min Summer	25.149	0.0	106
240 min Summer	20.078	0.0	136
360 min Summer	14.585	0.0	196
480 min Summer	11.622	0.0	254
600 min Summer	9.738	0.0	314
720 min Summer	8.424	0.0	374
960 min Summer	6.697	0.0	492
1440 min Summer	4.839	0.0	736
2160 min Summer	3.490	0.0	1104
2880 min Summer	2.766	0.0	1468
4320 min Summer	1.989	0.0	2180
5760 min Summer	1.573	0.0	2904
7200 min Summer	1.311	0.0	3672

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Micro Drainage	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
8640 min Summer	80.456	0.016	0.0	0.0	O K
10080 min Summer	80.455	0.015	0.0	0.0	O K
15 min Winter	80.530	0.090	0.5	0.6	O K
30 min Winter	80.543	0.103	0.5	0.8	O K
60 min Winter	80.542	0.102	0.5	0.7	O K
120 min Winter	80.525	0.085	0.5	0.5	O K
180 min Winter	80.512	0.072	0.5	0.4	O K
240 min Winter	80.502	0.062	0.4	0.3	O K
360 min Winter	80.490	0.050	0.3	0.2	O K
480 min Winter	80.485	0.045	0.3	0.1	O K
600 min Winter	80.481	0.041	0.2	0.1	O K
720 min Winter	80.478	0.038	0.2	0.1	O K
960 min Winter	80.474	0.034	0.2	0.1	O K
1440 min Winter	80.469	0.029	0.1	0.1	O K
2160 min Winter	80.465	0.025	0.1	0.0	O K
2880 min Winter	80.462	0.022	0.1	0.0	O K
4320 min Winter	80.459	0.019	0.0	0.0	O K
5760 min Winter	80.456	0.016	0.0	0.0	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
8640 min Summer	1.129	0.0	4360
10080 min Summer	0.994	0.0	5072
15 min Winter	138.153	0.0	21
30 min Winter	90.705	0.0	30
60 min Winter	56.713	0.0	48
120 min Winter	34.246	0.0	80
180 min Winter	25.149	0.0	110
240 min Winter	20.078	0.0	140
360 min Winter	14.585	0.0	194
480 min Winter	11.622	0.0	254
600 min Winter	9.738	0.0	316
720 min Winter	8.424	0.0	372
960 min Winter	6.697	0.0	502
1440 min Winter	4.839	0.0	744
2160 min Winter	3.490	0.0	1112
2880 min Winter	2.766	0.0	1400
4320 min Winter	1.989	0.0	2152
5760 min Winter	1.573	0.0	2936

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Micro Drainage	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
7200 min Winter	80.455	0.015	0.0	0.0	O K
8640 min Winter	80.454	0.014	0.0	0.0	O K
10080 min Winter	80.453	0.013	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
7200 min Winter	1.311	0.0	3632
8640 min Winter	1.129	0.0	4288
10080 min Winter	0.994	0.0	5064

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Micro Drainage	Source Control 2020.1	


Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.004

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From:	To: (ha)	From:	To: (ha)	From:	To: (ha)
0	4 0.001	4	8 0.001	8	12 0.001

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Micro Drainage	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 81.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.09720	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	8.0
Max Percolation (l/s)	11.1	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	80.440	Cap Volume Depth (m)	0.450