

MONSON

Structural Engineering
Roads & Car Parks
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Technical Audits & Assessments

**Barkham Road,
Barkham,
Berkshire,
RG41 4TJ**

Barkham Road

Drainage Strategy

Issue	B
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Contents

1.00 Introduction 2

2.00 Existing Site 2

3.00 Site Geology 4

4.00 Drainage Strategy 6

Surface water.....8

 Above the 1 in 30 year event 9

 Storage calculation 9

Foul Water 10

Surcharge condition.....10

Exceedance routes.....12

5.00 Water Quality.....13

6.00 Environment Agency Permit.....16

7.00 Maintenance 17

8.00 Conclusions 20

Appendices 21

Appendix A – Site Location Plan and Development Proposals.....22

Appendix B – UK SuDS Greenfield Estimation.....23

Appendix C – Drainage Strategy Layout 24

Appendix D – Flood Risk Maps.....25

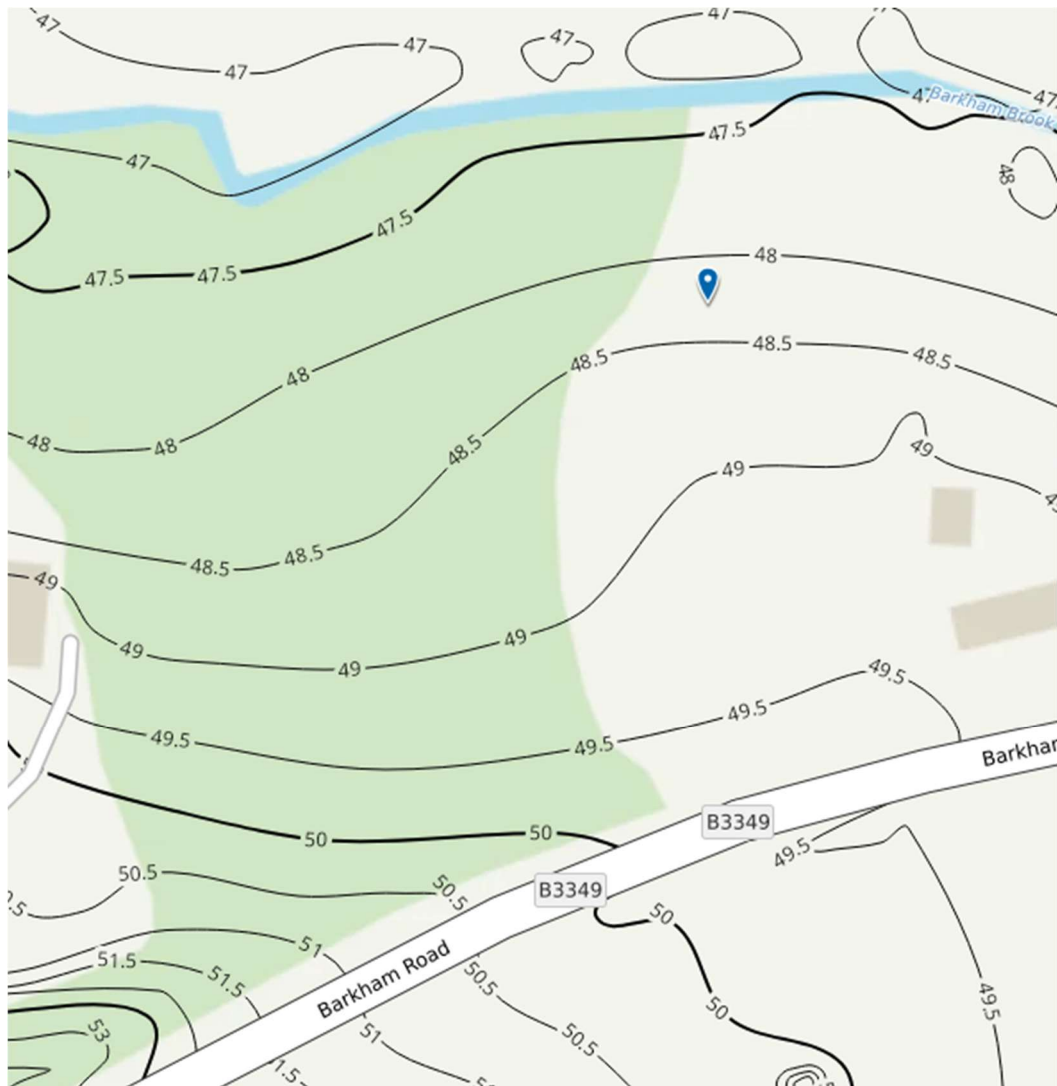
Appendix E – Exceedance flow paths.....26

1.00 Introduction

- 1.01 Monson Engineering have been instructed to prepare a Surface Water Drainage Strategy and sustainable drainage management and maintenance plan to support a planning application for the construction of a single dwelling residential development at Barkham Road, Barkham, Berkshire, RG41 4TJ.
- 1.02 The site of the proposal is a previously undeveloped plot of land located on the north side of Barkham Road adjacent to a small cluster of houses found between Barkham and Arborfield Cross.
- 1.03 The total site area, comprising undeveloped woodland, totals 1.4ha.
- 1.04 The approximate National Grid Reference of the site is SU 77523 66965 (477523 Easting, 166965 Northing).
- 1.05 The location of the site, as well as development proposals, can be found in **Appendix A**.

2.00 Existing Site

- 2.01 Topographical information taken from Scalgo mapping software indicates that there is a general slope from the entrance at the south of the site to the north. The levels indicate a fall from an average of 50.5m A.O.D to 47.5m A.O.D. The Scalgo mapping is included below:



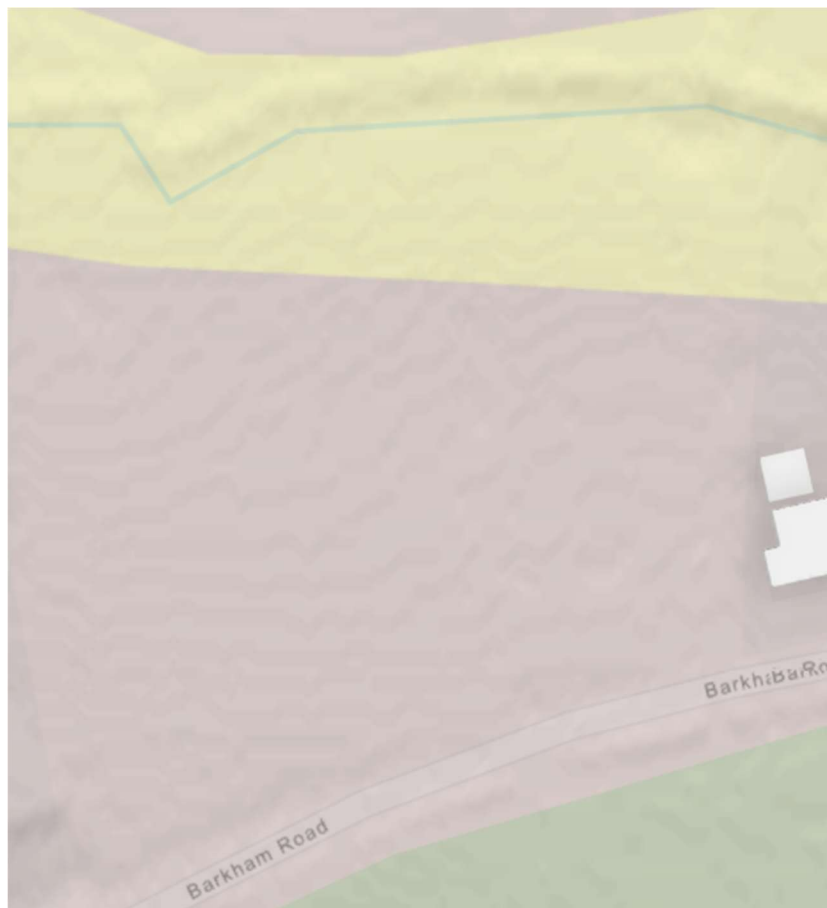
Topographical information – scalgo.com

- 2.02 The site is bounded by Barkham Road to the south with Barkham Brook sited at the northern boundary. There is a short run of semi-detached properties on the eastern boundary, and a similar pattern of sparse clusters of properties continues on for half a mile towards Barkham. To the west a small cluster of residential properties leads on to Arborfield. The wider catchment generally consists of farmland with the occasional cluster of residential properties.

