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1. INTRODUCTION

1.1 This Technical Note has been prepared by Paul Basham Associates on behalf of Endurance Estates Land Promotion Ltd to outline the flood risk and drainage work undertaken to date as it relates to Land East of the Village Centre, Horsford. The site forms a draft allocation in the emerging Horsford Neighbourhood Plan (Regulation 14 Version October 2025), under Policy SS2A, for a community hub building and a facilitating residential scheme of approximately 300 dwellings.

1.2 The plot size is approximately 24.8 ha and the land is currently open fields for agricultural use with a small cluster of buildings in the south-west of the site.

1.3 Following this introduction, this technical note is structured as follows:

- **Chapter 2 Horsford Neighbourhood Plan Regulation 14:** outlines the relevant drainage and flood risk comments from the Lead Local Flood Authority.
- **Chapter 3 Site Conditions:** provides a summary of the existing ground and soil conditions.
- **Chapter 4 Flood Risk:** provides a summary of the on site flood risks with climate change.
- **Chapter 5 Surface Water Drainage:** Outlines the possible surface water drainage solutions for the development.
- **Chapter 6 Summary and Conclusions:** summarises our findings in this technical note.



Figure 1: Site Location Plan

1.4 The site is accessed from Holt Road and is indicated by the red line boundary demonstrated within **Figure 1**. The nearest postcode is NR10 3HG.

2. HORSFORD NEIGHBOURHOOD PLAN REGULATION 14

2.1 Land East of the Village Centre is identified in the Horsford Neighbourhood Plan Regulation 14 version under Policy SS2A and as shown in **Figure 2**.

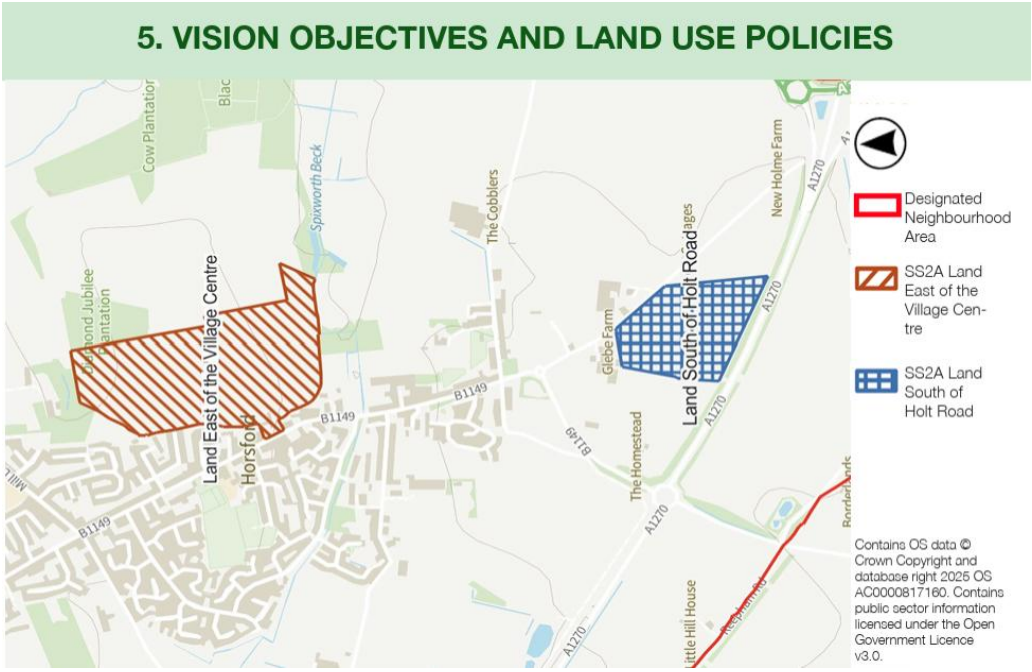


Figure 2: Extract from Horsford Neighbourhood Plan Regulation 14

2.2 Norfolk County Council LLFA provided comments on the Horsford Neighbourhood Plan (Reg 14) document dated 27th November 2025. The main comments raised were:

- *Whilst the LLFA notes the Regulation 14 document states that policies have only been included where they are not already covered in other Development Plan documents, however the LLFA would welcome references be included (either as part of existing relevant policies or within a dedicated policy), to the importance of the consideration of flood risk from all sources when considering the acceptability of new developments, along with highlighting the benefits of the inclusion of Sustainable Drainage Systems (SuDS) within development proposals. Given that the Parish of Horsford also has an Environment Agency Main River (Spixworth Beck) passing through it, areas covered by Flood Zones 2 and 3 and a number of Ordinary Watercourses, reference to these along with the inclusion of mapping identifying the location of these features would also be welcomed.*

2.3 This technical note provides further information regarding the flood risk for the development and also gives an indication on the possibilities for the proposed drainage strategy.

3. SITE CONDITIONS

3.1 A Topographical survey received from Sunshine Survey, dated November 2024, Reference-GY\5714.1\001, shows the site generally slopes both north and south from the middle of the plot. The highest point is approximately 34.80m AOD at the centre of the site and the lowest point is 22.89m AOD near the south-east of the site.

3.2 The nearest watercourse is the Spixworth Beck which runs adjacent to the southern boundary. The Spixworth Beck is a main river and tributary of the River Bure.

3.3 A review of the British Geological Survey (BGS) mapping shows that the site is underlain by bedrock Wroxham Crag Formation of sand and gravels, with various Superficial deposits, shown in **Figure 3** below.



Figure 3: BGS Mapping Extract- Combined Geology

3.4 The British Geological Survey (BGS) mapping presents information on the nearest boreholes in and around the site. Borehole TG11NE92, located in the South-West of the site, shows superficial drift deposits and Crag sands/clays to approximately 16.8 m bgl, overlying Upper Chalk bedrock which extends to at least 45.7 m bgl. See in **Figure 4** below.



Figure 4: BGS Borehole Mapping

3.5 DEFRA's magic map indicates that half the site falls within the source protection Zone III – total catchment. As seen in **Figure 5** below.

