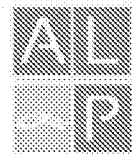


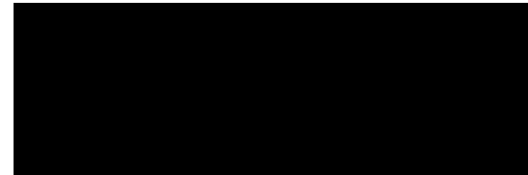
LAND SOUTH OF BARNHAM STATION, BARNHAM
FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

GLEESON STRATEGIC LAND

20 NOVEMBER 2020



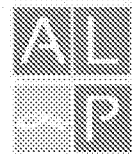
Abley Letchford Partnership Limited
3 Tealgate
Charnham Park
Hungerford
RG17 0YT



Quality Management:

Prepared by:	Charles Graham
Authorised by:	Leigh Abley
Date:	20 November 2020
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Appendices

Appendix 1 - Plans

Appendix 2 - LLFA Developer Checklist

Appendix 3 - Drainage Strategy

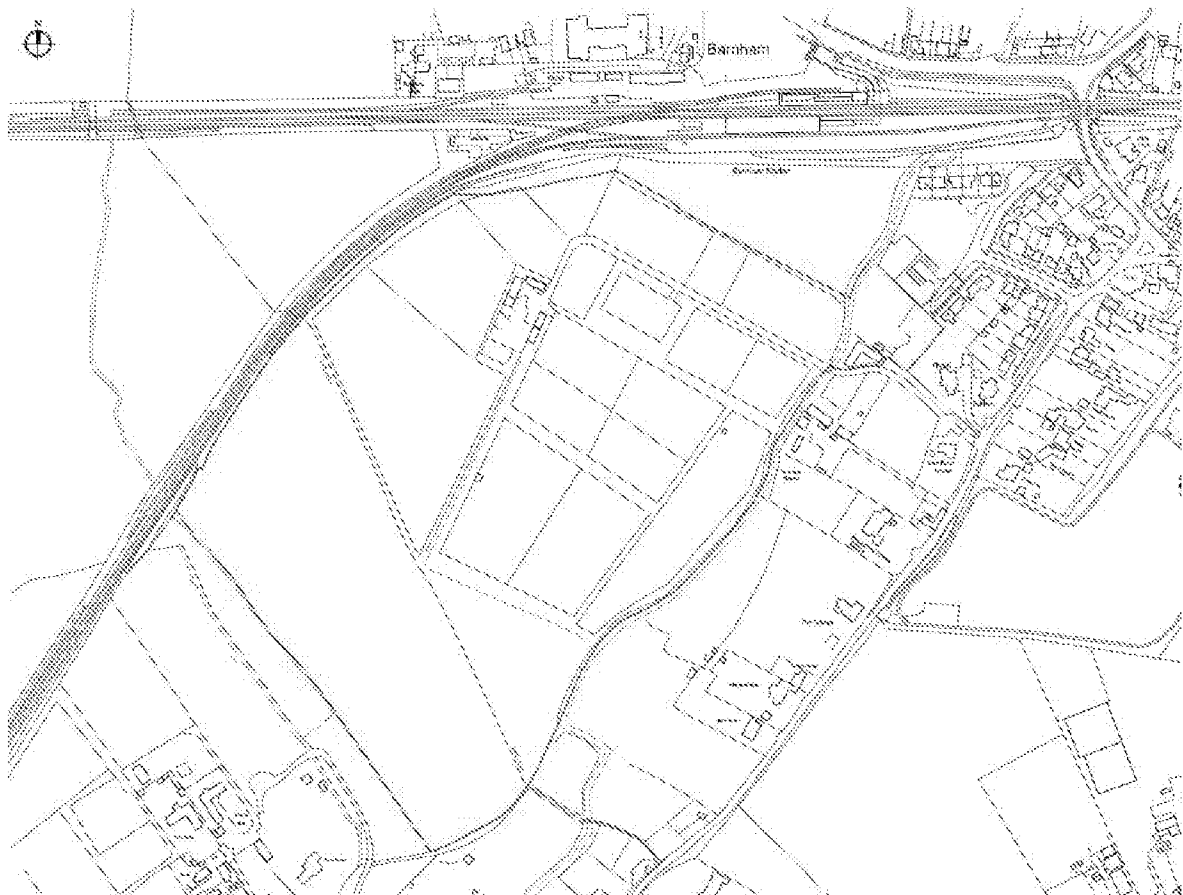
Appendix 4 - Environment Agency Data

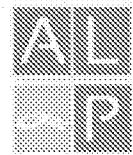
1.0 Introduction

Context

- 1.1. This report has been prepared by Abley Letchford Partnership Ltd, on behalf of Gleeson Strategic Land, in relation to an outline planning application for the proposed residential development on land south of Barnham Station, Barnham.
- 1.2. **Figure 1** shows the location of the proposed development area in the context of the wider locality.

Figure 1 – Site Location





Development Proposals

- 1.3. The proposals for the site centre upon the provision of 200 residential dwellings, together with associated infrastructure and landscaping as depicted on the Illustrative Masterplan within **Appendix 1**.

Requirement for a Flood Risk Assessment (FRA)

- 1.4. The requirement for a Flood Risk Assessment is set out in Section 14 of the revised National Planning Policy Framework (NPPF) as revised in February 2019.

- 1.5. Footnote 50 accompanying Paragraph 163 states:

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.

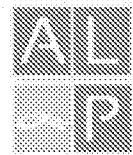
- 1.6. The site is a Greenfield site, extends greater than 1 hectare in total; therefore, a site-specific flood risk assessment is required. To comply with an Outline Planning Application, matters related to flood risk and drainage are addressed within this report.

Report Aim and Formation

- 1.7. The principal aim of this report is to demonstrate that the provision of a suitable drainage strategy will be achieved at the development.
- 1.8. This report will also outline the impacts the development could have on flood risk to the area and outlines the mitigation systems that will be implemented to minimise this risk.
- 1.9. The drainage design ensures that the guiding principles of Sustainable Drainage Systems (SuDS) are central to the design of the surface water drainage strategy for the proposed development.

Report Structure