- 2.03 The site itself is a densely populated cluster of woodland with no previous development history. The site will therefore be considered as greenfield. A proposed site plan is included in **Appendix A**.
- 2.04 The main site of the proposal is in the northeast corner of the development site boundary.

3.00 Site Geology

- 3.01 A desktop review of the British Geological Survey maps has shown that the site is underlain by bedrock described as Tunbridge Wells Sand Formation-Siltstone. An excerpt is included below:



Geology results excerpt – geologyviewer.bgs.ac.uk

Geology Results

Bedrock geology

London Clay Formation-Clay, silt and sand. These sedimentary rocks are marine in origin. They are detrital and comprise coarse- to fine-grained slurries of debris from the continental shelf flowing into a deep-sea environment, forming distinctively graded beds.

Minimum Age (Years):	47,800,000
Minimum Period:	Palaeogene
Maximum Age (Years):	56,000,000
Maximum Period:	Palaeogene
BGS Maps Portal Link:	View

Geology results key – geologyviewer.bgs.ac.uk

3.02 The BGS mapping has returned soil consisting of London Clay. This together with the findings of the Flood Risk Assessment pertaining to flood risk suggest that there is poor infiltration on site. Therefore, infiltration testing to BRE 365 has been ruled out.

4.00 Drainage Strategy

4.01 The contributing areas for this application have been identified as the roofs of the main building and the garage, as well as the access road.

4.02 The National Standards for Sustainable Drainage Systems (SuDS) require that drainage systems mimic natural runoff as closely as possible or manage runoff as close to the source as possible while optimising concurrent provision of amenable space and biodiversity. Considerations for water quality must also be made and implemented so that hazard mitigation is commensurate with the identified sources as per the CIRIA hazard mitigation indices outlined in the SuDS Manual.

4.03 To this end, the following hierarchy for surface water runoff destinations is advised:

- Priority 1: Collection for non-potable use.
- Priority 2: Infiltration to ground.
- Priority 3: Discharge to an above ground surface water body.
- Priority 4: Discharge to a surface water sewer, or another piped surface water drainage system.
- Priority 5: Discharge to a combined sewer.

4.04 The above priorities have been used as pivots to determine the most appropriate outfall. The section below will elaborate further on the decision process.

4.04.1. Priority 1: Collection for non-potable use

3 water butts and a rainwater harvesting tank are proposed for the site. It is intended that the named structures will retain roof water for all events up to the 1 in 30 year storm event.

4.04.2. Priority 2: Infiltration to ground

Because the site is underlain by London clay, infiltration to the ground has been deemed to be an unreliable method of surface water discharge.

4.04.3. Priority 3: Discharge to an above ground surface water body.

As the site is bounded by Barkham Brook to the north, this watercourse has been identified as a suitable discharge destination. Because this watercourse is a **main river**, discharge to the brook will be subject to the EA permit exemption process which will be discussed further on in this report.

4.04.4. Priority 4: Discharge to a surface water sewer, or another piped surface water drainage system.

As the development sits at the lower end of the site topographically, a piped outfall destination has been found to be impractical for this development.

4.04.5. Priority 5: Discharge to a combined sewer

Because there has been a more favourable outfall identified in discharging to Barkham Brook, discharge to a combined sewer has been ruled out.

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4.05 Considering the above review of the SuDS hierarchy, discharge to Barkham Brook has been found to be the most suitable option for this development.

## Surface water

- 4.06 The catchment of the SuDS proposal will consist exclusively of a single residential dwelling, a garage outbuilding, and vehicular access and parking.
- 4.07 The vehicular access is proposed to be a Type C pervious pavement, meaning no proposed infiltration to the subgrade.
- 4.08 The roof arrangement of the main building consists of 4 sets of roof fields at the 4 corners. Each set will direct collected rainwater to the outer extremities. The 2 northern sets are designed to fall into a pair of water butts, while the 2 southern sets are designed to discharge to a feature pond adjacent to the building.
- 4.09 The outbuilding (garage) is also designed to discharge to a single water butt.
- 4.10 The water butts are to be sized to collect all rainfall running off from their respective roofs in the 1 in 30 year rainfall event.
- 4.11 The majority of the runoff collected by the permeable access road surface will be retained within the granular subbase and rainwater harvesting tank.
- 4.12 The overflow from the water butts, and the granular subbase of the permeable access road are to be directed to a rainwater harvesting tank proposed beneath the garage.
- 4.13 The feature pond will be fitted with an overflow turret designed to control excess water levels following ingress of runoff from the adjacent roof as discussed in previous sections. The overflow pipe will be directed towards Barkham Brook.
- 4.14 All runoff apart from the pond overflow conveyed by the network described above will be attenuated to achieve the greenfield discharge rate in keeping with the requirements stipulated within the National Standards for SuDS.
- 4.15 The discharge will be controlled via a pump and attenuation tank arrangement that will outfall to Barkham Brook.

### **Above the 1 in 30 year event**

- 4.16 To cater to events more severe than the 1 in 30 year event, the water butts are to be fitted with overflow outlets that will join a conventional drainage system and convey the excess to the rainwater harvesting tank and eventually discharge at a controlled rate to Barkham Brook.

### **Storage calculation**

- 4.17 As the site is classified as greenfield site (and the discharge destination is a watercourse), discharge will be limited to the 50% Annual Event Probability (AEP) discharge rate in keeping with National Standards for SuDS.
- 4.18 The UK SuDS greenfield estimation tool was consulted, and a discharge rate of **5.5l/s** was derived. This was based on a total impermeable area for the site has been measured as 1,176m<sup>2</sup>. The estimation report can be found in **Appendix B**.
- 4.19 Hydraulic modelling software (Causeway Flow) was consulted to estimate the required storage volume based on the 50% AEP discharge rate and the proposed total impermeable area. The estimated attenuation volume was given as 56m<sup>3</sup> to attenuate the 1 in 100yr + 45%cc event.
- 4.20 The 3 water butts will have an approximate volume of 2m<sup>3</sup>, and so will provide a total storage volume of 6m<sup>3</sup>.
- 4.21 The rainwater harvesting tank will be assumed to retain approximately 10m<sup>3</sup>.
- 4.22 The assumed effective storage found in the subbase of the permeable access road has been calculated as 16m<sup>3</sup>.
- 4.23 The above storage leaves 24m<sup>3</sup> which will be provided in the attenuation tank up stream of the final discharge to Barkham Brook.
- 4.24 The discharge rate will be controlled by a pump that will discharge at **5.5l/s**.
- 4.25 While the discharge rate will remain the same to meet SuDS obligations, the above storage volume provisions, proportions, and even totals are given as proof-of-concept and are subject to change at detail design stage. A copy of the drainage layout is included in **Appendix C**.

