# CAMPFIELD, SOUTHWATER

## FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

December 2024

Miller Homes Ltd

# RESIDENTIAL SCHEME
# CAMPFIELD
# SOUTHWATER

## FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

CONTROLLED DOCUMENT

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RESIDENTIAL SCHEME
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SOUTHWATER

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

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## 1. EXECUTIVE SUMMARY

1.1 This Flood Risk Assessment (FRA) and Drainage Strategy has been prepared by Paul Basham Associates on behalf of Miller Homes to support an outline planning application for an 82-unit residential site. The land is in Southwater, West Sussex. The nearest postcode is RH13 9FR.

1.2 The site is located entirely within Flood Zone 1.

1.3 Summary of residual flood risk

- Fluvial and tidal flooding is considered to be **very low**.
- Surface water flooding is considered to be **low**.
- Groundwater flooding is considered to be **very low**.
- Reservoir flooding is considered to be **very low.**
- Sewer flooding is considered to be **very low**.

1.4 There is a small area in the northern part of the site that is subject to a low to medium risk of pluvial flooding. The site layout has been designed to ensure that all dwellings are positioned outside any areas at risk of flooding.

1.5 As part of the pre-application process, it was agreed with the LPA through consultation that the sequential test would not be required subject to the dwellings being proposed outside any flood risk areas. See confirmation with LPA officer in **Appendix G** and further information in **Sections 5.6 to 5.9**.

1.6 Attenuation swales have been proposed in the central, northern portion of the site where there is existing low-medium risk of surface water flooding. The attenuation swales have a total storage volume of 526.3m$^3$ (based on the indicative layout in **Appendix A**). The swales will provide compensatory storage for the surface water flooding displaced by the proposed road during the low-risk event (displaced flood volume calculated as 511m$^3$), in addition to providing betterment during the medium-risk event by storing all the surface water runoff (medium risk flooded volumes calculated to be 408m$^3$). The indicative drainage strategy layout is included in **Appendix I**.

1.7 BGS mapping, local borehole logs and the BGS infiltration SuDS Georeport indicate the site is underlain by Weald Clay formation, with minimal potential for infiltration. Additionally, no superficial deposits that may have infiltration potential were recorded on site. Therefore, drainage through infiltration is not considered a viable solution.

1.8 The surface water drainage proposal is to capture run-off at source, attenuate on-site within an attenuation basin and crates and discharge into the existing watercourse to the west of the site via a HydroBrake at the proposed impermeable area's greenfield Qbar rate (7.51 l/s). Please refer to Sections 3.13 and 3.14 for the greenfield runoff rates calculations.

1.9 All run-off (up to and including the 1-in-100-year rainfall event (+45% Climate Change)) shall be restricted to the proposed impermeable area's QBAR (7.51 l/s), per section 3.3.1 of The CIRIA SuDS manual. Discharging all run-off at QBAR is considered the more conservative approach when compared to the long-term storage approach (where discharge up to the up to the 1-100-year volume is discharged at the 1-in-100-year greenfield rate).

1.10 Water will be discharged from the HydroBrake to flow onto a swale with erosion control matting, which eventually drains into the water course.

1.11 Permeable paving shall be proposed for driveways and carparking to improve source control and improve water quality treatment.

1.12 Hydraulic calculations confirm that the network does not flood during the 100%AEP, 3.3%AEP (+40% climate change allowance) and 1%AEP storm events (+45% climate change allowance).

1.13 Foul water shall drain to a proposed pumping station, which will pump the effluent through a rising main towards the north, where it will connect into the nearest Southern Water manhole (Ref: 1205). The connection will be subject to a S106 agreement.

## 2. INTRODUCTION

2.1 This Flood Risk Assessment (FRA) and Drainage Strategy has been prepared by Paul Basham Associates on behalf of Miller Homes to support an outline planning application for a residential site. The land is in Southwater, West Sussex. The nearest postcode is RH13 9FR.

2.2 The plot size is approximately 4.50ha and the land is currently open field. The site location is shown in Figure 1 below.

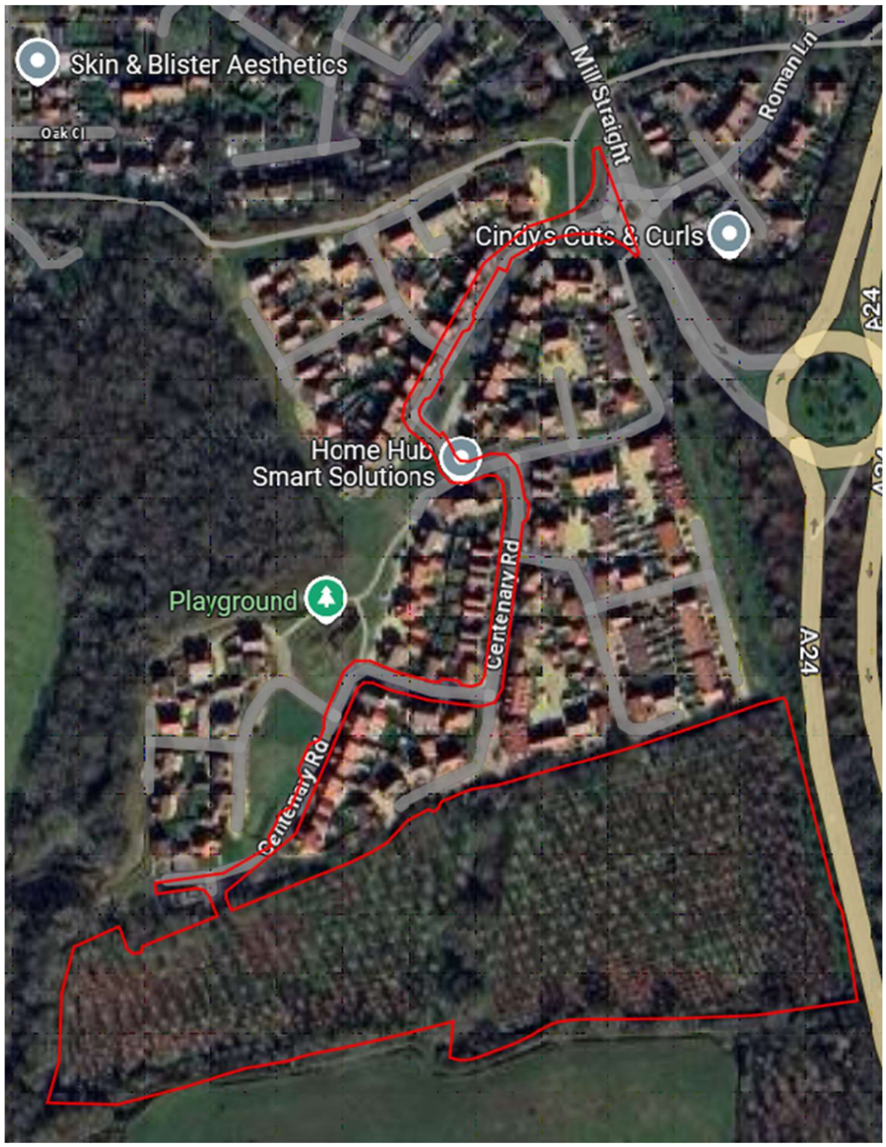



Figure 1: Site Location Plan (Source: Google Maps)

### Development Proposals

2.3 The development proposals for the site are for a residential development comprising of 82 dwellings, parking spaces and public open space. The proposed scheme is being submitted as an outline planning application with all matters reserved except for access. The indicative site layout is included in Appendix A.