- 1.10. This report addresses the requirements of revised NPPF and considers the following aspects:
- Section 2: Policy and Sources of Information – a review of policy relevant to the assessment and sources of information.
 - Section 3: Baseline Environmental Conditions – a description of the site location, its topography, geology and hydrology.
 - Section 4: Flood Risk – the effect of flooding within the existing site layout from all sources.
 - Sections 5 and 6: Drainage Strategy – offer appropriate mitigation measures to protect the site in the post development scenarios for surface and foul water drainage strategies.
 - Section 7: Summary and Conclusions – a review of the suitability of the development proposals in the context of site vulnerability and the requirements of the NPPF.



2.0 Policy and Sources of Information

Introduction

- 2.1. This chapter provides a review of policy relevant to the assessment and sources of information.

National Planning Policy

- 2.2. National Planning Policy in relation to Flood Risk is set out in Section 14 of the National Planning Policy Framework (NPPF) and Planning Practice Guidance ID:7 for Flood Risk and Coastal Change (PPG). Flood Risk is discussed in Paragraphs 155-165 of the NPPF.
- 2.3. Paragraphs 157-162 discuss the Sequential approach. Paragraph 158 refers to a Strategic Flood Risk Assessment (SFRA) that would form the basis of applying the Sequential Test for local authorities to allocate development, whilst Paragraphs 159-162 relates to the Exemption Tests.
- 2.4. Paragraph 163 discusses the determination of planning applications stating:

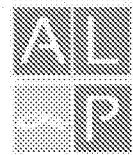
When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood risk assessment. Development should only be allowed in areas at risk of flooding where, in light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

- a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;*
- b) the development is appropriately flood resilient and resilient*
- c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate.*
- d) any residual risk can be safely managed; and*
- e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.*

- 2.5. The development would be classed as Major Development providing more than 10 homes and the site is greater than 0.5 hectares. Paragraph 165 states:

Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

- a) Take account of advice from the lead local flood authority (LLFA);*
- b) Have appropriate proposed minimum operational standards;*
- c) Have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and*
- d) Where possible, provide multifunctional benefits.*