## **Foul Water**

- 4.26 The foul water is to be collected via conventional underground drainage network and conveyed to a wastewater treatment plant. The treated effluent will be delivered to Barkham Brook separately from the surface water discharge train via a packaged pump station.
- 4.27 The anticipated occupancy for the development is 10 people.
- 4.28 The foul discharge rate associated with the development has been calculated based on occupancy in line with Flows and Loads 4 as published by British Water. Considering an occupancy of 10 people, a daily flow of 1,500l/d has been calculated. Therefore, the peak flow per second is 0.017l/s. A copy of the drainage layout is included in **Appendix C**.

## **Surcharge condition**

- 4.29 The accompanying Flood Risk Assessment (FRA) produced for the site has found that the site is subject to high risk of flooding from rivers and is also at high risk of flooding from reservoirs and other artificial sources. The flood risk mapping is included in **Appendix D**.
- 4.30 The flood levels obtained from the Product 6 flood data provided by the Environment Agency found that there is ample space to ensure no construction or change in level within the flood plain (defined by the level 47.24m A.O.D). This, together with signing up to the Flood Warning Service, would give credence to the findings that flood risk on site has been minimised. Despite this, there is a chance that the outfalls to Barkham Brook could be surcharged due to a rise in the watercourse level. In light of this, the SuDS strategy will have contingencies designed into the system to compensate for surcharged outfalls.
- 4.31 The extents of flooding as derived from the more accurate Product 6 data have been found to be largely confined to the southern bank of Barkham Brook, meaning that the vast majority of works will be carried out outside of the floodplain. That said, the outfalls themselves are still proposed adjacent to the banks, and therefore, may still be surcharged in extreme events
- 4.32 All water butts have been designed as bespoke open-top structures, meaning that where the designed overflow outlets are surcharged, they will be able to overflow directly towards Barkham Brook.

- 4.33 The water butts are to be fitted with slow letting features that ensure that problems with stagnant water never arise, and that capacity for storm events can realistically be expected.
- 4.34 The feature pond will be fitted with an overflow outlet to allow balancing during storm events. Chamber SWIC 10 will be fitted with a grated cover to allow overflow should the outfall be surcharged.
- 4.35 Chambers SWIC 6 and SWIC 7 are also to be fitted with grated covers to serve as overflow outlets for any flows directed toward the rainwater harvesting tank.

### Exceedance routes

- 4.36 The exceedance routes described above are intended to discharge over land and eventually into Barkham Brook.
- 4.37 As previously mentioned, the system will be designed to retain all roof water on site in the 1 in 30-year event, with any overtopping in more severe events being attenuated to the greenfield rate up to the 1 in 100 year + 45% cc event.
- 4.38 Exceedance under normal functioning is only anticipated during times when the outfalls are surcharged due to a rise in river levels.
- 4.39 During a surcharge event, rainfall collected in the water butts will overtop the structures and flow overland toward Barkham Brook. There are no proposed dwellings intercepting the flow paths in the current site arrangement.
- 4.40 When chambers SWIC 6 and SWIC 7 (which are proposed to serve as overflow outlet to the surcharged rainwater harvesting tank) are surcharged to the point that they overflow, the overflow will be directed north between the main residence and the garage, making its way toward Barkham Brook.
- 4.41 All grated covers and the wastewater treatment plant have been positioned in Flood Zone 1. More accurate Product 6 Data has been reviewed to confirm that the extent of flooding is less severe than illustrated on the publicly available planning flood maps. An exceedance flow path layout is included in **Appendix E**.

## 5.00 Water Quality

5.01 The National Standards for SuDS also require consideration for pollution mitigation in line with the CIRIA SuDS Manual.

5.02 Tables are given for the land uses and their associated pollutant indices, as well as the accompanying mitigation index table which describes the various SuDS devices and their mitigative properties. The tables are shown below:

**TABLE 26.14** Impermeability and pollution indices for different land use types<sup>1</sup>

| Land use surface type (LUST)                  | Impermeability (IMP <sub>RF</sub> ) | Total suspended solids pollution index (PI <sub>TSS</sub> ) | Organic pollution index (PI <sub>Org</sub> ) | Hydrocarbon pollution index (PI <sub>PAH</sub> ) | Metals pollution index (PI <sub>HM</sub> ) |
|-----------------------------------------------|-------------------------------------|-------------------------------------------------------------|----------------------------------------------|--------------------------------------------------|--------------------------------------------|
| Roofs                                         |                                     |                                                             |                                              |                                                  |                                            |
| ▪ industrial/commercial                       | 1.0                                 | 0.3                                                         | 0.3–0.4                                      | 0.2                                              | 0.4–0.8                                    |
| ▪ residential                                 | 0.9                                 | 0.4–0.5                                                     | 0.6–0.7                                      | 0.1                                              | 0.2–0.5                                    |
| Highways                                      |                                     |                                                             |                                              |                                                  |                                            |
| ▪ motorways                                   | 0.8–0.9                             | 0.9                                                         | 0.7                                          | 0.9                                              | 0.8                                        |
| ▪ major arterial highways                     | 0.7–0.8                             | 0.8                                                         | 0.7                                          | 0.8                                              | 0.8                                        |
| ▪ urban distributor roads                     | 0.6–0.7                             | 0.7–0.8                                                     | 0.5                                          | 0.8                                              | 0.7                                        |
| ▪ residential streets                         | 0.4–0.6                             | 0.4                                                         | 0.6                                          | 0.6                                              | 0.6                                        |
| ▪ pavements                                   | 0.5–0.6                             | 0.4                                                         | 0.6                                          | 0.3                                              | 0.3                                        |
| Car parks/hardstanding                        |                                     |                                                             |                                              |                                                  |                                            |
| ▪ industrial/commercial                       | 0.6–0.8                             | 0.6–0.7                                                     | 0.6–0.7                                      | 0.7                                              | 0.4–0.5                                    |
| ▪ driveways (residential)                     | 0.5                                 | 0.5                                                         | 0.6                                          | 0.4                                              | 0.3                                        |
| Open areas                                    |                                     |                                                             |                                              |                                                  |                                            |
| ▪ gardens (all types)                         | 0.1                                 | 0.3                                                         | 0.2–0.3                                      | 0                                                | 0.01                                       |
| ▪ parks/golf courses                          | 0.2                                 | 0.2–0.3                                                     | 0.2                                          | 0                                                | 0.02                                       |
| ▪ grassed areas (including verges, all types) | 0.1                                 | 0.2–0.3                                                     | 0.2–0.3                                      | 0.05                                             | 0.05                                       |

**Note**

<sup>1</sup> Pollution index values are based on reported land use type EMC distributions and impact potential thresholds from House *et al* (1993), Luker and Montague (1994), Butler and Clark (1995), D'Arcy *et al* (2000), Mitchell (2005) and Moy *et al* (2003).