## 3. SITE DESCRIPTION

### Topography

3.1 The site generally slopes from east to west, at an even gradient and gradually steepens towards the western boundary. The highest point is 50.723mAOD and is in the southeastern corner of the site and the lowest point is 35.717mAOD near the southwestern corner of the site. The topographical survey is included in **Appendix B.**

### Geology

3.2 A review of the British Geological Survey (BGS) mapping indicates that the bedrock geology beneath the site is *''weald clay formation – mudstone. Sedimentary bedrock formed between 133.9 and 126.3 million years ago during Cretaceous period''.* No superficial deposits were recorded on site. See **Figure 2** for the BGS map extract.

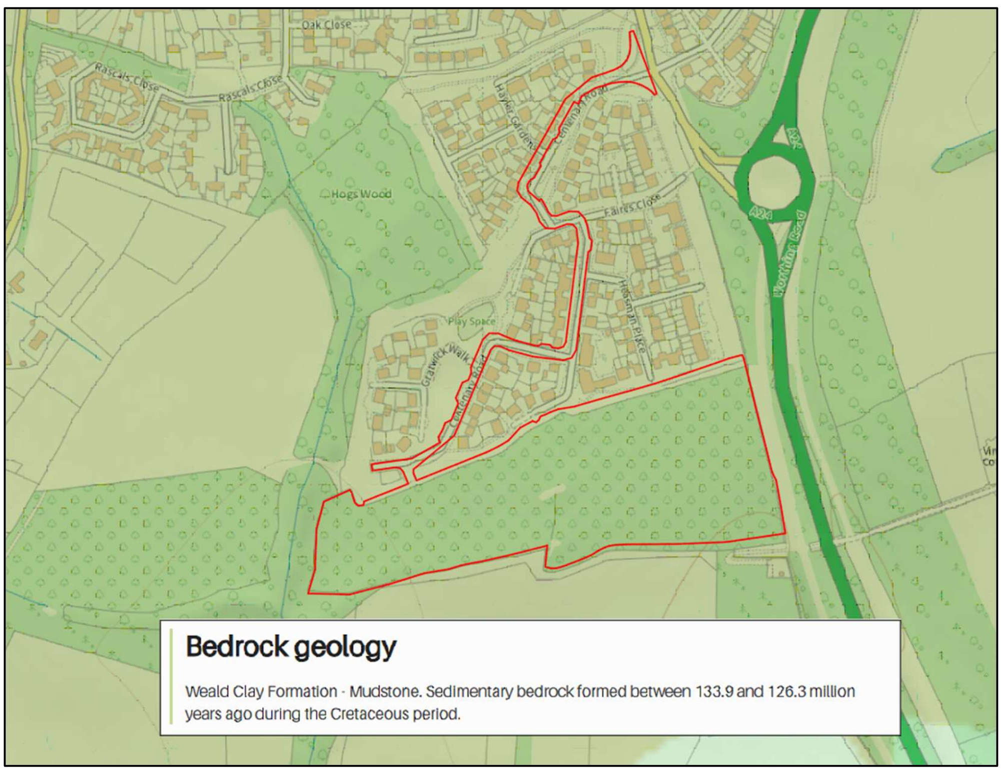



**Figure 2:** BGS bedrock mapping

3.3 **Figure 3**, obtained from the BGS website, shows the nearest boreholes: TQ12SE19, located northeast of the proposed development, and TQ12SE21, located south of the proposed development.


**Figure 3:** BGS borehole mapping

3.4 The BGS borehole log ref: TQ12SE19 indicates that the soil -consists of layers of friable and shaly clay (Weald Clay) down to 52m Below Ground Level (BGL), ground water depths were found at 4.90m BGL. Similarly, Borehole log ref: TQ12SE21 recorded Weald Clay strata down to 29.8m BGL; ground water struck at 9m BGL. Both borehole logs are included in **Appendix C**.

3.5 The BGS Infiltration SuDS Geo-report (**Appendix D**) was purchased to review the subsurface conditions for the proposed site. The report indicated that the bedrock permeability of the site was likely to be poorly draining (**Figure 4**). No superficial deposits were recorded on site (**Figure 5**).

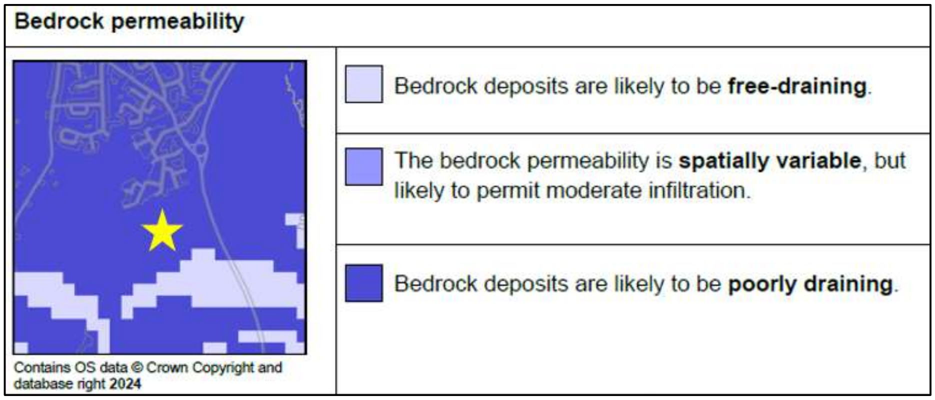



Figure 4: BGS SuDS Infiltration Geo-report - Bedrock Permeability Extract

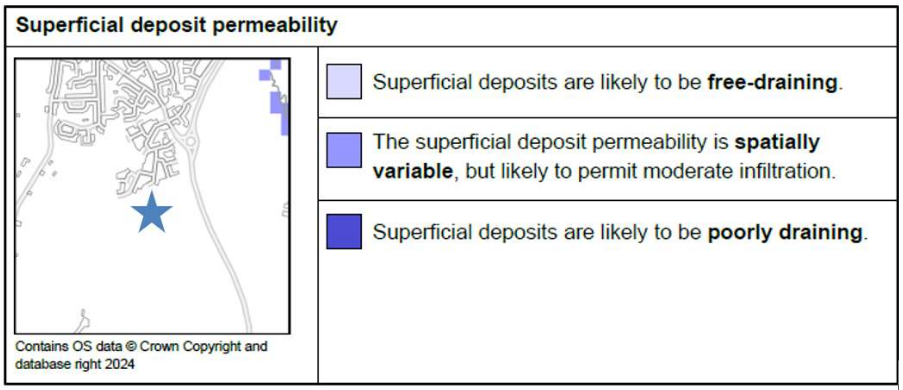



Figure 5: BGS SuDS Infiltration Geo-report – Superficial Deposit Permeability Extract

3.6 Given the ground conditions and considering that the site is entirely underlain by Weald Clay Formation, which is characterised by low permeability, infiltration is not considered a feasible drainage solution and the proposed strategy is to discharge to the adjacent watercourse.

## Hydrogeology

3.7 DEFRA (Department for Environment, Food & Rural Affairs) Magic Map shows the location and classification of underlying aquifers. **Figure 6** below shows an extract from the online map and indicates that the site's nearest postcode (marked blue), does not lie within any source protection zones.