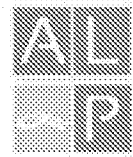


Environment Agency/GOV.UK

- 2.6. The Flood and Water Management Act (2010) provides the Environment Agency (EA) a strategic overview role for all forms of flooding and coastal erosion. They also have direct responsibility for the prevention, mitigation and remediation of flood damage for main rivers and coastal areas. The Environment Agency is a statutory consultee in relation to flood risk and planning dependent upon criteria.
- 2.7. Environment Agency Standing Advice has been consulted and reviewed within this Flood Risk Assessment.
- 2.8. The GOV.UK Flood Map for Planning, Long Term Flood Risk and Catchment Data Explorer websites have been interrogated in respect to flood risk extents and sources.

Local Authorities

- 2.9. The Site lies within the administrative area of Arun District Council (ADC).
- 2.10. Flood Risk Planning Policy published by Arun District Council (ADC) regarding the flood risk was referred to in order to assess the methodology best suited to suit the local area. These documents include the following key documents recognising development with regards to the wider area:
 - Barnham and Eastergate Neighbourhood Development Plan 2014-2029 – July 2014;
 - Arun Local Plan (2011-2031) Sequential & Exception Tests – October 2014;
 - Arun District Council Level 1 SFRA – Final Report (v2 August 2016);
 - Arun Strategic Surface Water Management Study – October 2016;
 - Arun District Council Final Combined Level 1 and Level 2 SFRA – Final Report (v5 November 2016);
 - Arun Local Plan (2011-2031) – July 2018;
 - West Sussex LLFA Policy for the Management of Surface Water – November 2018; and
 - Arun District Council Surface Water Drainage Proposal Checklist – November 2019.
- 2.11. West Sussex County Council (WSCC) became the Lead Local Flood Authority (LLFA) to Arun District Council (ADC) under the Flood and Water Management Act 2010. However, ADC as its agent can be contacted to provide guidance to assess, manage and inform flood risk.
- 2.12. ADC provide a Surface Water Drainage Proposals Checklist to assist developers seeking planning permission outlining expectations and requirements for Surface Water Drainage Proposals and to expedite their review. A completed checklist is included within **Appendix 2**.
- 2.13. WSCC, as LLFA and its agent, ADC, has permissive rights over any Ordinary Watercourses/land drainage ditches. If any work is required within the watercourse (improvements or crossings) then approval from the LLFA is required under the Flood and Water Management Act 2020.

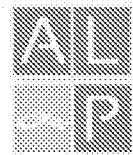


Local Water Authority

- 2.14. Southern Water (SW) is responsible for the supply of clean water and disposal of wastewater for the Barnham area.
- 2.15. Information with regards to sewer and water main flooding contained within the SFRA has been consulted as part of this FRA. All Water Companies have a statutory obligation to maintain a register of properties/areas which are at risk of flooding from the public sewerage system and is shown on the DG5 Flood Register.

Other Sources of Information

- 2.16. A desktop study of the Site was carried out using the following websites to ascertain local features, hydrology and soil characteristics:
- DEFRA's MAGIC portal,
 - British Geological Survey (BGS) and
 - Cranfield University Soilscales portal.
- 2.17. A Site walkover conducted in July 2020 allowed observation of existing topography, watercourses, and nearby drainage outfalls. A second walkover was undertaken in October 2020 with Paul Cann of Arun District Council in his capacity as LLFA.
- 2.18. The following Geotechnical Information was reviewed in respect to underlying strata, ground composition and groundwater.
- Leap Environmental Ltd's Phase I Desk Study & Site Reconnaissance (Ref: LP2292 dated August 2020)
- 2.19. Guidance with respect to Sustainable Drainage Systems (SuDS) is contained within DEFRA document Sustainable Drainage Systems, Non-statutory technical standards for sustainable drainage systems March 2015, as well as CIRIA C753 The SuDS Manual, BS8582:2013 – Code of Practice for Surface Water Management for Development Sites and Approved Document H of the Building Regulations.
- 2.20. Additional guidance on development and flood risk is contained within CIRIA C624 Development and Flood Risk – Guidance for the Construction Industry which identifies several key aims for a development to ensure it is sustainable in flood risk terms.