*Table 26.14 – CIRIA SuDS Manual*

**TABLE 26.15 Pollution mitigation indices for different SuDS components and conventional pipe drainage**

| SuDS type                            | Total suspended solids pollution mitigation index (PMI <sub>TSS</sub> ) | Hydrocarbon pollution mitigation index (PMI <sub>PAH</sub> ) | Organic pollution mitigation index (PMI <sub>Org</sub> ) | Heavy metal pollution mitigation index (PMI <sub>HM</sub> ) |
|--------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------|-------------------------------------------------------------|
| Filter drains                        | 0.6                                                                     | 0.8                                                          | 0.7                                                      | 0.7                                                         |
| Porous asphalt                       | 0.7                                                                     | 0.9                                                          | 0.9                                                      | 0.9                                                         |
| Porous paving                        | 0.2                                                                     | 0.3                                                          | 0.2                                                      | 0.3                                                         |
| Sedimentation tank                   | 0.95                                                                    | 0.95                                                         | 0.95                                                     | 0.95                                                        |
| Green roof                           | 0.8–0.9                                                                 | 0.9                                                          | 0.5                                                      | 0.7–0.9                                                     |
| Filter strip                         | 0.9                                                                     | 0.8                                                          | 0.8                                                      | 0.7                                                         |
| Swales                               | 0.7                                                                     | 0.6                                                          | 0.4                                                      | 0.4                                                         |
| Soakaways                            | 0.3                                                                     | 0.6                                                          | 0.5                                                      | 0.5                                                         |
| Infiltration trench                  | 0.3                                                                     | 0.6                                                          | 0.5                                                      | 0.5                                                         |
| Infiltration basin                   | 0.05                                                                    | 0.05                                                         | 0.01                                                     | 0.05                                                        |
| Retention pond                       | 0.6                                                                     | 0.5                                                          | 0.6                                                      | 0.5                                                         |
| Detention basin                      | 0.7                                                                     | 0.7                                                          | 0.8                                                      | 0.6                                                         |
| Extended detention basins            | 0.4                                                                     | 0.4                                                          | 0.4                                                      | 0.4                                                         |
| Lagoons                              | 0.9                                                                     | 0.9                                                          | 0.9                                                      | 0.8                                                         |
| Constructed wetlands                 |                                                                         |                                                              |                                                          |                                                             |
| ▪ subsurface flow                    | 0.2                                                                     | 0.1                                                          | 0.1                                                      | 0.1                                                         |
| ▪ surface flow                       | 0.4                                                                     | 0.2                                                          | 0.2                                                      | 0.2                                                         |
| Conventional gully and pipe drainage | 1.0                                                                     | 1.0                                                          | 1.0                                                      | 1.0                                                         |

*Table 26.15 – CIRIA SuDS Manual*

5.03 The land use identified is the residential roof and associated vehicular access/parking, which has the following hazard indices:

| Land use                                      | TSS pollution index | Organic pollution index | Hydrocarbon pollution index | Metals pollution index |
|-----------------------------------------------|---------------------|-------------------------|-----------------------------|------------------------|
| Carparks/Hardstanding (residential driveways) | 0.5                 | 0.6                     | 0.4                         | 0.3                    |

5.04 The SuDS devices used in this proposal and their associated mitigation indices are given as follows:

| SuDS type                            | TSS pollution index | Organic pollution index | Hydrocarbon pollution index | Metals pollution index |
|--------------------------------------|---------------------|-------------------------|-----------------------------|------------------------|
| Porous paving                        | 0.2                 | 0.2                     | 0.3                         | 0.3                    |
| Conventional gully and pipe drainage | 1.0                 | 1.0                     | 1.0                         | 1.0                    |

5.05 The tables above show that the sum of the mitigation indices surpasses that of the hazard indices, therefore the water quality goals for the scheme have been achieved.

## 6.00 Environment Agency Permit

6.01 The Environment Agency lists different scenarios pertaining to construction works adjacent to the banks of main rivers as well as their general requirements for the respective exemption criteria. The idea is that if an applicant can demonstrate that they have met the criteria for an exemption for the intended works, they do not have to apply for an environmental permit.

6.02 Under the web page title “Exempt flood risk activities: environmental permits” found here:

<https://www.gov.uk/government/publications/environmental-permitting-regulations-exempt-flood-risk-activities/exempt-flood-risk-activities-environmental-permits>

item 12, titled “*Outfall pipes less than 300mm diameter through a head wall (FRA12)*,” gives the following criteria for an exemption from a permit:

- *You plan your works to ensure there are no significant adverse effects on protected and priority species of importance for nature conservation - read Natural England’s guidance on construction near protected areas and wildlife.*
- *The headwall is not located within 50m of another man-made structure on or in the main river*
- *If the headwall is on a non-tidal main river, the outfall pipe is aligned to an angle of between 30° and 60° to the direction of flow in the river.*
- *The diameter of the outfall pipe is less than 300mm.*
- *The height of the headwall is no more than 1.5m or no more than 75% of the height of the bank, whichever is less.*
- *The total length of bank affected during construction of the headwall is no more than 1.5m.*
- *The headwall, wing walls and apron do not project beyond the line of the bank prior to the works being carried out.*
- *The headwall is not within 8m of a flood defence structure or river control works.*

- *The outfall pipe does not pass through or under any culvert, remote defence, river control works or sea defence, or any raised embankment or wall forming part of the bank of the main river.*
- *You remove from the floodplain all excavated material nor re-used on the site of the works.*
- *Any pipe that discharges through the headwall does not pass within 8m of a flood defence structure.*

6.03 An ecological survey may be required to ensure that there are no priority species of importance as outlined in the first criterion above.

6.04 At the time of writing, all other criteria are achievable.

6.05 Even in the case that all criteria are achievable, the exemption must still be registered with the Environment Agency.

## **7.00 Maintenance**

7.01 Maintenance of drainage features is usually carried out when necessary, such as when there is blockage resulting in flooding. Accompanying this should be a maintenance routine that serves to prevent such scenarios or identify developing problems within the system.

7.02 The items identified as requiring a maintenance schedule are listed as follows:

- Pervious pavement proposed in the access road,
- Conventional piped drainage system

7.03 It is noted that the rainwater harvesting tank, feature pond, wastewater treatment plant, and pump station will also require maintenance schedules. The harvesting tank, pump station, and wastewater treatment plant maintenance is to be sought from their respective manufacturers. The maintenance of the feature pond is to be advised by a specialist.

7.04 Maintenance of permeable pavements as presented within the CIRIA SuDS manual (C753) is included below:

| <b>TABLE 20.15 Operation and maintenance requirements for pervious pavements</b> |                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Maintenance schedule</b>                                                      | <b>Required action</b>                                                                                                                                                               | <b>Typical frequency</b>                                                                                                                                                                                                                                                                                                     |
| Regular maintenance                                                              | Brushing and vacuuming (standard cosmetic sweep over whole surface)                                                                                                                  | Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment |
| Occasional maintenance                                                           | Stabilise and mow contributing and adjacent areas                                                                                                                                    | As required                                                                                                                                                                                                                                                                                                                  |
|                                                                                  | Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying                                                                | As required – once per year on less frequently used pavements                                                                                                                                                                                                                                                                |
| Remedial Actions                                                                 | Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving                                             | As required                                                                                                                                                                                                                                                                                                                  |
|                                                                                  | Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material | As required                                                                                                                                                                                                                                                                                                                  |
|                                                                                  | Rehabilitation of surface and upper substructure by remedial sweeping                                                                                                                | Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)                                                                                                                                                                                                                     |
| Monitoring                                                                       | Initial inspection                                                                                                                                                                   | Monthly for three months after installation                                                                                                                                                                                                                                                                                  |
|                                                                                  | Inspect for evidence of poor operation and/or weed growth – if required, take remedial action                                                                                        | Three-monthly, 48 h after large storms in first six months                                                                                                                                                                                                                                                                   |
|                                                                                  | Inspect silt accumulation rates and establish appropriate brushing frequencies                                                                                                       | Annually                                                                                                                                                                                                                                                                                                                     |
|                                                                                  | Monitor inspection chambers                                                                                                                                                          | Annually                                                                                                                                                                                                                                                                                                                     |