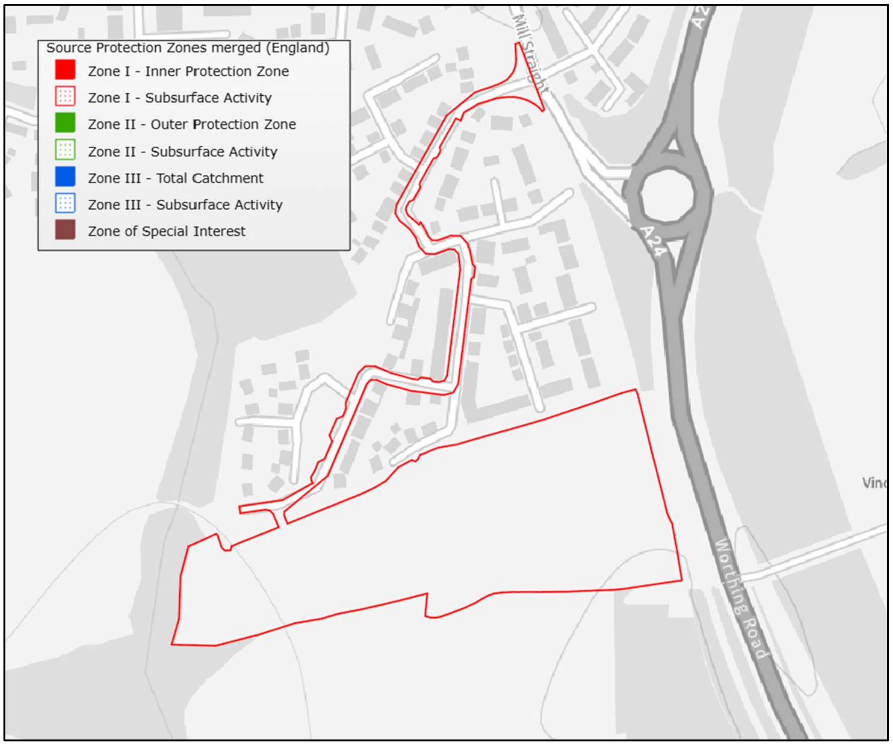



**Figure 6:** Magic Map – Source Protection Zones

3.8 The BGS Infiltration SuDS Geo-report (**Appendix D**) indicates that groundwater levels are expected to lie deeper than 5m BGL for the majority of the site, except for the western boundary of the site where the watercourse runs, which is associated with shallower groundwater levels between 3-5m BGL (**Figure 7**).

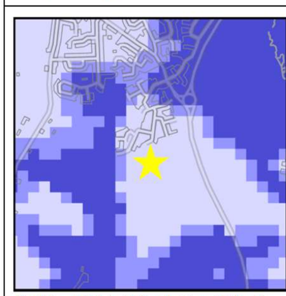
<table>
<tr><th colspan="2">Depth to groundwater table</th></tr>
<tr><td rowspan="3"><br>Contains OS data © Crown Copyright and database right 2024</td><td>Groundwater is likely to be more than 5 m below the ground surface throughout the year.</td></tr>
<tr><td>Groundwater is likely to be between 3 and 5 m below the ground surface for at least part of the year.</td></tr>
<tr><td>Groundwater is likely to be less than 3 m below the ground surface for at least part of the year.</td></tr>
</table>

**Figure 7: BGS SuDS Infiltration Geo-report – Depth to Groundwater Extract**

### Hydrology

3.10 **Figure 8** below shows there is an existing watercourse that runs along the western boundary of the site.


**Figure 8:** Nearby watercourses. (Source: Google Maps)

### Public Sewer

3.11 Based on the sewer mapping provided by Southern Water (Appendix E), there are surface and foul sewers, which serve the neighbouring development to the north of the proposed site.

### Pre-development greenfield rates

3.12 The site is currently a greenfield with no existing drainage. It appears that surface water runoff flows across the site, eventually discharging into the watercourse along the western boundary.

3.13 The greenfield run-off rates for the existing, undeveloped site have been calculated using the HR Wallingford online calculator. The Qbar for the greenfield 4.50ha site is calculated to be 24.58l/s. A summary of the greenfield run-off rates are shown in Table 1 below. The full report can be found in Appendix F.

| | |
|---|---|
| $Q_{BAR}$ (l/s) | 24.58 |
| 1 in 1 year (l/s) | 20.90 |
| 1 in 30 years (l/s) | 56.54 |
| 1 in 100 years (l/s) | 78.42 |

Table 1: Pre-Development Greenfield runoff rates

3.14 The proposed impermeable area (including 10% urban creep) is 1.375ha. the greenfield runoff rates for this have also been calculated using the HR Wallingford calculator and have been summarised below. The full set of calculations are also included in Appendix F.

| | |
|---|---|
| $Q_{BAR}$ (l/s) | 7.51 |
| 1 in 1 year (l/s) | 6.38 |
| 1 in 30 years (l/s) | 17.28 |
| 1 in 100 years (l/s) | 23.96 |

Table 2: Proposed impermeable area greenfield runoff rates

## 4. PLANNING POLICY

4.1 The planning policies and guidance that are relevant to the proposed Development with regard to flood risk and surface water management are outlined below.

National Planning policy

4.2 2024 updated National Planning Policy Framework (NPPF) and the associated 2022 updated Planning Practice Guidance (PPG) by the Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government

- 2022 updated EA Standing Advice
- EA National Strategy for Flood and Coastal Erosion Risk Management 2020
- DEFRA Sustainable Drainage System: Non-Statutory Technical Standards 2015
- CIRIA C753 The Suds Manual 2015
- Flood and Water Management Act 2010
- Flood Risk Regulations 2009
- Flood risk assessments: climate change allowances 2016 (updated in 2022).

Regional Planning policy

- West Sussex County Council Local Flood Risk Management Strategy 2021-2023
- West Sussex Local Flood Risk Management Strategy (2013-2018)
- West Sussex's LLFA Policy for Management of Surface Water

Figure 9 below shows a summary of West Sussex's LLFA Suds Policies

**Table 5.1: West Sussex LLFA SuDS Policies**

| Policy | Summary |
|---|---|
| SuDS Policy 1 | Follow the drainage hierarchy |
| SuDS Policy 2 | Manage Flood Risk Through Design |
| SuDS Policy 3 | Mimic Natural Flows and Drainage Flow Paths |
| SuDS Policy 4 | Seek to Reduce Existing Flood Risk |
| SuDS Policy 5 | Maximise Resilience |
| SuDS Policy 6 | Design to be Maintainable |
| SuDS Policy 7 | Safeguard Water Quality |
| SuDS Policy 8 | Design for Amenity and Multi-Functionality |
| SuDS Policy 9 | Enhance Biodiversity |
| SuDS Policy 10 | Link to Wider Landscape Objectives |

Figure 9: Extract from WSCC SuDS Policies

Local Planning Policy

- Horsham District Council (HDC) Strategic Flood Risk Assessment 2010

4.3 The Horsham District Council local plan contains the following policies relating to flooding, drainage, and surface water:

- Local Plan, Policy 24 Environmental Protection
- Local Plan, Policy 35 Climate Change
- Local Plan, Policy 38 Flooding

4.4 Based on the above policies, the key requirements in relation to the surface water management and flood risk for the proposed Development are considered as to be follows:

- National Planning Policy Framework (2024): "A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use."