3.0 Baseline Environmental Conditions

Introduction

3.1. This chapter provides a description of the site location, its topography, geology and hydrology.

Site Location

- 3.2. The site is located at South of Barnham Station, Barnham, Bognor Regis in West Sussex (the Site).
- 3.3. The Site is bounded to the north-west by grassed fields with Barnham Railway Station to the north and existing residential properties in Marshall Close to the north-east.
- 3.4. The site is bounded to the south-east by the Barnham Rife and an existing watercourse and hedgerow on its south-western boundary. Tars Farm House lies to the east.
- 3.5. The Site consists predominantly of grass covered fields divided into paddocks, enclosed by dense vegetation and a drainage ditch which routes north-west to south east between two paddock boundaries located in the central area of the site together with dispersed agricultural buildings.
- 3.6. The Site covers an area of circa 15.1 hectares (Ha) approximately centred on OS grid reference 495720E, 104120N. The nearest postcode is PO22 0DG.

Topography

- 3.7. The Site falls to the south-east and south-west boundaries with site levels at approximately 8.6m AOD along the northern boundary to the level of 2.1m AOD close to the southern tip of the site adjacent to Barnham Rife, and at circa 4.0m AOD adjacent to the existing watercourse.
- 3.8. On the eastern side of the Barnham Rife, levels rise towards Church Lane, which is at circa 6.4m AOD and towards Marshall Close at circa 3.4m AOD.

Watercourses and Ditches

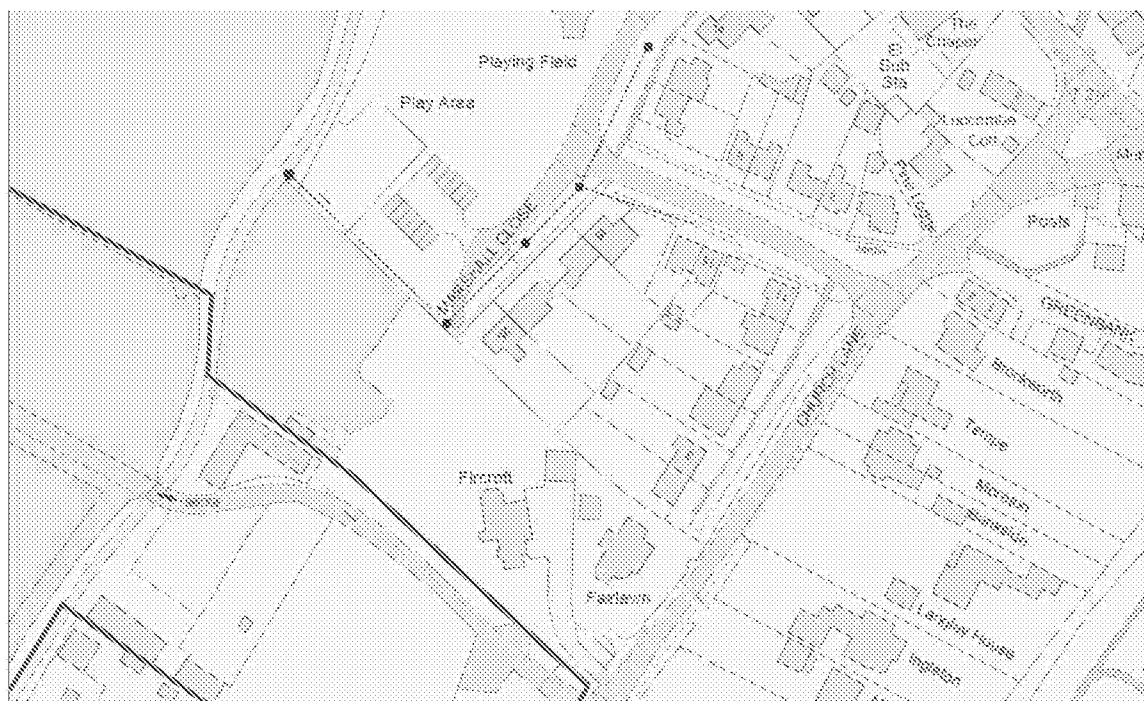
- 3.9. Barnham Rife lies to the south east of the Site. This is classed as a Main River by the Environment Agency. All works within 8m of the top of bank are licenced activities and must be agreed with the EA.
- 3.10. A network of drainage ditches is prevalent throughout the Site, coincidental with paddock boundaries, and hedgerows with dispersed trees. These ditches, which are not main river or highway drains, are classed as Ordinary Watercourses. They flow into the Barnham Rife river which heads south westwards away from the Site.