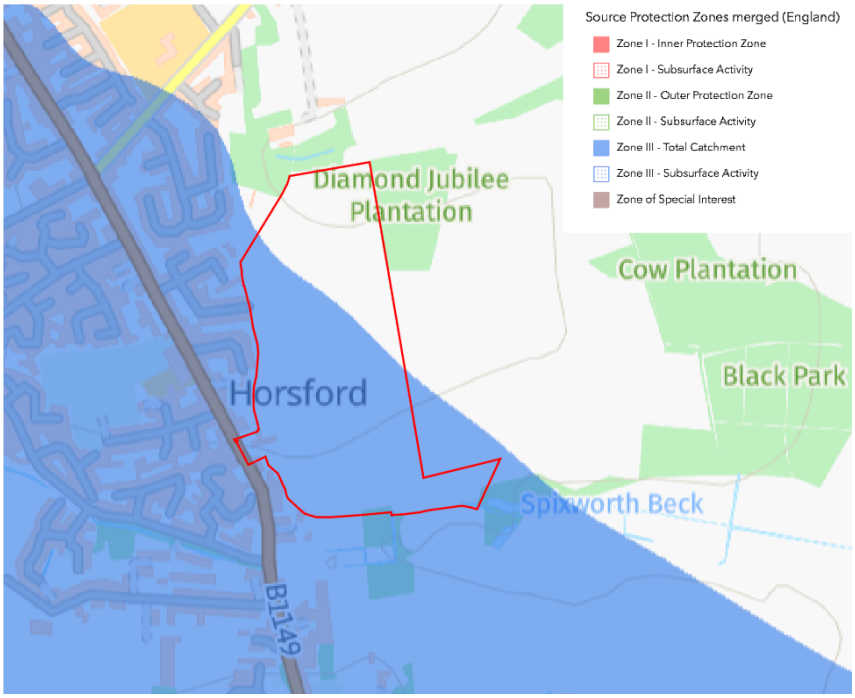


Figure 5: Source protection zones

4. FLOOD RISK

Fluvial flooding

4.1 DEFRA's map for flood risk from Rivers and Seas indicates that the majority of the proposed site lies outside areas at risk of flooding. A small section along the southern boundary falls within an area of identified flood risk. This is seen in **Figure 6** below.



Figure 6:Flood risk from Rivers and Seas

Fluvial flooding – Mitigation Measures and Considerations

4.2 The site layout will be developed in accordance with the NPPF to ensure that residential dwellings and community use facilities are located outside any areas of flood risk.

Fluvial flooding – Residual Risk

4.3 The residual fluvial flood risk to the development is considered to be very low.

Surface water flooding

4.4 DEFRA's map for flood risk from surface water. indicates that the majority of the proposed site lies outside areas at risk of flooding. Small pockets present areas of identified flood risk, shown on Figure 7 below.

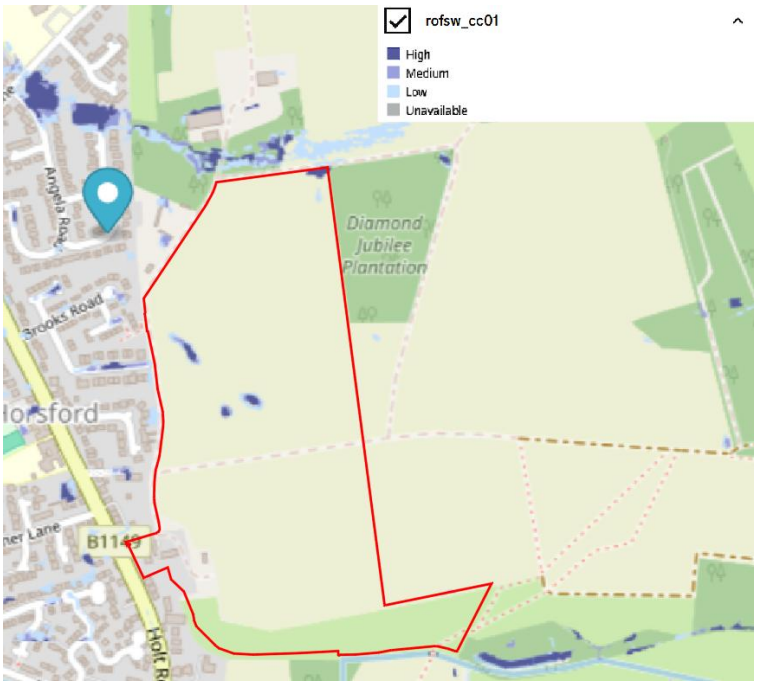


Figure 7: Flood risk from surface water

Surface water flooding – Mitigation Measures and Considerations

4.5 Isolated areas of surface water flooding are encountered but determined to be localised run-off occurring within the site boundary. These areas will be mitigated through the drainage design to serve the proposed development.

Surface water flooding – Residual Risk

4.6 Based on review of the above information, the site is considered to be at very low risk of flooding from surface water.

Reservoir flooding

4.7 The EA long-term flood risk mapping for flooding due to reservoirs indicates that the site is 'not considered to be at risk' from reservoir flooding. This is shown in **Figure 8**.



Figure 8: flood risk from reservoirs

Groundwater flooding

4.8 The government's long term Flood Risk page indicates the site is at no risk of flooding due to groundwater. Seen in **Figure 9** below.

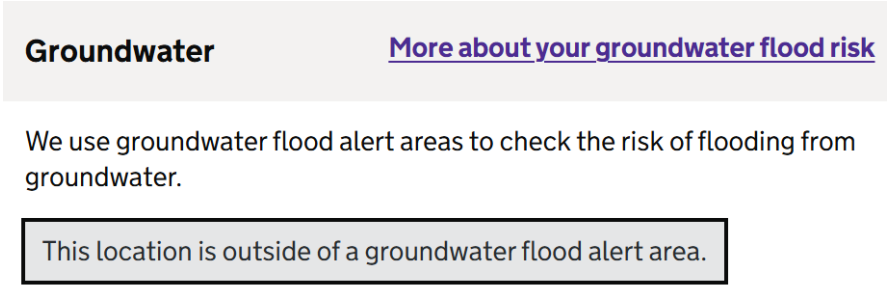


Figure 9: flood risk from groundwater

Summary flood risk

4.9 A summary of flood risk and mitigation measures are presented in Table 1 below.

Source of Flood Risk	Level of risk	Mitigation measures
Fluvial	Very Low probability	None required
Surface water	Very low probability	None required
Reservoir	No risk	None required
Groundwater	No risk	None required

Table 1: Summary of flood risk

5. SURFACE WATER STRATEGY

Sustainable drainage principles

5.1 Sustainable drainage systems (SuDS) are designed to manage storm water as close to its source as possible to mimic natural drainage arrangements and where possible, encourage its infiltration, attenuation and passive treatment. SuDS should be designed to both manage the flood and pollution risks resulting from urban runoff and to contribute wherever possible to environmental enhancement and place making. With this in mind, the multi-functionality and multiple benefits of SuDS should always be considered. There are four pillars of SuDS that should consider the delivery of multiple benefits through design. These are as defined by Figure 10 below.