*Maintenance Schedule for pervious pavements – CIRIA SuDS Manual*

7.05 The maintenance of conventional piped drainage is carried out as outlined below:

|                                                                                                                                                                                                                                                                               |                            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| Inlets, outlets, controls and inspection chambers                                                                                                                                                                                                                             |                            |
| <b>Regular Maintenance</b>                                                                                                                                                                                                                                                    | <b>Frequency</b>           |
| <b>Inlets, outlets and surface control structures</b><br><br>Inspect surface structures removing obstructions and silt as necessary. Check there is no physical damage.<br><br>Trim vegetation 1m min. surround to structures and keep hard aprons free from silt and debris. | Monthly<br><br><br>Monthly |
| Inspection chambers and below ground control chambers                                                                                                                                                                                                                         |                            |
| Remove cover and inspect ensuring water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt.<br><br>Undertake inspection after leaf fall in autumn                                                                                    | Annually                   |

## 8.00 Conclusions

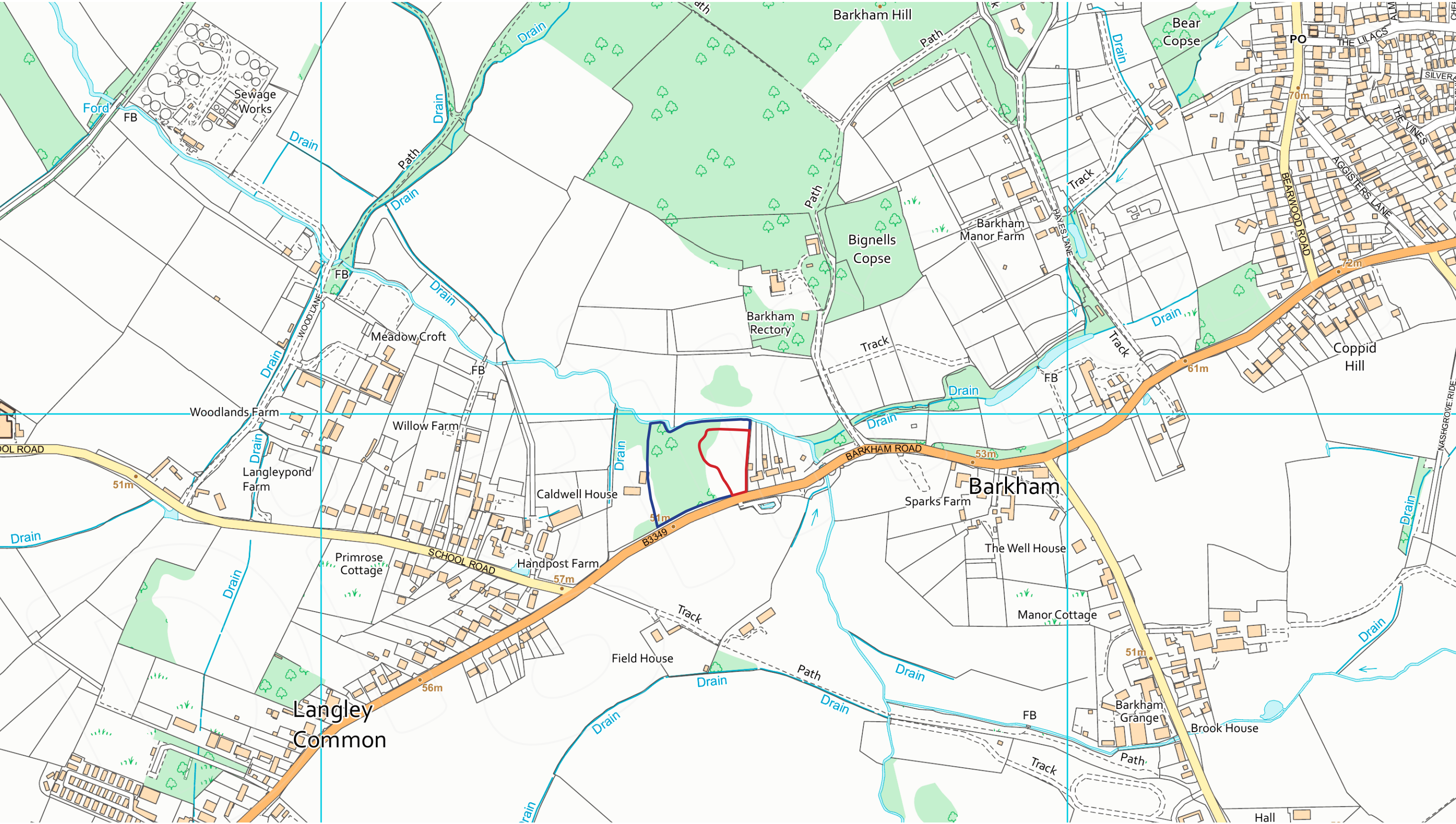
- 8.01 The preceding drainage strategy was for the construction of a single residential dwelling and a garage.
- 8.02 The site of the proposal is an undeveloped plot of land found in a sparsely developed residential estate.
- 8.03 Discharge to watercourse (Barkham Brook) has been deemed the most appropriate outfall for the site.
- 8.04 The drainage strategy will harvest the surface water runoff from the roofs up to the 1 in 30 year rainfall event with the use of water butts and a rainwater harvesting tank. It is anticipated that the majority of the runoff in the same event from the permeable road will be contained within the granular subbase, with runoff in excess of this for both the roofs and the road being attenuated and discharged at greenfield rate up to the 1 in 100 year + 45%cc event.
- 8.05 Part of the roofs will drain into an adjacent feature pond, which will be fitted with an overflow turret. The overflow turret will direct excess flows toward Barkham Brook to the north.
- 8.06 The foul water will be directed to a wastewater treatment plant, which will in turn discharge treated effluent into Barkham Brook via a pump.
- 8.07 The accompanying flood risk assessment has found that the site is subject to high flood risk from rivers and seas, and flood risk from reservoirs and artificial sources. The SuDS strategy therefore makes contingencies for the possibility of surcharged outfalls.
- 8.08 The water butts, and several grated outfalls have been designed to allow controlled exceedance of the system.
- 8.09 All exceedance flows will be directed over land towards Barkham Brook while avoiding interaction with the 2 proposed structures.
- 8.10 Discharge to Barkham Brook will require registration of exemption with the Environment Agency.

## **Appendices**

## **Appendix A – Site Location Plan and Development Proposals**

SITE LOCATION PLAN

LAND NORTH OF BARKHAM ROAD, WOKINGHAM, RG41 4TJ



0m 500m

1:5000

- APPLICATION SITE BOUNDARY
- AREA UNDER APPLICANT OWNERSHIP

Hawkes Architecture - Barkham Road  
Site Plan 1 to 500  
Showing 0.5 hectare red line