Surface and Foul Water Sewers

- 3.11. Sewer Asset Records obtained from Southern Water do indicate the presence of foul water sewers and manholes within the Site and within Church Lane.
- 3.12. The topographical survey does not indicate the presence of any formal drainage system for the existing on-site farm tracks.

- 3.13. The topographical survey indicated highway gullies within the Marshall Close to the east of the Site. Details of the highway drainage network have been provided by Arun District Council. This highway drainage system discharges directly into the nearby Barnham Rife. See **Figure 2** below:

Figure 2 – Arun District Highway Drainage Mapping



- 3.14. A copy of Southern Water's Asset Record and Response Letter is included within **Appendix 1**.

Geology and Hydrogeology

- 3.15. British Geological Survey mapping indicates that the site is mapped as being underlain by superficial deposits of River Terrace Deposits in the north west portion of the site, overlying Raised Beach Deposits. Raised Marine Deposits are mapped along the eastern and southern site boundaries.
- 3.16. British Geological Survey mapping indicates that the bedrock geology underlying the Site as London Clay Formation. The Lambeth Formation was mapped circa 40m south of the site and the White Chalk Subgroup are mapped circa 120m south of the site.
- 3.17. The Cranfield University Soilsapes maps indicate the site overlies loamy soils with naturally high groundwater.
- 3.18. Intrusive ground investigations, groundwater monitoring and soakage testing to BRE DG365 are planned to be undertaken to provide confirmation of the hydrogeology.
- 3.19. Environment Agency (EA) mapping confirms that the Site lies outside of any Groundwater Source Protection Zone (SPZ) and Principal aquifer designation.
- 3.20. MAGIC confirms that the Groundwater Vulnerability ranges from 'Unproductive' to 'Medium to Low' across the site.

Hydrology

3.21. The Catchment Data Explorer online facility provided by the Environment Agency indicates that the site is wholly located within the Arun and Western Streams – Western Streams – Lidsey Rife Catchment which flows south of the Site through Bognor Regis and therein to the English Channel. **Figure 3** provides an overview of the Arun and Western Streams catchment with the approximate Site denoted by an orange dot.

Figure 3 – EA Catchment Data Explorer Extract





4.0 Flood Risk

Introduction

- 4.1. This chapter assesses flood risk at the site from all sources including appropriate allowance for climate change required by relevant National and Local planning policy.

Flood Risk to the Site from Tidal Sources

- 4.2. The Site is at a low risk from tidal flooding due to its inland elevated location.

Flood Risk to the Site from Fluvial Flooding Sources

- 4.3. A review of the EA's Flood Map for Planning maps show the Site to lie predominantly within Flood Zone 1 in respect of fluvial flows, however sections of the site are located within both Flood Zone 2 and 3, where risks are higher.
- 4.4. Flood Zone 1 comprises land where flooding from rivers and the sea (fluvial) is very unlikely. There is less than a 0.1% (1 in 1000) chance of flooding occurring each year. Large parts of the Site are at a low risk of flooding from fluvial sources.
- 4.5. The land surrounding the Barnham Rife is classed as Flood Zone 2 and 3. Flood Zone 2 is land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%). Flood Zone 3 is land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%).
- 4.6. The EA Flood Map for Planning maps shows that part of the site benefits from an existing flood defence to the river flowing south westwards along the site's south eastern boundary. See orange line adjacent to the Barnham Rife in extracts from the EA Flood Map included below in **Figures 4 and 5**.
- 4.7. Mapping from the SFRA shows the recorded incidents and flood outlines in Barnham provided by Arun District Council, West Sussex County Council, Southern Water and Environment Agency. An extract is shown in **Figure 7**. There are two incidents shown upstream of the site and the sources of flooding was classed as river (fluvial) flooding (blue) and unknown (purple). Green dots denote surface water flooding (pluvial). The Site boundary is shown in orange.
- 4.8. Latest hydrology data for the Barnham Rife was requested from the EA and this was received in August 2020. A copy of the obtained information on flood defences and historical flood events are included within **Appendix 4**.
- 4.9. The proposed residential development will be directed to areas where the site lies within Flood Zone 1 in collaboration with the LLFA and EA mitigating the risks of fluvial flooding.
- 4.10. On the basis that the provision of the new site access road across the Barnham Rife does not unduly restrict the existing cross-sectional area, nor reduce the existing flood zone extents without compensation or mitigation, the Site is considered to be a low risk of fluvial flooding.