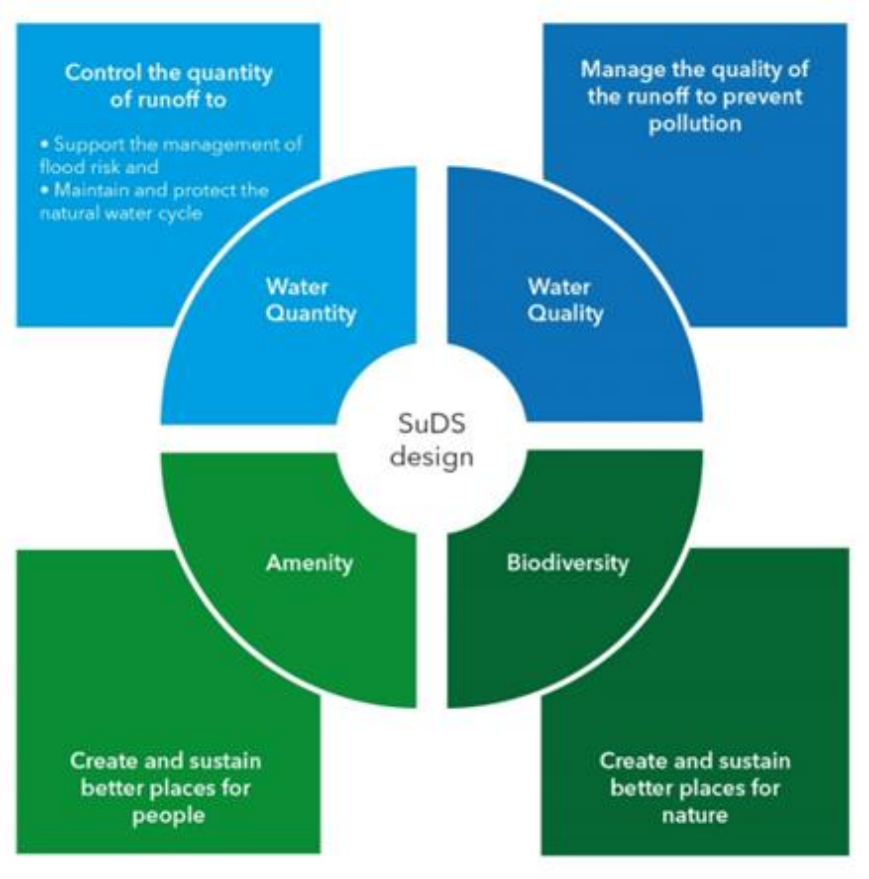


Figure 10: The four pillars of SuDS

5.2 Runoff from development should be discharged to the final destinations in accordance with the National Standards for sustainable drainage systems (NSS) to the hierarchy in order of preference:

- priority 1: collected for non-potable use
- priority 2: infiltrated to ground
- priority 3: discharged to an above ground surface water body
- priority 4: discharged to a surface water sewer, or other piped surface water drainage system
- priority 5: discharged to a combined sewer

5.3 Mechanical rainwater harvesting systems can be expensive to install and a maintenance burden to operate and maintain. A rainwater harvesting system is considered unviable for inclusion within the development. Guidance should be sought from the LLFA to establish appropriate means of satisfaction of this requirement.

SuDS features and disposal

5.4 SuDS principles must be applied for the control, management and storage of all design rainfall events including making allowance for climate change. They should also be used to convey flows towards a point of outfall(s) from the site, prioritising infiltration for disposal where it proves feasible.

5.5 The recommended rate to be considered viable for infiltration should exceed a measured rate of 10mm/hr (2.78 x10^{-6}m/s) in accordance with the recommendation of Norfolk CC's LLFA Guidance Document.

5.6 Initial infiltration tests have been undertaken on site on the by Nott Group on the 5th May 2025. Four trial pits were dug with three consecutive infiltration tests undertaken in each. Recorded rates of infiltration range significantly from 1.4 x 10^{-6}m/s (interpolated in TP1) to 7.1 x 10^{-5}m/s. The test locations were not targeted based on a development proposal so can only be considered indicative.

5.7 A BGS Infiltration SuDS GeoReport has been commissioned to support review of the viability for infiltration and indication of potential for groundwater flooding prior to site specific intrusive winter groundwater monitoring. On review of the report we can advise that groundwater is likely to be between 3.0 and 5.0m below ground level in some areas of the site and the majority of the site is likely to be more than 5.0m below ground level. The report is included in Appendix A.

5.8 The BGS Infiltration SuDS GeoReport has indicated that the Superficial deposits permeability ranges from Very Low – Very High on site with most of the site freely draining. Some areas on the site that are spatially variable but likely to permit moderate infiltration.

5.9 The BGS Infiltration SuDS GeoReport has indicated the Bedrock permeability ranges from High to Very High with Bedrock deposits likely to be free draining.

5.10 These findings establish infiltration should be used for the disposal of all surface water runoff but additional infiltration tests will be required to support the detailed design. Additionally a regime of winter groundwater monitoring will be required to demonstrate appropriate clearance from the base of infiltration devices to protect receiving groundwaters.

6. SUMMARY AND CONCLUSION

6.1 This Technical Note has been prepared by Paul Basham Associates on behalf of Endurance Estates Land Promotion Ltd. to outline the flood risk and drainage work undertaken to date as it relates to Land East of the Village Centre, Horsford. The site forms a draft allocation in the emerging Horsford Neighbourhood Plan (Regulation 14 Version October 2025), under Policy SS2A, for a community hub building and a facilitating residential scheme of approximately 300 dwellings.

6.2 The site falls wholly within Flood Zone 1.

6.3 The proposed site has a design lifetime of 100 years. As such, flood risk has been assessed up to 2130 (allowing a buffer of five years from the preparation of this report).

6.4 Residual flood risk from:

- Fluvial and tidal flooding is considered to be very low
- Reservoir flooding is considered to be very low
- Surface water flooding is considered to be very low
- Groundwater flooding is considered to be very low
- Public sewer flooding is considered to be very low

6.5 There are small pockets of Surface Water flooding on the development, these small areas of flooding will be located outside of the developable area.

6.6 The BGS Infiltration SuDS GeoReport and the initial on site testing has indicated that infiltration should be used for the disposal of all surface water runoff from the development.