- Environment Agency Standing Advice: "The surface water management needs to meet requirements set out in either your local authority's Surface Water Management Plan (SWMP), Strategic Flood Risk Assessment (SFRA) and Building Regulations Part H. Emergency escape plans for any parts of a building that are below the estimated flood level are required"

- CIRIA C753 The SuDS manual 2015: "Control the quantity of runoff to support the management of flood risk and maintain and protect the natural water cycle. To ensure that the surface water runoff from a developed site does not have a detrimental impact on people, property, and the environment, it is important to control how fast runoff is discharged from the site (i.e., the peak runoff rate) and how much runoff is discharged from the site (i.e., the runoff volume). Suds that are designed to manage water quantity in this way reduce the likelihood of flooding caused by the development. They can help protect natural water cycles by promoting the recharge of soil moisture levels, by maintaining stream and river baseflows and by replenishing groundwater".

- SuDS Policy 2 of WSCC LLFA Policy for management of surface water states: "The drainage system must be designed to operate without any flooding occurring during any rainfall event up to (and including) the critical 1 in 30-year storm (3.33% AEP). The system must also be able to accommodate the rainfall generated by events of varying durations and intensities up to (and including) the critical, climate change adjusted 1 in 100-year storm (1% AEP) without any on-site property flooding and without exacerbating the off-site flood-risk. Sufficient steps are to be taken to ensure that any surface flows between the 1 in 30 and 1 in 100-year events are retained on site. Storage should be based upon analyses of a range of winter and summer storm profiles to determine a critical storm event."

- Horsham DC *Policy 24- Environmental Protection, Section 3* promotes ensuring developments "Maintain or improve the environmental quality of any watercourses, groundwater and drinking water supplies, and prevents contaminated run-off to surface water sewers".

- Horsham DC *Policy 35- Climate Change, Section 2* promotes developments being adaptive to climate change through the "Use of green infrastructure and dual use SuDS to help absorb heat, reduce surface water runoff, provide flood storage capacity and assist habitat migration"

- Horsham DC *Policy 38 – Flooding.* An extract of Policy 38 is shown in Figure 10 overleaf.

**Policy 38**

**Strategic Policy: Flooding**

1. **Development proposals will follow a sequential approach to flood risk management, giving priority to development sites with the lowest risk of flooding and making required development safe without increasing flood risk elsewhere. Development proposals will;**
   a. **take a sequential approach to ensure most vulnerable uses are placed in the lowest risk areas.**
   b. **avoid the functional floodplain (Flood zone 3b) except for water-compatible uses and essential infrastructure.**
   c. **only be acceptable in Flood Zone 2 and 3 following completion of a sequential test and exceptions test if necessary.**
   d. **require a site-specific Flood Risk Assessments for all developments over 1 hectare in Flood Zone 1 and all proposals in Flood Zone 2 and 3.**
2. **Comply with the tests and recommendations set out in the Horsham District Strategic Flood Risk Assessment (SFRA).**
3. **Where there is the potential to increase flood risk, proposals must incorporate the use of sustainable drainage systems (SuDS) where technically feasible, or incorporate water management measures which reduce the risk of flooding and ensure flood risk is not increased elsewhere.**
4. **Consider the vulnerability and importance of local ecological resources such as water quality and biodiversity when determining the suitability of SuDS. New development should undertake more detailed assessments to consider the most appropriate SuDS methods for each site. Consideration should also be given to amenity value and green infrastructure.**
5. **Utilise drainage techniques that mimic natural drainage patterns and manage surface water as close to its source as possible will be required where technically feasible.**
6. **Be in accordance with the objective of the Water Framework Directive, and accord with the findings of the Gatwick Sub Region Water Cycle Study in order to maintain water quality and water availability in rivers and wetlands and wastewater treatment requirements.**

Figure 10: Extract for HDC Planning Framework 2015 - Policy 38

## 5. CLIMATE CHANGE

### Peak Rainfall Intensity Allowance

5.1 The "Flood Risk Assessments: Climate Change Allowances Guidance" 2016 (updated in 2022) published by the EA indicates that climate change is currently expected to result in increased peak rainfall and rising sea levels.

5.2 **Table 3** and **Table 4** shows anticipated changes in peak rainfall intensity in small and urban catchments within the Adur and Ouse Management Catchment.

5.3 The peak rainfall intensity allowance based on the Upper End allowance is 40% in the 3.3% AEP and 45% in the 1% AEP event.

| Epoch | Central Allowance | Upper End Allowance |
|---|---|---|
| 2050s | 20% | 35% |
| 2070s | 20% | 40% |

**Table 3:** Peak Rainfall Intensity allowance in small and urban catchments. 3.3%AEP Events*

| Epoch | Central Allowance | Upper End Allowance |
|---|---|---|
| 2050s | 20% | 45% |
| 2070s | 25% | 45% |

**Table 4:** Peak Rainfall Intensity allowance in small and urban catchments. 1%AEP Events*

**Source: https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall*

### Peak River Flow Allowances

5.4 **Table 5** shows the anticipated changes in the peak river flow allowances in the Adur and Ouse Management Catchment.

| Epoch | Central Allowance | Higher Allowance | Upper End Allowance |
|---|---|---|---|
| 2050s | 16% | 23% | 40% |
| 2070s | 18% | 28% | 57% |
| 2080s | 37% | 55% | 107% |

**Table 5:** Peak River Flow Allowances

**Source: https://environment.data.gov.uk/hydrology/climate-change-allowances/river-flow*

5.5 The development is located within Flood Zone 1, is classed as more vulnerable, and the design life is approximately 100 years, based on GOV.UK Flood Risk and Coastal Change Guidance. The peak river flow allowance is therefore estimated to be 37% based on central allowance.

National Planning Policy Framework (NPPF)

5.6 This report has been prepared considering the National Planning Policy Framework (NPPF) Technical Guidance and the Environment Agency's (EA) flood risk standing advice.

5.7 Table 2 from the Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government Flood risk and coastal change guidance has been included as **Figure 11: Flood risk vulnerability and flood zone 'compatibility'** below. This provides the classes of development (based on flood risk vulnerability) that are permitted within each of the flood zones. The Flood Risk Vulnerability Classification for the site is 'More Vulnerable' as it is a housing development, which is defined in Annexxe 3 of the NPPF. The site lies entirely within Flood Zone 1, which does not trigger the need a sequential nor exception test.

5.8 There is, however, a localised area that is subject to a medium-low risk of long-term flooding from surface water within the northern portion of the site (See Section 6.7). Based on the NPPF guidance, the presence of medium flood risk could trigger the need for a sequential test.

5.9 As such, a consultation has been undertaken woth Horsham Dstrict Council (HDC) as part of the pre-application process. It was agreed with the Local Planning Authority (LPA) that all proposed dwellings lie outside of any surface water flood risk area (as outlided in Section 6.9), which would not trigger the sequential test. The correspondence and confirmation from the case officer is included in **Appendix G.**

| Flood Zones | Essential infrastructure | Highly vulnerable | More vulnerable | Less vulnerable | Water compatible |
|---|---|---|---|---|---|
| Zone 1 | ✓ | ✓ | ✓ | ✓ | ✓ |
| Zone 2 | ✓ | Exception Test required | ✓ | ✓ | ✓ |
| Zone 3a † | Exception Test required † | ✗ | Exception Test required | ✓ | ✓ |
| Zone 3b * | Exception Test required * | ✗ | ✗ | ✗ | ✓* |

Key: ✓ Exception test not required ✗ Development should not be permitted.