Figure 5 – Environment Agency Flood Map for Planning (Fluvial)

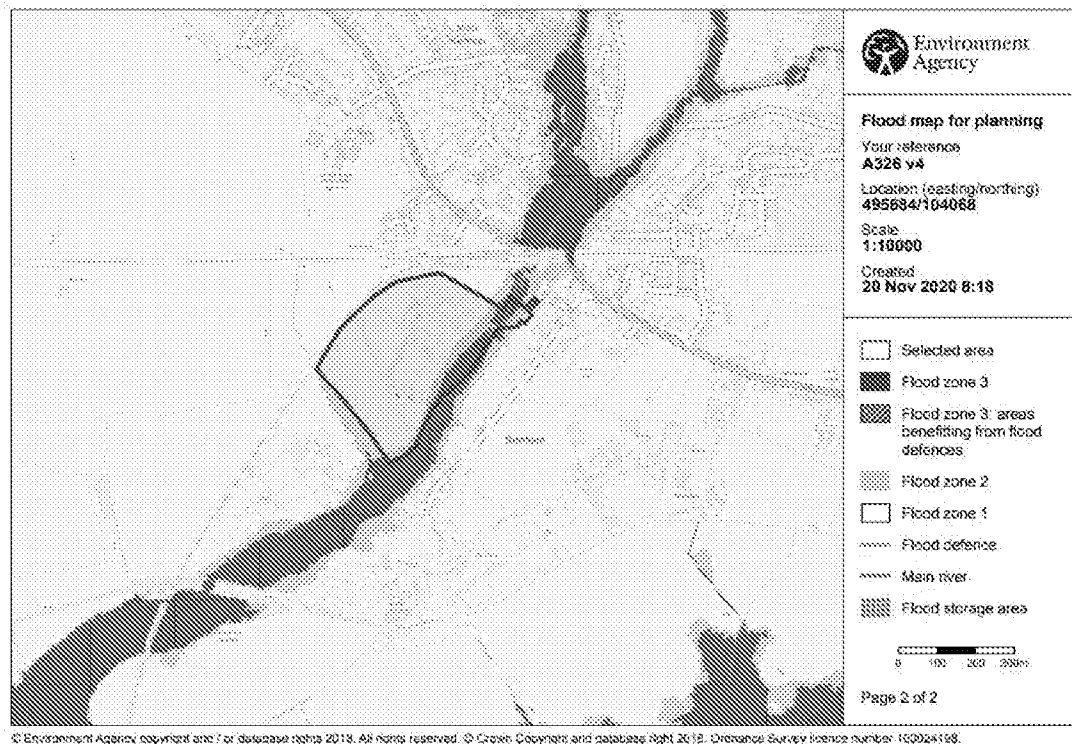


Figure 6 – Environment Agency Flood Map for Planning (Fluvial)