6.7 From review of the information as summarised above development proposals can be delivered with no increase to flood risk on or off site. The suggested residential led development with community facilities and associated infrastructure is considered suitable from a flood risk perspective.

Appendix A

GeoReports

British Geological Survey

Paul Basham Associates
The Bothy
Cams Hall Estate
Fareham
PO16 8UT

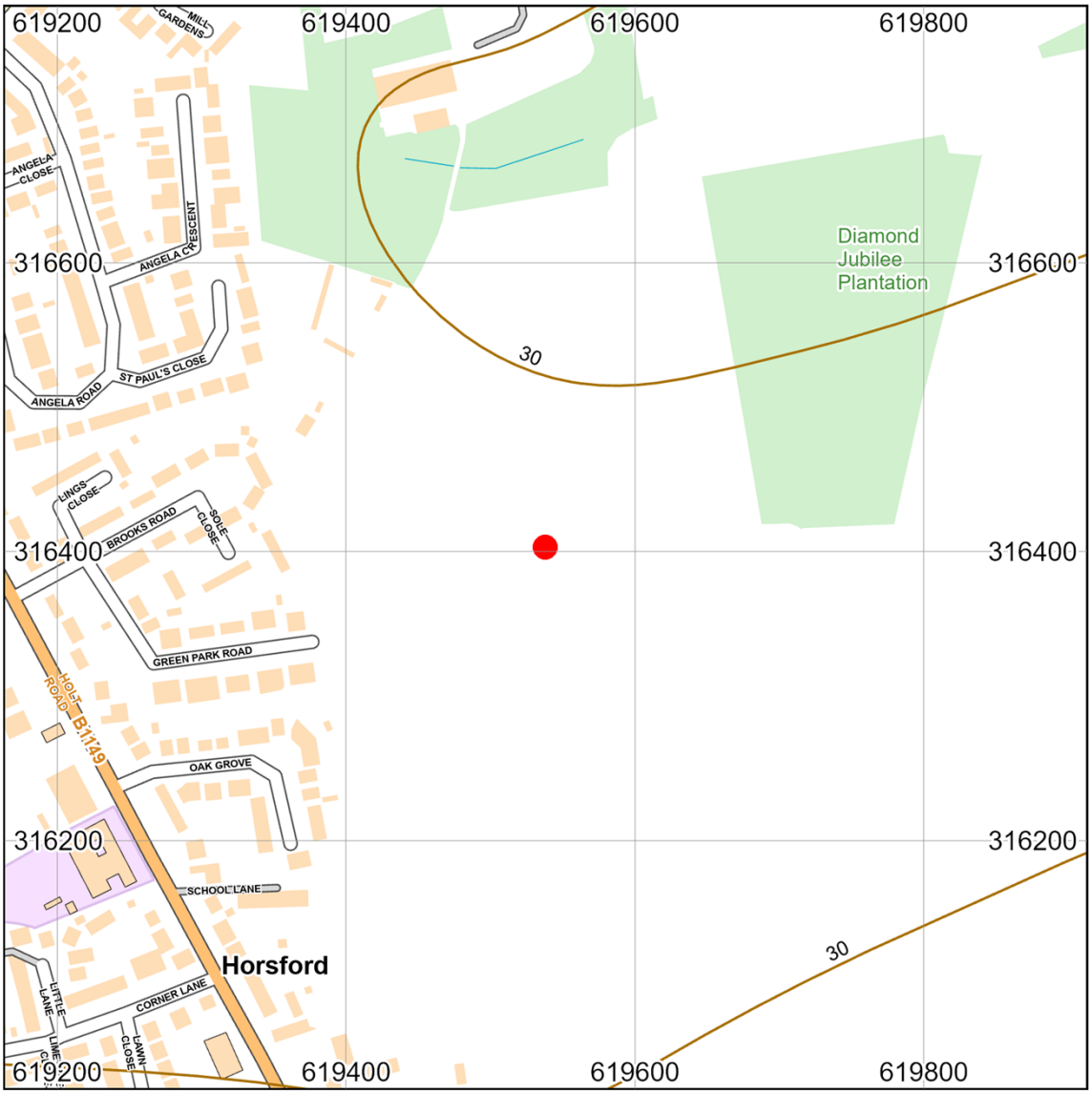
Infiltration SuDS GeoReport:

This report provides information on the suitability of the subsurface for the installation of infiltration sustainable drainage systems (SuDS). It provides information on the properties of the subsurface with respect to significant constraints, drainage, ground stability and groundwater quality protection.

Report Id: ***BGS_347477/66585***

Client reference: 1009.5004 - Holt Road, Horsford

Search location



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Search location indicated in red

Point centred at: 619538,316403

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Assessment for an infiltration sustainable drainage system

Introduction

Sustainable drainage systems (SuDS) are drainage solutions that manage the volume and quality of surface water close to where it falls as rain. They aim to reduce flow rates to rivers, increase local water storage capacity and reduce the transport of pollutants to the water environment. There are four main types of SuDS, which are often designed to be used in sequence. They comprise:

- **source control:** systems that control the rate of runoff
- **pre-treatment:** systems that remove sediments and pollutants
- **retention:** systems that delay the discharge of water by providing surface storage
- **infiltration:** systems that mimic natural recharge to the ground.

This report focuses on infiltration SuDS. It provides subsurface information on the properties of the ground with respect to drainage, ground stability and groundwater quality protection. It is intended principally for those involved in the preliminary assessment of the suitability of the ground for infiltration SuDS, and those involved in assessing proposals from others for sustainable drainage, but it may also be useful to help house-holders judge whether or not further professional advice should be sought. If in doubt, users should consult a suitably-qualified professional about the results in this report before making any decisions based upon it.

This GeoReport is structured in two parts:

- **Part 1. Summary data**.

  Comprises three maps that summarise the data contained within Part 2.

- **Part 2. Detailed data**.

  Comprises a further 24 maps in four thematic sections:

  - **Very significant constraints.** Maps highlight areas where infiltration may result in adverse impacts due to factors including: ground instability (soluble rocks, non-coal shallow mining and landslide hazards); persistent shallow groundwater, or the presence of made ground, which may represent a ground stability or contamination hazard.
  - **Drainage potential**. Maps indicate the drainage potential of the ground, by considering subsurface permeability, depth to groundwater and the presence of floodplain deposits.
  - **Ground stability**. Maps indicate the presence of hazards that have the potential to cause ground instability resulting in damage to some buildings and structures, if water is infiltrated to the ground.
  - **Groundwater protection**. Maps provide key indicators to help determine whether the groundwater may be susceptible to deterioration in quality as a result of infiltration.