## Appendix B – UK SuDS Greenfield Estimation

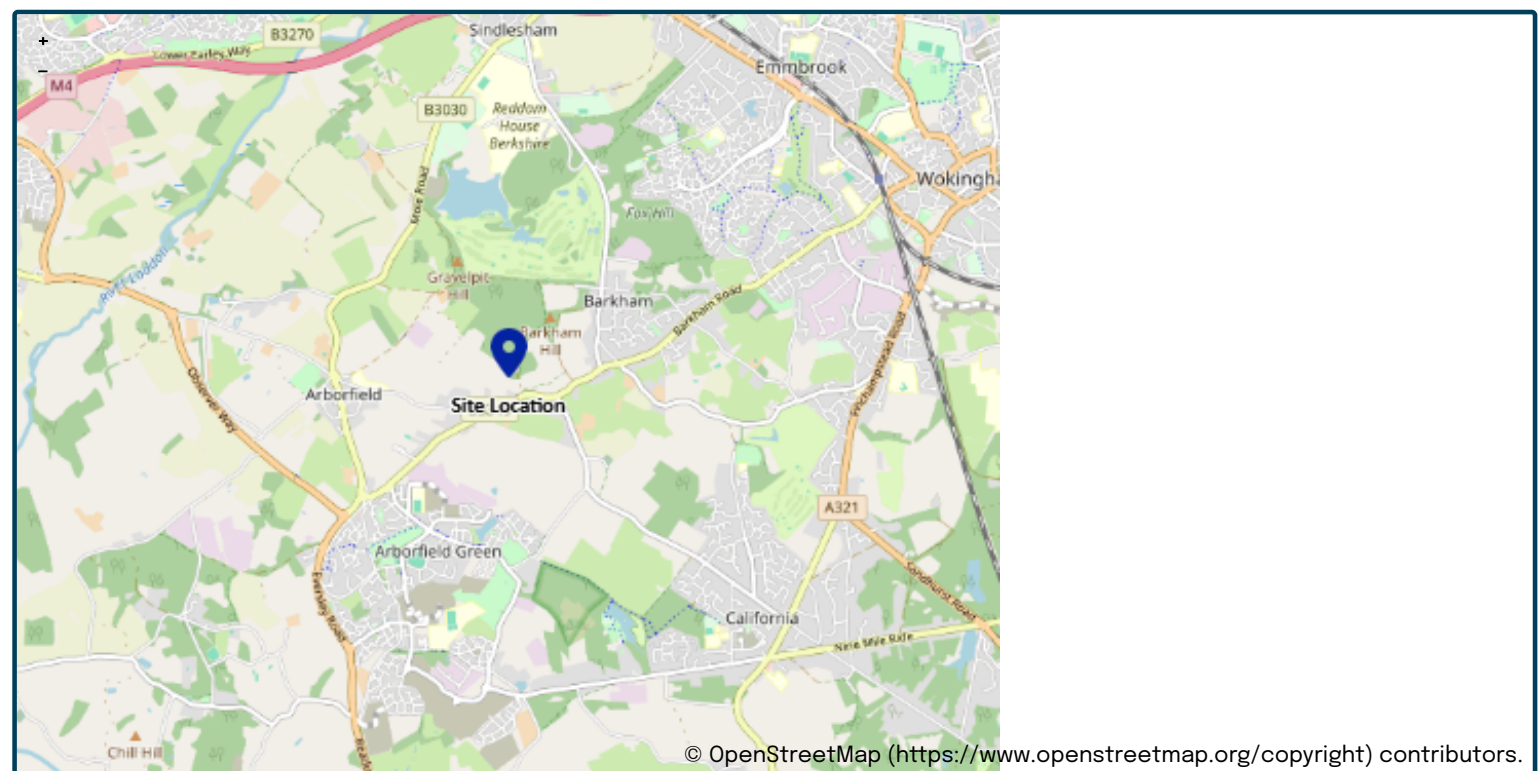
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015).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

## Project details

|               |                |
|---------------|----------------|
| Date          | 08/07/2026     |
| Calculated by | Taurai Harahwa |
| Reference     | 26191          |
| Model version | 2.2.3          |

## Location

|               |              |
|---------------|--------------|
| Site name     | Barkham Road |
| Site location | Barkaham     |



|                                       |        |
|---------------------------------------|--------|
| Site easting (British National Grid)  | 477580 |
| Site northing (British National Grid) | 166913 |

## Site details

|                      |     |    |
|----------------------|-----|----|
| Total site area (ha) | 1.4 | ha |
|----------------------|-----|----|

# Greenfield runoff

## Method

|                            |                           |                       |                  |
|----------------------------|---------------------------|-----------------------|------------------|
| Method                     | <div>IH124</div>          |                       |                  |
| IH124                      |                           |                       |                  |
|                            | <u>My value</u>           | <input type="radio"/> | <u>Map value</u> |
| SAAR (mm)                  | <div>654mm</div>          |                       | <div>654</div>   |
| How should SPR be derived? | <div>WRAP soil type</div> |                       |                  |
| WRAP soil type             | <div>4</div>              | <input type="radio"/> | <div>4</div>     |
| SPR                        | <div>0.47</div>           |                       |                  |
| QBar (IH124) (l/s)         | <div>6.2l/s</div>         |                       |                  |

## Growth curve factors

|                        |                 |                       |                  |
|------------------------|-----------------|-----------------------|------------------|
|                        | <u>My value</u> | <input type="radio"/> | <u>Map value</u> |
| Hydrological region    | <div>6</div>    |                       | <div>6</div>     |
| 1 year growth factor   | <div>0.85</div> |                       |                  |
| 2 year growth factor   | <div>0.88</div> |                       |                  |
| 10 year growth factor  | <div>1.62</div> |                       |                  |
| 30 year growth factor  | <div>2.3</div>  |                       |                  |
| 100 year growth factor | <div>3.19</div> |                       |                  |
| 200 year growth factor | <div>3.74</div> |                       |                  |