***Notes to table 2:***

- *This table does not show the application of the Sequential Test which should be applied first to guide development to Flood Zone 1, then Zone 2, and then Zone 3; nor does it reflect the need to avoid flood risk from sources other than rivers and the sea;*
- *The Sequential and Exception Tests do not need to be applied to minor developments and changes of use, except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site;*
- *Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.*

**Figure 11:** Flood risk vulnerability and flood zone 'compatibility'

## 6. FLOOD RISK

6.1 In line with the EA Standing Advice, the estimated flood level is considered to be the higher of:

- A river flood level with a 1 in 100 or greater annual probability plus an allowance for climate change; and
- A tidal flood level with a 1 in 200 or greater annual probability plus an allowance for climate change.

6.2 The following Flood Zone definitions ignoring flood defence, are set out in the Planning Practice Guidance:

- Zone 1 Low Probability - Land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%);
- Zone 2 Medium Probability - Land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5%– 0.1%) in any year; and
- Zone 3 High Probability - Land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Fluvial / Tidal Flood Risk

6.3 Flood mapping obtained from the government's 'flood map for planning' website has identified that the site falls entirely within Flood Zone 1. (Figure 12)

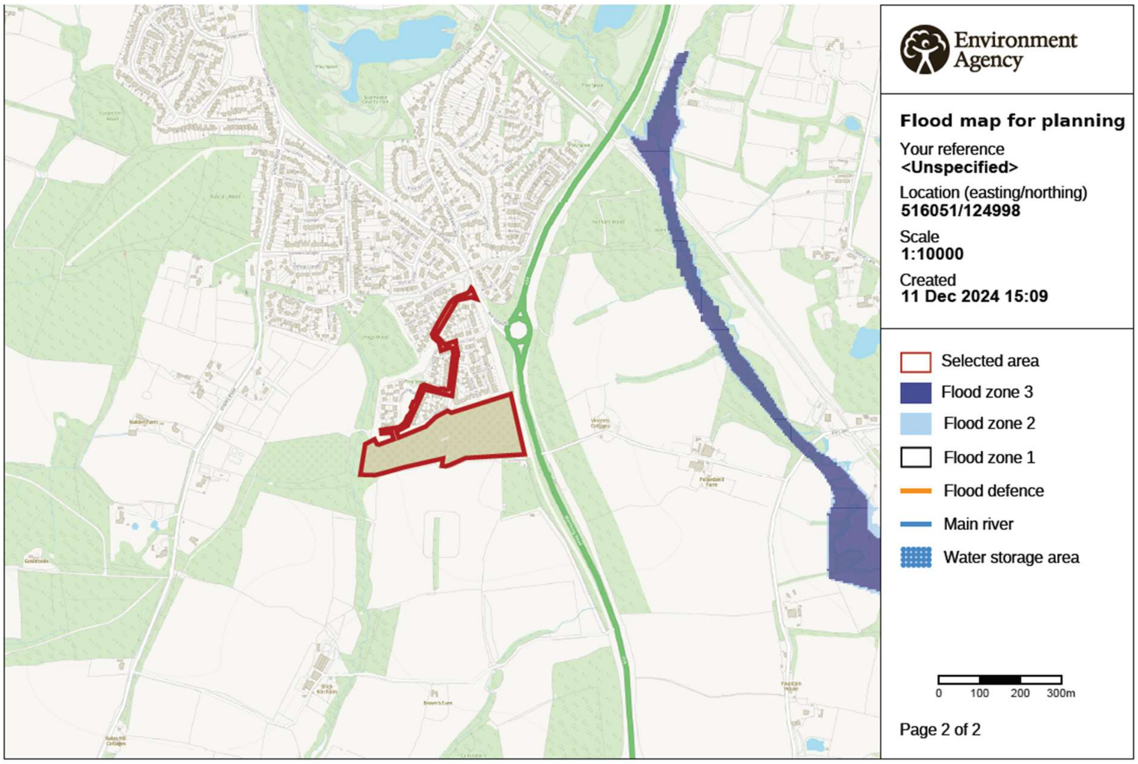





Figure 12: Flood Map for Rivers and Seas

6.4 The EA's long-term flood risk from rivers and seas mapping shows that the site is not considered to be at risk of long-term flooding from rivers or seas. (Figure 13)

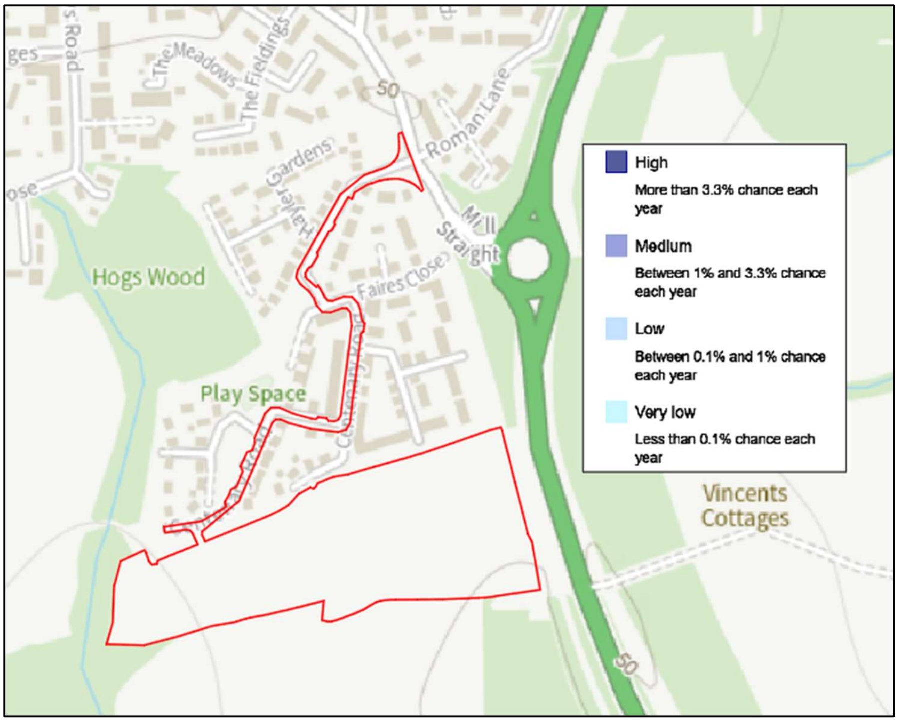



Figure 13: Long-term flood risk from rivers and seas map

### Fluvial/tidal flooding – Residual Risk

6.5 In light of the above mapping, the site is considered to be at very low residual risk of flooding from rivers or seas.

Surface Water Flood Risk

6.6 Surface water or 'pluvial' flooding results from rainfall running over ground before eventually entering a watercourse or sewer. It is usually associated with high intensity rainfall events but can also occur with lower intensity rainfall or melting snow where the ground is already saturated, frozen, developed (for example in an urban setting), or otherwise has low permeability.

6.7 The surface water flood risk map, shown in **Figure 14** , indicates that most of the site is at a very low risk of surface water flooding, except for a small area on the northern boundary, which is considered to be at low to medium risk.