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This report considers the suitability of the subsurface for the installation of infiltration SuDS, such as soakaways, infiltration basins or permeable pavements. It provides subsurface data to indicate whether, and which type of infiltration system may be appropriate. It does not state that infiltration SuDS are, or are not, appropriate as this is highly dependent on the design of the individual system. This report therefore describes the subsurface conditions at the site, allowing the reader to determine the suitability of the site for infiltration SuDS.

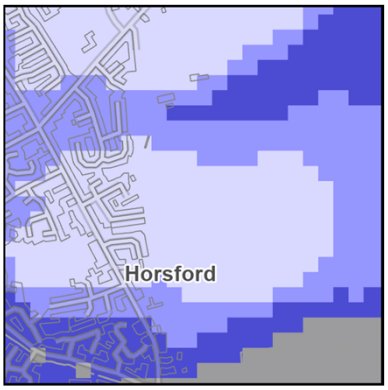
The map and text data in this report is similar to that provided in the '*Infiltration SuDS Map: Detailed'* national map product. For further information about the data, consult the '*User Guide for the Infiltration SuDS Map: Detailed'*, available from http://nora.nerc.ac.uk/16618/.

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PART 1: SUMMARY DATA

This section provides a summary of the data.

In terms of the drainage potential, is the ground suitable for infiltration SuDS?



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- Highly compatible for infiltration SuDS. The subsurface is likely to be suitable for free-draining infiltration SuDS.
- Probably compatible for infiltration SuDS. The subsurface is probably suitable although the design may be influenced by the ground conditions.
- Opportunities for bespoke infiltration SuDS. The subsurface is potentially suitable although the design will be influenced by the ground conditions.
- Very significant constraints are indicated. There is a very significant potential for one or more hazards associated with infiltration.

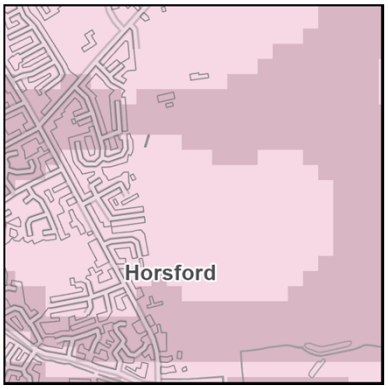
Is ground instability likely to be a problem?



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- Increased infiltration is very unlikely to result in ground instability.
- Ground instability problems may be present or anticipated, but increased infiltration is unlikely to result in ground instability.
- Ground instability problems are probably present. Increased infiltration may result in ground instability.
- There is a very significant potential for one or more geohazards associated with infiltration.

Is the groundwater susceptible to deterioration in quality?



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- The groundwater is not expected to be especially vulnerable to contamination.
- The groundwater may be vulnerable to contamination.
- The groundwater is likely to be vulnerable to contaminants.
- Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

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PART 2: DETAILED DATA

This section provides further information about the properties of the ground and will help assess the suitability of the ground for infiltration SuDS.

Section 1. Very significant constraints

Where maps are overlain by grey polygons, geological or hydrogeological hazards may exist that could be made worse by infiltration. The following hazards are considered:

- soluble rocks
- landslides
- shallow mining (not including coal)
- shallow groundwater
- made ground

For more information read ‘Explanation of terms’ at the end of this report.

Soluble rock hazard



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■ Very significant soluble rock hazard.

Soluble rocks are present with a very significant possibility of localised subsidence that could be initiated or made worse by infiltration. The site investigation should consider whether the potential for or the consequences of subsidence as a result of infiltration are significant.

☐ Very significant soluble rock hazards are not present; however this hazard may still need to be considered. See Part 3.

Landslide hazard



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■ Very significant landslide hazard.

Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail. The site investigation should consider whether the potential for or the consequences of landslide as a result of infiltration are significant.

☐ Very significant landslide hazards are not present; however this hazard may still need to be considered. See Part 3.

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Shallow mining hazard (not including coal)



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■ Very significant mining hazard.

Shallow mining is likely to be present with a very significant possibility of localised subsidence that could be initiated or made worse by increased infiltration. Also, infiltration may increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of subsidence and/or remobilisation of pollutants as a result of infiltration are significant.

☐ Very significant mining hazards are not present; however this hazard may still need to be considered. See Part 3.

Persistent shallow groundwater



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■ Very high likelihood of persistent or seasonally shallow groundwater.

Persistent or seasonally shallow groundwater is likely to be present. Infiltration may increase the likelihood of soakaway inundation, or groundwater emergence at the surface. The site investigation should consider whether the potential for or the consequences of groundwater level rise as a result of infiltration are significant.

☐ See Part 2 for the likely depth to water table.

Made ground



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■ Made ground present.

Made ground is present at the surface. Infiltration may affect ground stability or increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of ground instability and/or pollutant leaching as a result of infiltration are significant.

☐ None recorded

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Section 2. Drainage potential

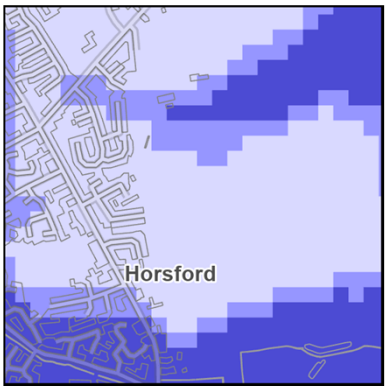
The following pages contain maps that will help you assess the drainage potential of the ground by considering the:

- depth to water table
- permeability of the superficial deposits
- thickness of the superficial deposits
- permeability of the bedrock
- presence of floodplains

Superficial deposits are not present everywhere and therefore some areas of the *superficial deposit permeability* map may not be coloured. Where this is the case, the *bedrock permeability* map shows the likely permeability of the ground. Superficial deposits in some places are very thin and hence in these places you may wish to consider both the permeability of the superficial deposits and the permeability of the bedrock. The *superficial thickness* map will tell you whether the superficial deposits are thin (< 3 m thick) or thick (>3 m). Where they are over 3 m thick, the permeability of the bedrock may not be relevant.

For more information read ‘Explanation of terms’ at the end of this report.