## Results

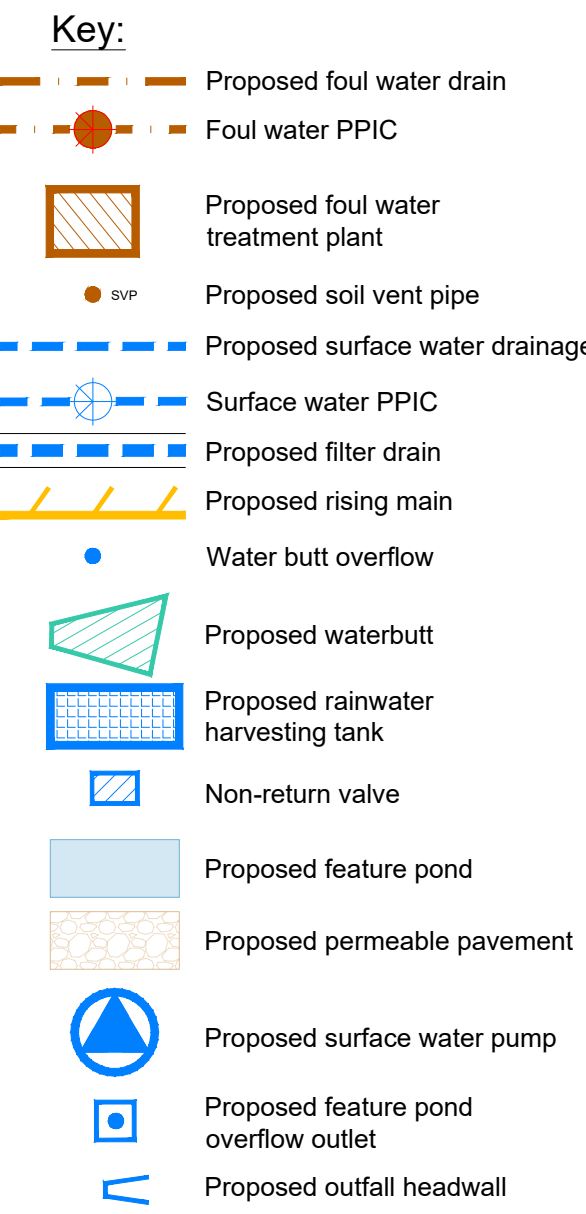
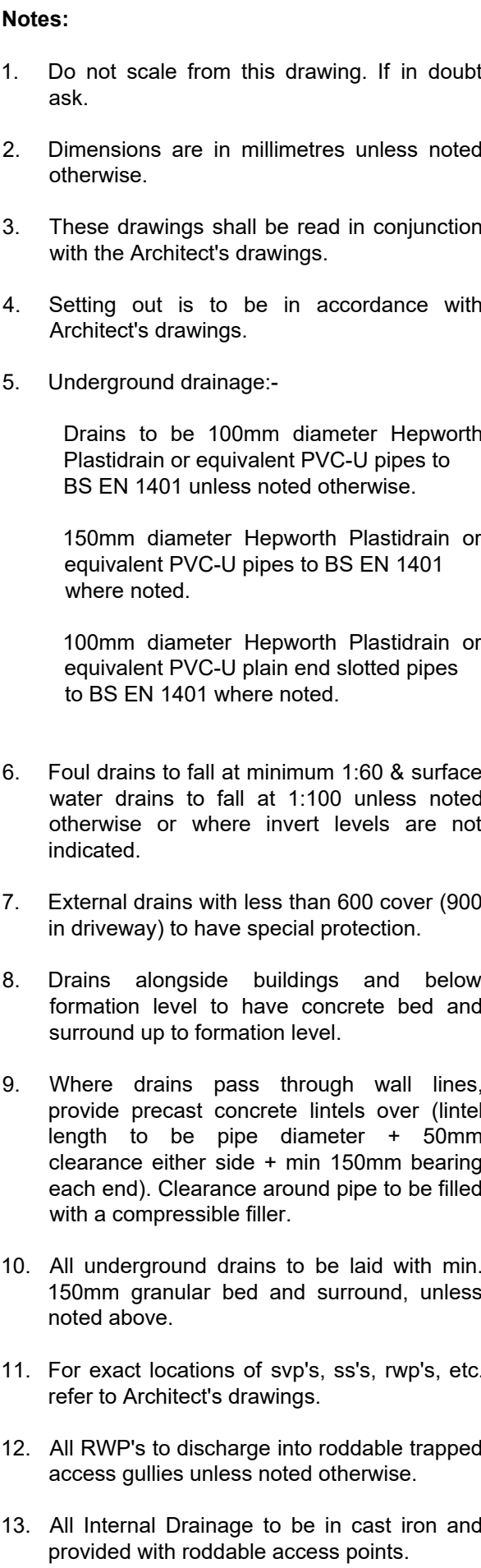
|                           |                    |
|---------------------------|--------------------|
| Method                    | <div>IH124</div>   |
| Flow rate 1 year (l/s)    | <div>5.3l/s</div>  |
| Flow rate 2 year (l/s)    | <div>5.5l/s</div>  |
| Flow rate 10 years (l/s)  | <div>10.1l/s</div> |
| Flow rate 30 years (l/s)  | <div>14.4l/s</div> |
| Flow rate 100 years (l/s) | <div>19.9l/s</div> |
| Flow rate 200 years (l/s) | <div>23.3l/s</div> |

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent ‘zero’ figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

### Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.2.3) developed by HR Wallingford and available at [uksuds.com](https://www.uksuds.com/) (<https://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 [uksuds.com/terms-conditions](https://www.uksuds.com/terms-conditions) (<https://www.uksuds.com/terms-conditions>). The outputs from this tool have been used to estimate 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, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

## Appendix C – Drainage Strategy Layout



**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.

|                           |       |    |                |
|---------------------------|-------|----|----------------|
| © Monson Engineering Ltd. |       |    |                |
|                           | A     | TH | 08/07/2026     |
|                           | Issue | By | Date           |
|                           |       |    | Original Issue |
|                           |       |    | Amendments     |

**MONSON**

---

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Project:  
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Berkshire  
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|                   |                    |    |          |            |
|-------------------|--------------------|----|----------|------------|
| Original Drawing: | Prepared           | TH | Approved | MW         |
| Origin:           | Crowborough        |    | Size     | A1         |
| Current Issue:    | Preliminary        | MW | Date     | 08/07/2026 |
| Drawing Status:   | <b>PRELIMINARY</b> |    |          |            |

Description:

Preliminary Drainage Layout

|                  |                      |             |
|------------------|----------------------|-------------|
| Scale:<br>1:1000 | Dwg No:<br>26191/201 | Issue:<br>A |
|------------------|----------------------|-------------|

## Appendix D – Flood Risk Maps

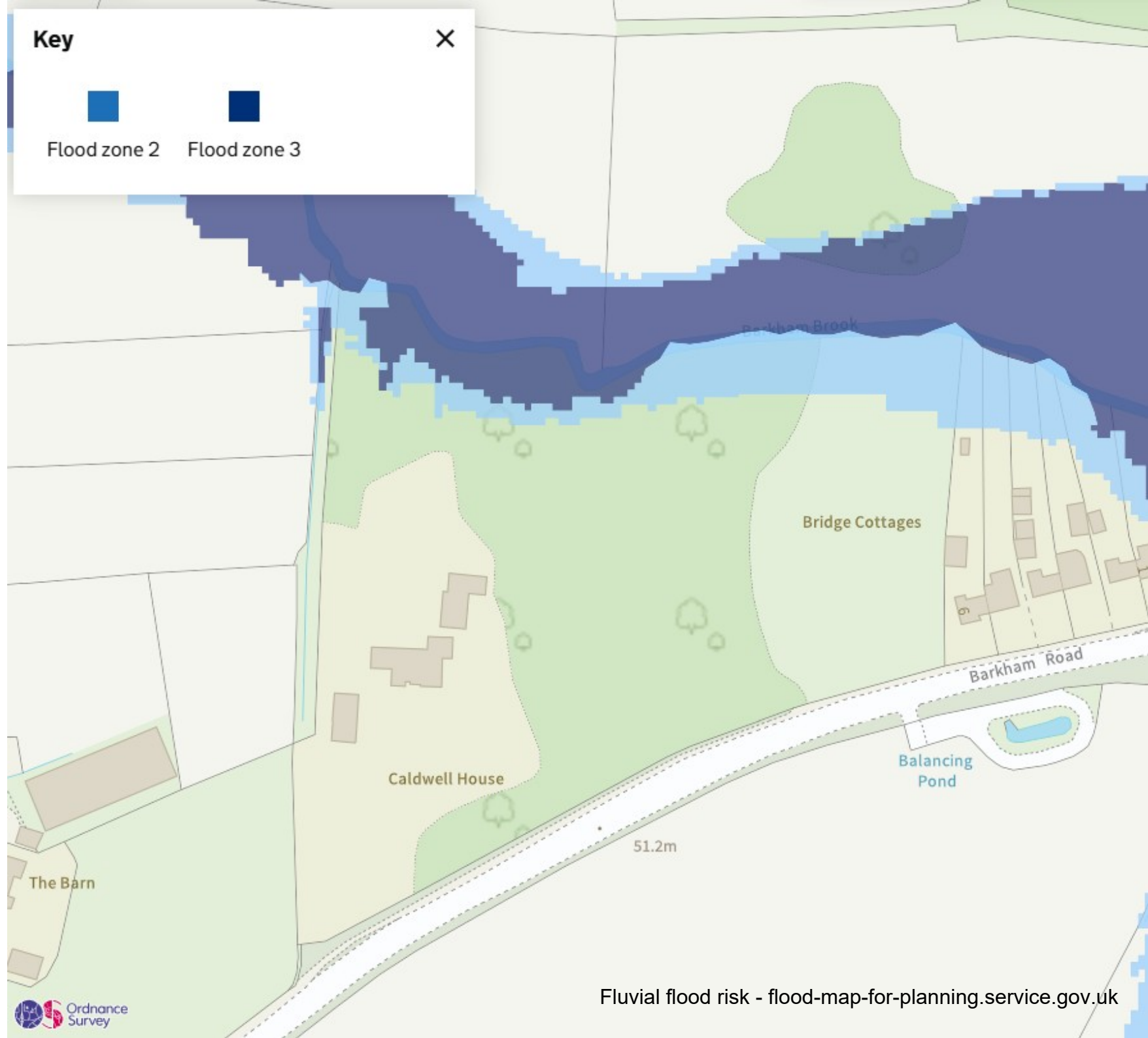
Key



Flood zone 2



Flood zone 3



# Key



Flood zone 2  
(present day)