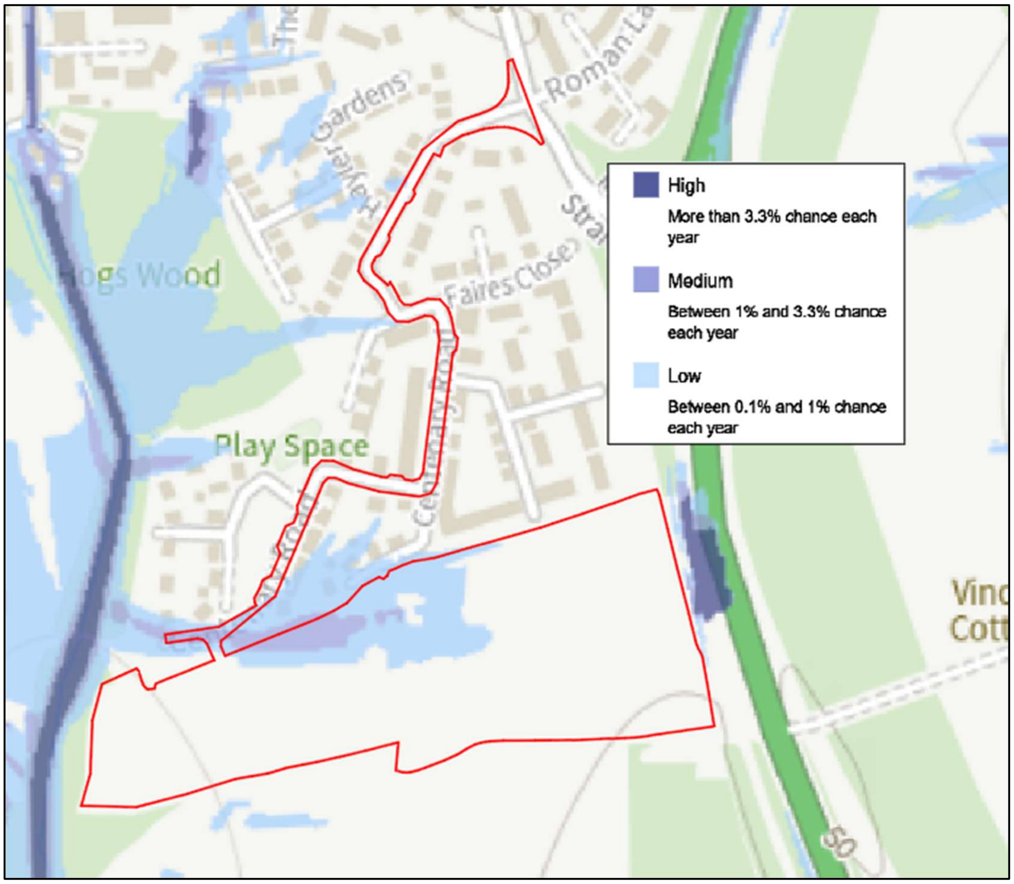



Figure 14: Long term flood risk from surface water

6.8 **Figure 15** is extracted from the EA's online flood mapping and indicates the flood depths associated with the medium risk flooding from surface water. The map indicates that flood depths are below 30cm.

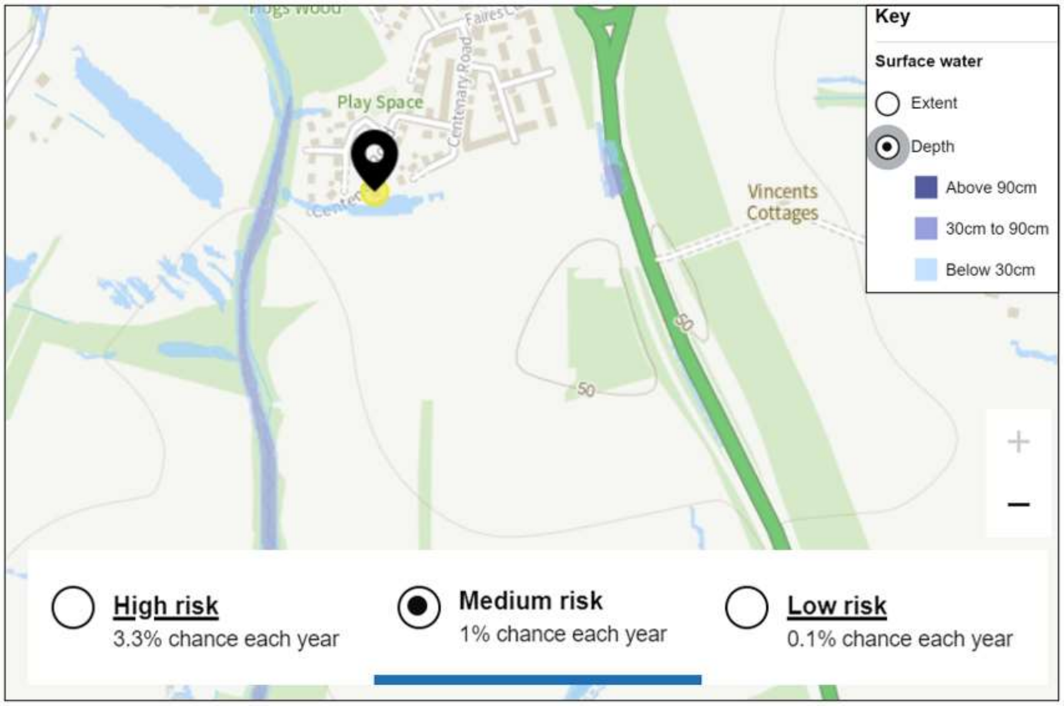



Figure 15: Depth of Surface Water Flooding (Medium Risk) – EA Mapping

Surface water flooding – Mitigation

6.9 The site layout has been developed to ensure that residential dwellings are located outside of any areas of flood risk.

6.10 Attenuation swales shall be provided in the northern area to capture any existing medium risk floods during extreme rainfall events. Furthermore, the swales have been sized to provide compensatory storage volume for the small area of existing low-risk surface water flooding that will be displaced by the proposed road.

6.11 The layout has been developed to ensure that the road is outside of medium-risk areas, and only landscaped areas/ public open spaces are within the medium risk zones. A portion of the road lies within an area of low surface water flood risk. It should be noted that the road levels are approximately 400mm higher than the existing ground therefore, any existing low risk pluvial floods (less than 300mm deep) shall be contained within the northern landscaped area where the attenuation swales are proposed, which would allow emergency access for vehicles.

6.12 Medium Risk Scenario: Attenuation swales with an indicative storage volume of 526.3m$^3$ have been sized based on the layout included in Appendix A. the swales will temporarily store the existing medium risk surface water flooding. The area of the medium risk extents (hatched in purple on the drainage layout- Appendix I) was calculated to be 1359m$^2$. Assuming a flood depth of 300mm across the hatched area, the total surface water volume generated from the medium risk area is estimated to be 408m$^3$. Hence, the attenuation swales provide a betterment during the medium risk scenario, where all the existing medium risk flooding is contained within the swales.

6.13 Low Risk Scenario: The area of low-risk surface water flooding displaced by the proposed road and parking areas is shown on the drainage strategy layout (Appendix I) in a cyan hatch. The area is calculated to be 1703.7m$^2$, based on the indicative layout (Appendix A), and assuming a maximum depth of 300mm across the hatched area (based on EA mapping), the total displaced surface water will have an indicative volume of 511m$^3$. Given that the attenuation swales have a total volume of 526.3m$^3$, the swales would be able to provide compensation volume for the displaced surface water flooding during the low-risk scenario.

6.14 The existing site lacks drainage, and, as noted in the geology section, it is underlain by highly impermeable clay, resulting in a high rate of greenfield surface water run-off. The "unmanaged" surface water flooding currently occurs due to the site's topography and poor drainage characteristics in its undeveloped state.