Depth to groundwater table

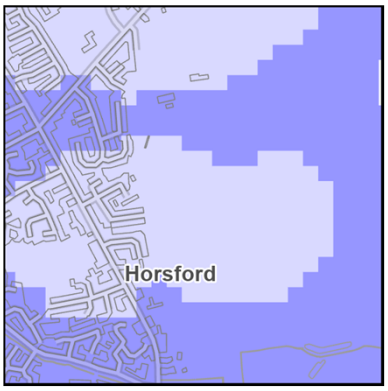


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	Groundwater is likely to be **more than 5 m** below the ground surface throughout the year.
	Groundwater is likely to be between **3 and 5 m** below the ground surface for at least part of the year.
	Groundwater is likely to be **less than 3 m** below the ground surface for at least part of the year.

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Superficial deposit permeability



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Superficial deposits are likely to be **free-draining**.

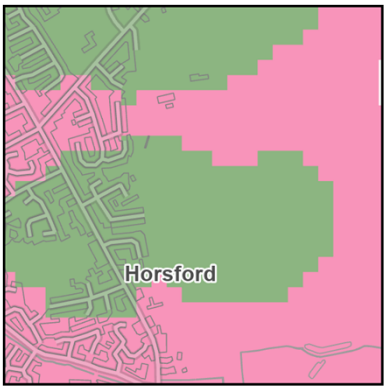
The superficial deposit permeability is **spatially variable**, but likely to permit moderate infiltration.

Superficial deposits are likely to be **poorly draining**.

These maps show the permeability range that is summarised above.

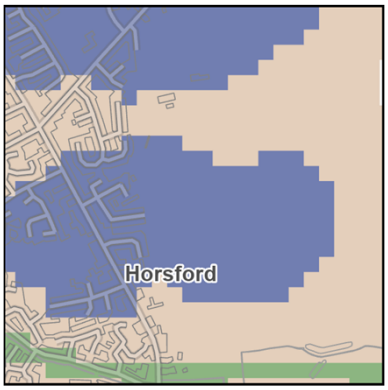
- Very Low
- Low
- Moderate
- High
- Very High

Minimum



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Maximum



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Superficial deposit thickness



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The thickness of superficial deposits is **< 3 m** and hence the permeability of the ground may be dependent on both the superficial deposits (where present) and underlying bedrock (see below).

The thickness of superficial deposits is **> 3 m** and hence the permeability of the superficial deposits is likely to determine the permeability of the ground.

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Bedrock permeability



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Bedrock deposits are likely to be **free-draining**.

The bedrock permeability is **spatially variable**, but likely to permit moderate infiltration.

Bedrock deposits are likely to be **poorly draining**.

These maps show the permeability range that is summarised above.

Key

- Very Low
- Low
- Moderate
- High
- Very High

Minimum



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Maximum



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Geological indicators of flooding



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Superficial floodplain deposits or low-lying coastal areas have been identified. Groundwater levels may rise in response to high river or tide levels, potentially causing inundation of subsurface infiltration SuDS.

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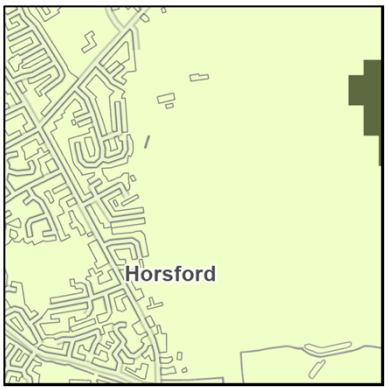
Section 3. Ground stability

The following pages contain maps that will help you assess whether infiltration may impact the stability of the ground. They consider hazards associated with:

- soluble rocks
- landslides
- shallow mining
- running sands
- swelling clays
- compressible ground, and
- collapsible ground

In the following maps, geohazards that are identified in green are unlikely to prevent infiltration SuDS from being installed, but they should be considered during design. For more information read ‘Explanation of terms’ at the end of this report.

Soluble rocks



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	Increased infiltration is unlikely to result in subsidence.
	Increased infiltration is unlikely to cause localised subsidence, but potential impacts should be considered.
	Increased infiltration may result in localised subsidence. The potential for or the consequences of subsidence associated with soluble rocks should be considered.
	Very significant possibility of localised subsidence that could be initiated or made worse by infiltration.

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Landslides



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- Increased infiltration is unlikely to lead to slope instability.
- Slope instability problems may be present or anticipated, but increased infiltration is unlikely to cause instability
- Slope instability problems are probably present or have occurred in the past, and increased infiltration may result in slope instability.
- Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail.

Shallow mining



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- Increased infiltration is unlikely to lead to subsidence.
- Shallow mining is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Shallow mining could be present with a significant possibility that localised subsidence could be initiated or made worse by increased infiltration.
- Shallow mining is likely to be present, with a very significant possibility that localised subsidence may be initiated or made worse by increased infiltration.

Running sand



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- Increased infiltration is unlikely to cause ground collapse associated with running sands.
- Running sand is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Significant possibility for running sand problems. Increased infiltration may result in a geohazard.

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Swelling clays



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- Increased infiltration is unlikely to cause shrink-swell ground movement.
- Ground is susceptible to shrink-swell ground movement. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Ground is susceptible to shrink-swell ground movement. Increased infiltration may result in a geohazard.

Compressible ground



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- Increased infiltration is unlikely to lead to ground compression.
- Compressibility and uneven settlement hazards are probably present. Increased infiltration may result in a geohazard.

Collapsible ground



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- Increased infiltration is unlikely to result in subsidence.
- Deposits with potential to collapse when loaded and saturated are possibly present in places. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Deposits with potential to collapse when loaded and saturated are probably present in places. Increased infiltration may result in a geohazard.

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Section 4. Groundwater quality protection

The following pages contain maps showing some of the information required to ensure the protection of groundwater quality. Data presented includes:

- groundwater source protection zones (Environment Agency data)
- predominant flow mechanism
- made ground

For more information read ‘Explanation of terms’ at the end of this report.

Groundwater source protection zones

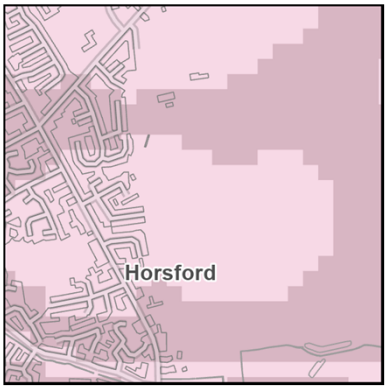


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Derived in part from Source Protection Zone data provided under licence from the Environment Agency © Environment Agency 2026.

- Groundwater is not within a source protection zone.
- Source protection zone IV
- Source protection zone III
- Source protection zone II
- Source protection zone I

Predominant flow mechanism



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- Water is likely to percolate through the unsaturated zone to the groundwater through either the pore space in granular media or through porespace and fractures; these processes have some potential for contaminant removal and breakdown.
- Water is likely to percolate through the unsaturated zone to the groundwater through fractures, a process which has little potential for contaminant removal and breakdown.