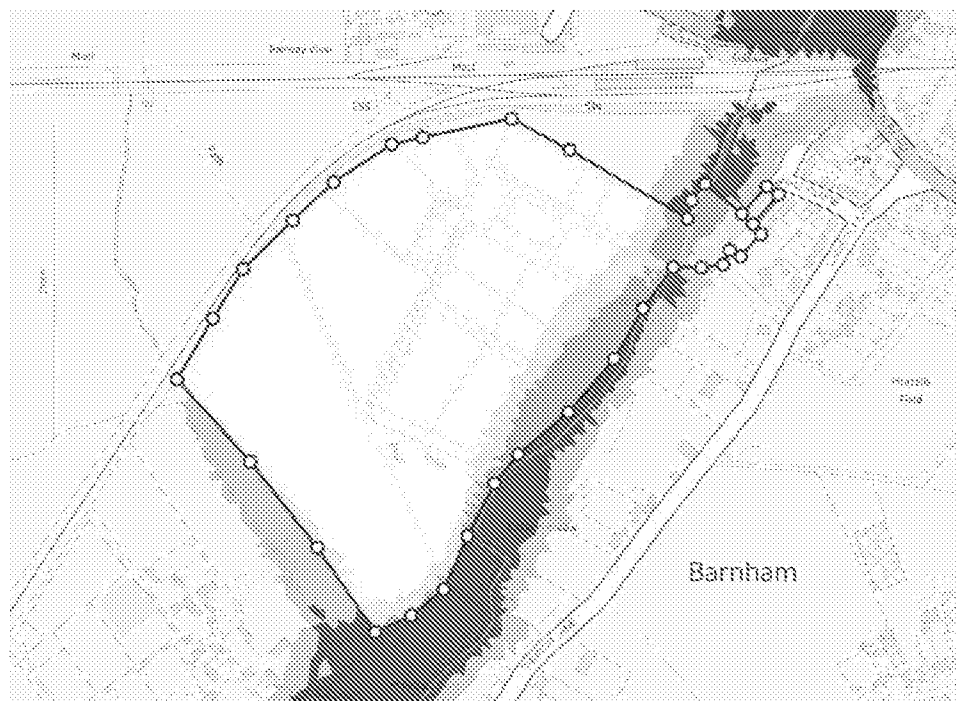
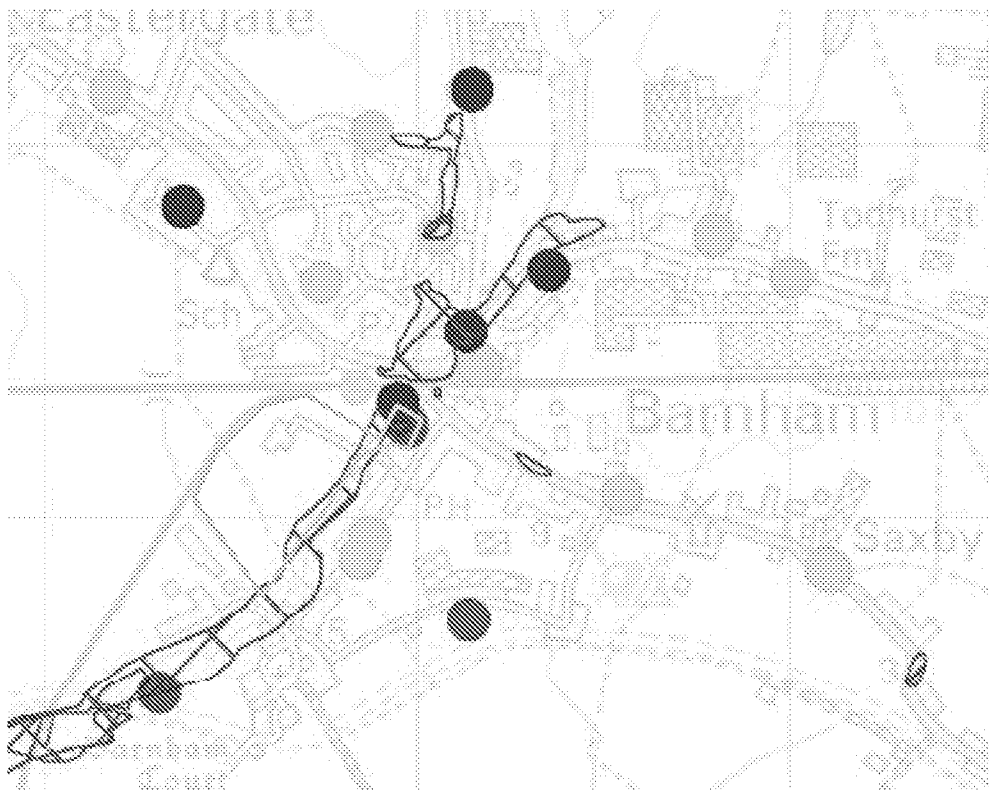