6.15 The proposed development will address these issues by capturing and attenuating surface run-off within a sustainable drainage system before it contributes to surface water flooding. As a result, the development will lower the risk of surface water flooding both on-site and downstream

6.16 Please refer to Section 8 for the proposed drainage strategy.

Surface water flooding – Residual Risk

6.17 As outlined in Section 5.9 above, this proposal has been discussed with HDC as part of the pre-application process and it has been agreed with the LPA that this approach is acceptable and would negate the need for a sequential test. Please see Appendix G for the confirmation from the planning officer at HDC and Appendix H for the drainage technical note prepared in support of the pre-application.

6.18 In light of the above, the site is considered to have low residual risk of surface water flooding.

Reservoirs Flood Risk

6.19 The EA's long-term flood risk from reservoirs shows that the site is considered to be at very low risk of flooding from reservoirs. (**Figure 16**)


**Figure 16:** Long term flood risk from reservoirs map

Reservoirs – Residual Risk

6.20 Flooding risk from reservoirs is extremely low as there are no reservoirs within the vicinity of the site. Accordingly, it can be concluded that the residual risk of flooding from reservoirs is considered to be very low.

Groundwater Flood Risk

6.21 Groundwater flooding occurs when groundwater levels increase sufficiently for the water table to intersect the ground surface. Groundwater flooding can occur in a variety of geological settings including valleys and in areas underlain by chalk, and in river valleys with thick deposits of alluvium and river gravels.

6.22 The EA's flood risk summary indicates that flooding from groundwater is unlikely for the site.

| **Other flood risks** | |
|---|---|
| **Groundwater** | Flooding from groundwater is unlikely in this area. |

Figure 17: Groundwater flood risk

6.23 HDC SFRA noted that there are no records of groundwater flooding within the northern study area of Horsham district council, where the site is located.

Groundwater- Residual risk

6.24 Based on the above, the proposed site is considered to be at very low residual risk of groundwater flooding.

Surface Water and Foul Water Sewers Flood Risk

6.25 According to the West Sussex SFRA, records did not show historical floods within the vicinity of the site. However, the SFRA notes that in 1981 a "*significant event occurred in Billingshurst after heavy rains that caused flooding in the High Street and Rosehill area due to inadequate highway drainage and blockages of surface water flow to sewers. The same event affected Southwater Street in Pulborough and Southwater*". The flooded area is further north of the site and is therefore not considered to be a flood risk.

Public Sewer- Residual risk

6.26 Based on the above, it can be summarised that the site is considered to be at very low risk of sewer flooding.

## 7. RESIDUAL FLOOD RISK

7.1 **Table 5** outlines the initial qualitative assessment of risk posed by the potential sources of flooding, the mechanisms for flooding and the likely consequences. It also includes a review of possible mitigation measures and the effect that the proposed mitigation measures are likely to have on the residual risk posed by the potential flood source.

| Flood Risk | Flood Mechanism and Possible Consequences | Existing Assessment of Risk | Mitigation Measures | Residual Risk |
|---|---|---|---|---|
| Fluvial / Tidal | Flooding from River Adur | Very Low | NA | Very Low |
| Reservoirs | Flooding due to a reservoir failure | Very Low | NA | Very Low |
| Surface Water (Pluvial) | Flooding from surface water runoff caused by poor drainage and water logging, specifically in the northern portion of the site. | Medium-Low | The existing site lacks drainage, and, as noted in the geology section, it is underlain by highly impermeable clay, resulting in a high rate of greenfield surface water run-off. Surface water flooding currently occurs due to the site's topography and poor drainage characteristics in its undeveloped state.<br><br>The proposed development will address these issues by capturing and attenuating surface run-off within a sustainable drainage system before it contributes to surface water flooding. As a result, the development will lower the risk of surface water flooding both on-site and downstream. Attenuation swales are proposed within low-medium pluvial flood risk areas to attenuate existing pluvial floods in the northern portion of the site. Additionally, the layout has been developed to ensure all dwellings lie outside of flood risk areas. This approach has been agreed with the LPA it was agreed that a sequential test would not be required using this approach. | Low |
| Groundwater | Flooding form high groundwater table | Very Low | EA mapping and HDC SFRA confirm no risk of groundwater flooding. | Very Low |
| Sewers | Flooding caused by overloaded sewers, mainly caused by surface water runoff. | Very Low | N/A | Very Low |

**Table 5:** Summary of Existing and Residual Flood Risk

## 8. DRAINAGE STRATEGY

### Potential Surface Water Drainage Strategy

8.1 In line with the Building Regulations Part H3, surface water shall discharge to one of the following, listed in order of priority:

- An adequate infiltration system: or, where not reasonably practicable,
- A watercourse; or, where not reasonably practicable,
- A sewer.

8.2 Given that the BGS SuDS Infiltration Geo-report indicated that the bedrock geology is Weald Clay Formation, which is expected to be "Poorly Draining" and no superficial deposits with infiltration potential were recorded on site, infiltration on-site is not considered to be feasible (See Section 3.5). Therefore, the proposals for the surface water drainage are to attenuate on-site and discharge into the nearest watercourse via. a HydroBrake at Qbar rate (7.51 l/s). Qbar has been calculated based on the proposed impermeable catchment area, please refer to Sections 3.13 and 3.14 for the greenfield runoff rates calculations.

8.3 The indicative drainage layout is included in Appendix I.

8.4 To mitigate the impact of surface water discharge from the proposed development, all run-off (up to and including the 1-in-100-year rainfall event (+45% Climate change) shall be restricted to the proposed impermeable area's QBAR (7.51 l/s), per section 3.3.1 of The CIRIA SuDS manual. Discharging all run-off at QBAR is considered the more conservative approach when compared to the long-term storage approach (where discharge up to the up to the 1-100-year volume is discharged at the 1-in-100-year greenfield rate).

8.5 Discharge from the basin into the watercourse shall be designed with consideration to the ancient woodland, which runs along the western boundary of the site. The proposal is to discharge surface water at restricted rates via. a HydroBrake manhole, towards a wide swale with erosion control matting, where water will flow towards the stream. This ensures that water flowing through the woodland mimics the existing flow.

8.6 Runoff from roads and roofs shall be collected and drained into the proposed piped network. Runoff will be attenuated on site within a basin located along the western boundary. Additional storage shall be provided within attenuation crates located near the northern boundary of the site.

8.7 Permeable block paving shall be proposed for driveways and carpark areas to provide source control and manage water quantity. The permeable paving systems shall be constructed as Type-C systems, which will intercept and store runoff within the sub-base prior to discharging into the network.

8.8 Attenuation swales with a total storage volume of 526.3m$^3$ have been proposed along the northern boundary where there is existing low-medium risk of surface water flooding. The swales are designed to mitigate the existing surface water flooding by capturing and temporarily storing the existing pluvial flooding during extreme storm events. The swales will provide compensatory storage for the surface water flooding displaced by the proposed road during the low-risk scenario (displaced flood volume calculated as 511m$^3$), in addition to providing betterment during the medium-risk scenario by storing all the surface water runoff (medium risk flooded volumes calculated to be 408m$^3$).

8.9 The West Sussex Surface Water Drainage Pro-forma has been completed for the proposed site and is included in Appendix J.

### Hydraulic Calculations

8.10 Hydraulic calculations have been undertaken using Site3D software and show that the drainage network does not flood during the 100% AEP, 3.3%AEP and 1% AEP storm events (Including climate change allowances). The full set of calculations is included in Appendix K.