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Made ground



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Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

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Section 5. Geological Maps

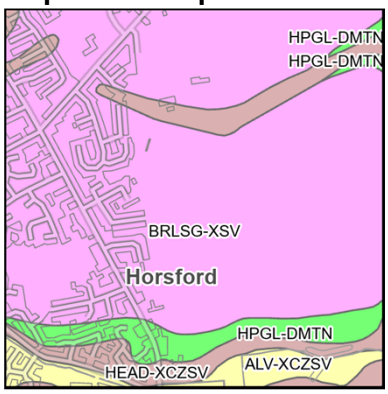
The following maps show the artificial, superficial and bedrock geology within the area of interest.

Artificial deposits



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Superficial deposits



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Bedrock



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Fault

Coal, ironstone or mineral vein

Note: Faults and Coals, ironstone & mineral veins are shown for illustration and to aid interpretation of the map. Not all such features are shown and their absence on the map face does not necessarily mean that none are present

Key to Artificial deposits:
No deposits recorded by BGS in the search area

Key to Superficial deposits:

Map colour	Computer Code	Rock name	Rock type
	BRLSG-XSV	Briton's Lane Sand And Gravel Member	Sand and gravel
	HPGL-DMTN	Happisburgh Glacigenic Formation	Diamicton
	ALV-XCZSV	Alluvium	Clay, silt, sand and gravel
	HEAD-XCZSV	Head	Clay, silt, sand and gravel

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Key to Bedrock geology:

Map colour	Computer Code	Rock name	Rock type
	WRCG-XSV	Wroxham Crag Formation	Sand and gravel

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Limitations of this report:

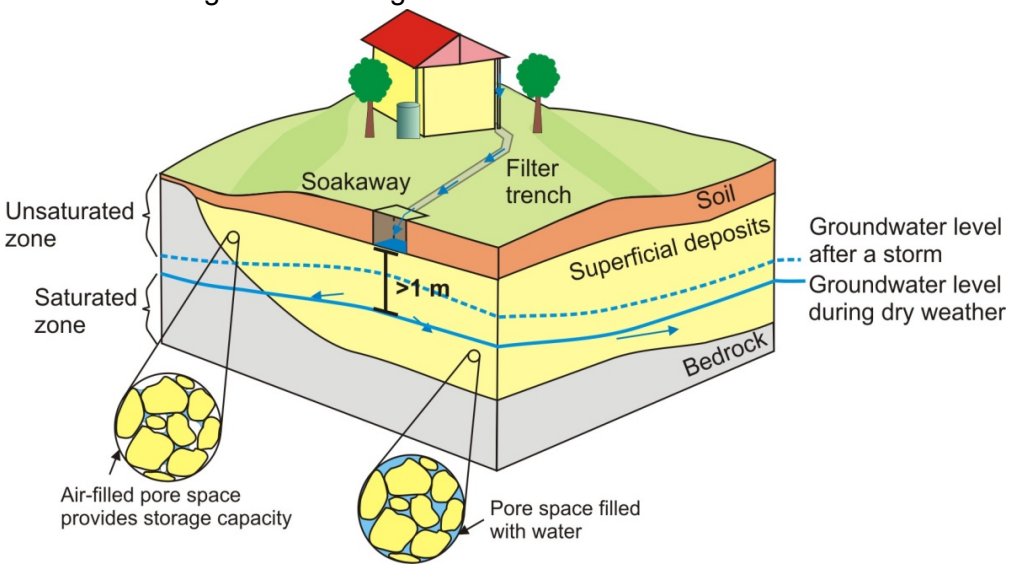
- This report is concerned with the potential for infiltration-to-the-ground to be used as a SuDS technique at the site described. It only considers the subsurface beneath the search area and does NOT consider potential surface or subsurface impacts outside of that area.
- This report is NOT an alternative for an on-site investigation or soakaway test, which might reach a different conclusion.
- This report must NOT be used to justify disposal of foul waste or grey water.
- This report is based on and limited to an interpretation of the records held by the British Geological Survey (BGS) at the time the search is performed. The datasets used (with the exception of that showing depth to water table) are based on 1:50 000 digital geological maps and not site-specific data.
- Other more specific and detailed ground instability information for the site may be held by BGS, and an assessment of this could result in a modified assessment.
- To interpret the maps correctly, the report must be viewed and printed in colour.
- The search does NOT consider the suitability of sites with regard to:
    - previous land use,
    - potential for, or presence of contaminated land
    - presence of perched water tables
    - shallow mining hazards relating to coal mining. Searches of coal mining should be carried out via The Coal Authority Mine Reports Service: **https://www.miningremediation.co.uk/miningreports/**.
    - made ground, where not recorded
    - proximity to landfill sites (searches for landfill sites or contaminated land should be carried out through consultation with local authorities/Environment Agency)
    - zones around private water supply boreholes that are susceptible to groundwater contamination.
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Explanation of terms

Depth to groundwater

In the shallow subsurface, the ground is commonly unsaturated with respect to water. Air fills the spaces within the soil and the underlying superficial deposits and bedrock. At some depth below the ground surface, there is a level below which these spaces are full of water. This level is known as the groundwater level, and the water below it is termed the groundwater. When water is infiltrated, the groundwater level may rise temporarily. To ensure that there is space in the unsaturated zone to accommodate this, there should be a minimum thickness of 1 m between the base of the infiltration system and the water table. An estimate of the *depth to groundwater* is therefore useful in determining whether the ground is suitable for infiltration.



Groundwater flooding

Groundwater flooding occurs when a rise in groundwater level results in very shallow groundwater or the emergence of groundwater at the surface. If infiltration systems are installed in areas that are susceptible to groundwater flooding, it is possible that the system could become inundated. The susceptibility map seeks to identify areas where the geological conditions and water tables indicate that groundwater level rise could occur under certain circumstances. A high susceptibility to groundwater flooding classification does not mean that groundwater flooding has ever occurred in the past, or will do so in the future as the susceptibility maps do not contain information on how often flooding may occur. The susceptibility maps are designed for planning; identifying areas where groundwater flooding might be an issue that needs to be taken into account.

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Geological indicators of flooding

In floodplain deposits, groundwater level can be influenced by the water level in the adjacent river. Groundwater level may increase during periods of fluvial flood and therefore this should be taken into account when designing infiltration systems on such deposits. The *geological indicators of flooding* dataset shows where there is geological evidence (floodplain deposits) that flooding has occurred in the past.