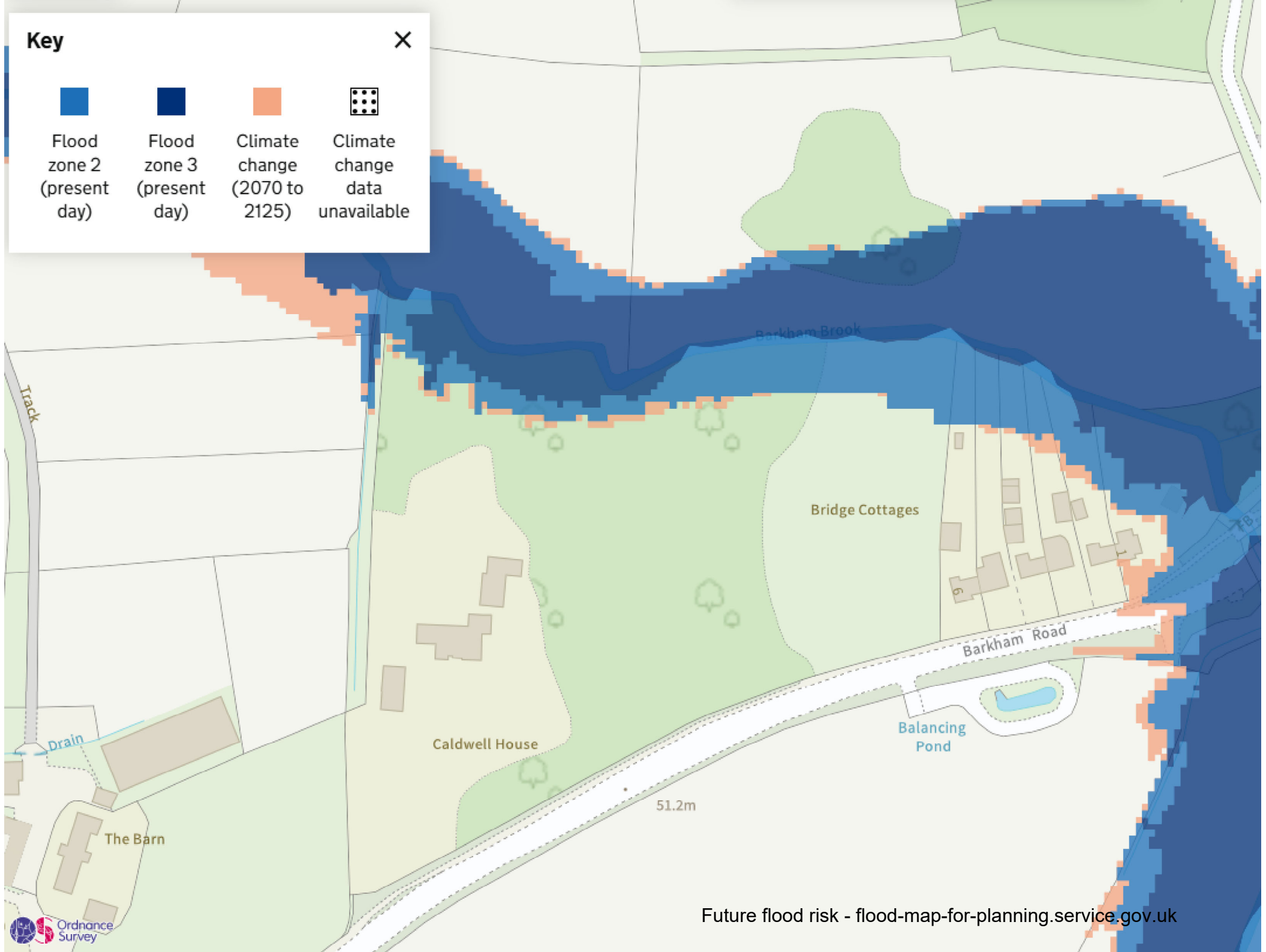
Flood zone 3  
(present day)



Climate change  
(2070 to 2125)



Climate change data  
unavailable





## Reservoirs map

### Extent

- ☒ When river levels are normal
- ☐ When there is also flooding from rivers

### Map details

- ☒ Show flooding

## Appendix E – Exceedance flow paths



- Notes:**
1. Do not scale from this drawing. If in doubt ask.
  2. Dimensions are in millimetres unless noted otherwise.
  3. These drawings shall be read in conjunction with the Architect's drawings.
  4. Setting out is to be in accordance with Architect's drawings.
  5. Underground drainage:-  
  
Drains to be 100mm diameter Hepworth Plastidrain or equivalent PVC-U pipes to BS EN 1401 unless noted otherwise.  
  
150mm diameter Hepworth Plastidrain or equivalent PVC-U plain end slotted pipes to BS EN 1401 where noted.  
  
100mm diameter Hepworth Plastidrain or equivalent PVC-U plain end slotted pipes to BS EN 1401 where noted.
  6. Foul drains to fall at minimum 1:60 & surface water drains to fall at 1:100 unless noted otherwise or where invert levels are not indicated.
  7. External drains with less than 600 cover (900 in driveway) to have special protection.
  8. Drains alongside buildings and below formation level to have concrete bed and surround up to formation level.
  9. Where drains pass through wall lines, provide precast concrete lintels over (lintel length to be pipe diameter + 50mm clearance either side + min 150mm bearing each end). Clearance around pipe to be filled with a compressible filler.
  10. All underground drains to be laid with min. 150mm granular bed and surround, unless noted above.
  11. For exact locations of svp's, ss's, rwp's, etc. refer to Architect's drawings.
  12. All RWP's to discharge into roddable trapped access gullies unless noted otherwise.
  13. All Internal Drainage to be in cast iron and provided with roddable access points.

**Key:**

- Proposed foul water drain
- Foul water PPIC
- Proposed foul water treatment plant
- Proposed soil vent pipe
- Proposed surface water drainage
- Surface water PPIC
- Proposed filter drain
- Water butt overflow
- Proposed waterbutt
- Proposed rainwater harvesting tank
- Non-return valve
- Proposed feature pond
- Proposed permeable pavement
- Proposed surface water pump
- Proposed feature pond overflow outlet
- Proposed outfall headwall
- Overflow source
- Overland flow path
- Extent of Flooding 1in100yr + cc Event

- 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.

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|   |       |            |                         |
|---|-------|------------|-------------------------|
| B | TH    | 08/07/2026 | Product 6 Data reviewed |
| A | TH    | 08/07/2026 | Original Issue          |
|   | Issue | By         | Date                    |
|   |       |            | Amendments              |

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Original Drawing: Prepared TH Approved MW  
Origin: Crowborough Size A1  
Current Issue: Preliminary MW Date 08/07/2026

Drawing Status: PRELIMINARY

Description:

Exceedance Flow paths

Scale: 1:1000  
Dwg No: 26191/C/D/011  
Issue: B

ISSUE SHEET

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