8.11 The below table contains the parameters used in the supporting network modelling

| Parameter | Input | Guidance/notes |
|---|---|---|
| Rainfall Data | FEH22 | |
| Urban Creep | 10% | Table 5.2 of West Sussex LLFA Policy for the Management of Surface Water |
| CV (Summer and Winter) | 1.0 | SFA 7 |
| Climate Change<br>3.3% AEP<br>1% AEP | <br>40%<br>45% | EA Climate change allowances for peak rainfall in England<br>https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall |

Table 6: Hydraulic Modelling Parameters

### Potential Foul Water Drainage Strategy

8.12 The proposals for the foul drainage are to a pumping station located in the western portion of the site. The proposed pumping station will pump the foul water through a rising main in a northerly direction into the nearest Southern Water foul manhole (Ref: 1205).

8.13 The proposed pumping station is located near the site's north-western access to facilitate maintenance access. The location also allows for a 15m odour offset from the wet well to the nearest habitable dwelling. The foul drainage proposals are included in Appendix I.

8.14 The peak design flow rates generated from the site, is calculated to be 4.1l/s. This is based on an estimated rate of 0.05 litres per second per dwelling, in accordance with the SSG- Appendix C.

8.15 The connection into Southern Water's network will be subject to a S106 agreement.

## 9. WATER QUALITY

9.1 **Figure 18** and **Figure 19** are extracted from the SuDS Manual and demonstrate the pollution risks associated with various discharge situations.

**TABLE 26.2 Pollution hazard indices for different land use classifications**

| Land use | Pollution hazard level | Total suspended solids (TSS) | Metals | Hydro-carbons |
|---|---|---|---|---|
| Residential roofs | Very low | 0.2 | 0.2 | 0.05 |
| Other roofs (typically commercial/ industrial roofs) | Low | 0.3 | 0.2 (up to 0.8 where there is potential for metals to leach from the roof) | 0.05 |
| Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day | Low | 0.5 | 0.4 | 0.4 |
| Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1] | Medium | 0.7 | 0.6 | 0.7 |
| Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1] | High | 0.8[2] | 0.8[2] | 0.9[2] |

**Figure 18:** Table 26.2 of the SuDS Manual

**TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters**

| | Mitigation indices[1] | | |
|---|---|---|---|
| **Type of SuDS component** | **TSS** | **Metals** | **Hydrocarbons** |
| Filter strip | 0.4 | 0.4 | 0.5 |
| Filter drain | 0.4[2] | 0.4 | 0.4 |
| Swale | 0.5 | 0.6 | 0.6 |
| Bioretention system | 0.8 | 0.8 | 0.8 |
| Permeable pavement | 0.7 | 0.6 | 0.7 |
| Detention basin | 0.5 | 0.5 | 0.6 |
| Pond[4] | 0.7[3] | 0.7 | 0.5 |
| Wetland | 0.8[3] | 0.8 | 0.8 |
| Proprietary treatment systems[5,6] | These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area. | | |

**Figure 19:** Table 26.3 of the SuDS Manual

9.2 The UKSuDS Water Quality toolkits (based on the Simple Index Assessment method) has been used to assess water quality improvement for the site. Table 7 below summarises the results of the toolkit, and a full copy of the toolkit can be found in Appendix L.

| **Land Use** | | | **SuDS Component** | | | **Water Treatment** |
|---|---|---|---|---|---|---|
| Residential Roofing | | | Attenuation Basin | | | Sufficient |
| Pollution Indices | | | Mitigation Indices | | | |
| TSS | Metals | Hydrocarbons | TSS | Metals | Hydrocarbons | |
| 0.5 | 0.4 | 0.4 | 0.5 | 0.5 | 0.6 | |
| Residential Parking/ individual Driveways | | | Permeable Pavement | | | Sufficient |
| Pollution Indices | | | Mitigation Indices | | | |
| TSS | Metals | Hydrocarbons | TSS | Metals | Hydrocarbons | |
| 0.5 | 0.4 | 0.4 | 0.7 | 0.6 | 0.7 | |
| Low Traffic Roads | | | Attenuation Basin | | | Sufficient |
| Pollution Indices | | | Mitigation Indices | | | |
| TSS | Metals | Hydrocarbons | TSS | Metals | Hydrocarbons | |
| 0.5 | 0.4 | 0.4 | 0.5 | 0.5 | 0.6 | |

Table 7: Water Quality Summary

## 10. SUMMARY AND CONCLUSION

10.1 This Flood Risk Assessment (FRA) and Drainage Strategy has been prepared by Paul Basham Associates on behalf of Miller Homes to support an outline planning application for an 82-unit residential site. The land is in Southwater, West Sussex. The nearest postcode is RH13 9FR.

10.2 The site is located entirely within Flood Zone 1.

10.3 Summary of residual flood risk

- Fluvial and tidal flooding is considered to be **very low**.
- Surface water flooding is considered to be **low**.
- Groundwater flooding is considered to be **very low**.
- Reservoir flooding is considered to be **very low.**
- Sewer flooding is considered to be **very low**.

10.4 There is a small area in the northern part of the site that is subject to a low to medium risk of pluvial flooding. The site layout has been designed to ensure that all dwellings are positioned outside any areas at risk of flooding.

10.5 As part of the pre-application process, it was agreed with the LPA through consultation that the sequential test would not be required subject to the dwellings being proposed outside any flood risk areas. See confirmation with LPA officer in **Appendix G** and further information in **Sections 5.6 to 5.9**.

10.6 Attenuation swales have been proposed in the central, northern portion of the site where there is existing low-medium risk of surface water flooding. The attenuation swales have a total storage volume of 526.3m$^3$ (based on the indicative layout in **Appendix A**). The swales will provide compensatory storage for the surface water flooding displaced by the proposed road during the low-risk event (displaced flood volume calculated as 511m$^3$), in addition to providing betterment during the medium-risk event by storing all the surface water runoff (medium risk flooded volumes calculated to be 408m$^3$). The indicative drainage strategy layout is included in **Appendix I**.

10.7 BGS mapping, local borehole logs and the BGS infiltration SuDS Georeport indicate the site is underlain by Weald Clay formation, with minimal potential for infiltration. Additionally, no superficial deposits that may have infiltration potential were recorded on site. Therefore, drainage through infiltration is not considered a viable solution.

10.8 The surface water drainage proposal is to capture run-off at source, attenuate on-site within an attenuation basin and crates and discharge into the existing watercourse to the west of the site via a HydroBrake at the proposed impermeable area's greenfield Qbar rate (7.51 l/s). Please refer to Sections 3.13 and 3.14 for the greenfield runoff rates calculations.

10.9 All run-off (up to and including the 1-in-100-year rainfall event (+45% Climate Change)) shall be restricted to the proposed impermeable area's QBAR (7.51 l/s), per section 3.3.1 of The CIRIA SuDS manual. Discharging all run-off at QBAR is considered the more conservative approach when compared to the long-term storage approach (where discharge up to the up to the 1-100-year volume is discharged at the 1-in-100-year greenfield rate).

10.10 Water will be discharged from the HydroBrake to flow onto a swale with erosion control matting, which eventually drains into the water course.

10.11 Permeable paving shall be proposed for driveways and carparking to improve source control and improve water quality treatment.

10.12 Hydraulic calculations confirm that the network does not flood during the 100%AEP, 3.3%AEP (+40% climate change allowance) and 1%AEP storm events (+45% climate change allowance).

10.13 Foul water shall drain to a proposed pumping station, which will pump the effluent through a rising main towards the north, where it will connect into the nearest Southern Water manhole (Ref: 1205). The connection will be subject to a S106 agreement.