For further information on flood-risk, the likely frequency of its recurrence in relation to any proposed development of the site, and the status of any flood prevention measures in place, you are advised to contact the local office of the Environment Agency (England and Wales) at www.environment-agency.gov.uk/ or the Scottish Environment Protection Agency (Scotland) at www.sepa.org.uk.

Artificial ground

Artificial ground comprises deposits and excavations that have been created or modified by human activity. It includes ground that is worked (quarries and road cuttings), infilled (back-filled quarries), landscaped (surface re-shaping), disturbed (near surface mineral workings) or classified as made ground (embankments and spoil heaps). The composition and properties of artificial ground are often unknown. In particular, the permeability and chemical composition of the artificial ground should be determined to ensure that the ground will drain and that any contaminants present will not be remobilised.

Superficial permeability

Superficial deposits are those geological deposits that were formed during the most recent period of geological time (as old as 2.6 million years before present). They generally comprise relatively thin deposits of gravel, sand, silt and clay and are present beneath the pedological soil in patches or larger spreads over much of Britain. The ease with which water can percolate through these deposits is controlled by their permeability and varies widely depending on their composition. Those deposits comprising clays and silts are less permeable and thus infiltration is likely to be slow, such that water may pool on the surface. In comparison, deposits comprising sands and gravels are more permeable allowing water to percolate freely.

Bedrock permeability

Bedrock forms the main mass of rock forming the Earth. It is present everywhere, commonly beneath superficial deposits. Where the superficial deposits are thin or absent, the ease with which water will percolate into the ground depends on the permeability of the bedrock.

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Natural ground instability

Natural ground instability refers to the propensity for upward, lateral or downward movement of the ground that can be caused by a number of natural geological hazards (e.g. ground dissolution/compressible ground). Some movements associated with particular hazards may be gradual and of millimetre or centimetre scale, whilst others may be sudden and of metre or tens of metres scale. Significant natural ground instability has the potential to cause damage to buildings and structures, especially when the drainage characteristics of a site are altered. It should be noted, however, that many buildings, particularly more modern ones, are built to such a standard that they can remain unaffected in areas of significant ground movement.

Shrink-swell

A shrinking and swelling clay changes volume significantly according to how much water it contains. All clay deposits change volume as their water content varies, typically swelling in winter and shrinking in summer, but some do so to a greater extent than others. Contributory circumstances could include drought, leaking service pipes, tree roots drying-out the ground or changes to local drainage patterns, such as the creation of soakaways. Shrinkage may remove support from the foundations of buildings and structures, whereas clay expansion may lead to uplift (heave) or lateral stress on part or all of a structure; any such movements may cause cracking and distortion.

Landslides (slope stability)

A landslide is a relatively rapid outward and downward movement of a mass of ground on a slope, due to the force of gravity. A slope is under stress from gravity but will not move if its strength is greater than this stress. If the balance is altered so that the stress exceeds the strength, then movement will occur. The stability of a slope can be reduced by removing ground at the base of the slope, by placing material on the slope, especially at the top, or by increasing the water content of the materials forming the slope. Increase in subsurface water content beneath a soakaway could increase susceptibility to landslide hazards. The assessment of landslide hazard refers to the stability of the present land surface. It does not encompass a consideration of the stability of excavations.

Soluble rocks (dissolution)

Some rocks are soluble in water and can be progressively removed by the flow of water through the ground. This process tends to create cavities, potentially leading to the collapse of overlying materials and possibly subsidence at the surface. The release of water into the subsurface from infiltration systems may increase the dissolution of rock or destabilise material above or within a cavity. Dissolution cavities may create a pathway for rapid transport of contaminated water to an aquifer or water course.

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Compressible ground

Many ground materials contain water-filled pores (the spaces between solid particles). Ground is compressible if a building (or other load) can cause the water in the pore space to be squeezed out, causing the ground to decrease in thickness. If ground is extremely compressible the building may sink. If the ground is not uniformly compressible, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The compressibility of the ground may alter as a result of changes in subsurface water content caused by the release of water from soakaways.

Collapsible deposits

Collapsible ground comprises certain fine-grained materials with large pore spaces (the spaces between solid particles). It can collapse when it becomes saturated by water and/or a building (or other structure) places too great a load on it. If the material below a building collapses it may cause the building to sink. If the collapsible ground is variable in thickness or distribution, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The subsurface underlying a soakaway will experience an increase in water content that may affect the stability of the ground. This hazard is most likely to be encountered only in parts of southern England.

Running sand

Running sand conditions occur when loosely-packed sand, saturated with water, flows into an excavation, borehole or other type of void. The pressure of the water filling the spaces between the sand grains reduces the contact between the grains and they are carried along by the flow. This can lead to subsidence of the surrounding ground. Running sand is potentially hazardous during the drainage system installation. During installation, excavation of the ground may create a space into which sand can flow, potentially causing subsidence of surrounding ground.

Shallow mining hazards (non coal)

Current or past underground mining for coal or for other commodities can give rise to cavities at shallow or intermediate depths, which may cause fracturing, general settlement, or the formation of crown-holes in the ground above. Spoil from mineral workings may also present a pollution hazard. The release of water into the subsurface from soakaways may destabilise material above or within a cavity. Cavities arising as a consequence of mining may also create a pathway for rapid transport of contaminated water to an aquifer or watercourse. The mining hazards map is derived from the geological map and considers the potential for subsidence associated with mining on the basis of geology type. Therefore if mining is known to occur within a certain rock, the map will highlight the potential for a hazard within the area covered by that geology.

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For more information regarding underground and opencast **coal mining**, the location of mine entries (shafts and adits) and matters relating to subsidence or other ground movement induced by **coal mining** please contact the Coal Authority, Mining Reports, 200 Lichfield Lane, Mansfield, Nottinghamshire, NG18 4RG; telephone 0845 762 6848 or at www.coal.gov.uk**.** For more information regarding other types of mining (i.e. non-coal), please contact the British Geological Survey.

Groundwater source protection zones

In England and Wales, the Environment Agency has defined areas around wells, boreholes and springs that are used for the abstraction of public drinking water as source protection zones. In conjunction with Groundwater Protection Policy the zones are used to restrict activities that may impact groundwater quality, thereby preventing pollution of underlying aquifers, such that drinking water quality is upheld. The Environment Agency can provide advice on the location and implications of source protection zones in your area (www.environment-agency.gov.uk/)

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