Figure 7 – Arun District Council (extract of Arun District Council Final Combined Level 1 and Level 2 SFRA (v5 November 2016: Appendix H Historic Flood Records)

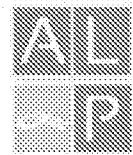


Flood Risk to the Site from Pluvial Flooding Sources

- 4.11. The GOV.UK Long Term Flood Risk website identifies where land is subject to flooding from surface water (pluvial) wherein excess run off flows over the ground surface following the natural topography to nearby rivers and streams.
- 4.12. Pluvial flooding is shown as affecting the site following existing drains on-site and adjacent to the south western boundary
- 4.13. The proposed development will be directed to areas that are not affected by pluvial flooding in collaboration with the LLFA and EA due to the topography and elevation of the Site i.e. it being higher than the surrounding area close to the river on the eastern boundary.
- 4.14. The Site is therefore considered to be a low risk of pluvial flooding.

Flood Risk to the Site from Groundwater

- 4.15. Groundwater flooding has the potential to occur after prolonged periods of unusually high rainfall. During such periods, more water than usual infiltrates through the ground, raising the water table above its normal depth below the surface. Where the water table is at shallow depth in any case, the water table can reach the surface. This can cause ground water to merge with rainfall and cause localised flooding.



- 4.16. The Site is underlain by London Clay which is known to have impeded drainage and high groundwater characteristics.
- 4.17. The SFRA mapping indicates that the Site is in an area susceptible to Groundwater Flooding classified as being between ' $\geq 50\% < 75\%$ ' and ' $\geq 75\%$ '.
- 4.18. Investigations are planned over the winter period (October – March) to establish maximum winter groundwater levels achieved during prolonged periods of rainfall.
- 4.19. The results of the investigations will enable the finished floor levels of the proposed residential dwellings to be determined so measures can be implemented to ensure the site is robust with respect to groundwater flooding.
- 4.20. There is no known evidence of flooding from groundwater affecting the site. The risk of flooding from groundwater sources is considered medium but with measures implemented would be considered low.

Flood Risk to the Site from Sewers

- 4.21. When exceeded, surcharged sewer networks can lead to flooding from backed up manholes and gully connections.
- 4.22. There are foul water sewers within the Site. There are no on-site surface water sewers.
- 4.23. Southern Water was contacted regarding their sewer network. Southern Water's response did not include any evidence of sewer flooding from the on-site sewers.
- 4.24. Anecdotal evidence of foul water flooding was reported by the LLFA during the October 2020 Site Walkover. Odours were present during the visit adjacent to the public foul sewer system, which confirmed that this could be a possibility.
- 4.25. The risk of flooding from this source is considered low given the lower elevation of said sewers.

Flood Risk to the Site from Other Sources

- 4.26. The SFRA, EA and GOV.UK websites indicate the Site does not fall within the extent of flooding from reservoirs, canals or other artificial sources.
- 4.27. The Site is deemed of low risk of flooding from these sources.

Site Specific Sequential Test

- 4.28. NPPF states that Local Planning Authorities allocating land for development should apply the Sequential Test to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.
- 4.29. PPG ID: 7 (Table 1) appropriate uses have been identified for the Flood Zones. By applying the Flood Risk Vulnerability Classification in Table 2 and 3 of PPG ID: 7 repeated below for ease of reference as **Figure 8**, the proposed development is a 'residential development' and therefore is classified as 'More Vulnerable'.
- 4.30. The proposed development will be directed to the area situated in Flood Zone 1 away from Flood Zone 2 and Flood Zone 3.



- 4.31. By applying the Flood Risk Vulnerability test, all development types are deemed to be accepted in Flood Zone 1.

Figure 8 – Flood Risk Vulnerability Classification

Flood Risk Vulnerability classification (see Table 1 PPG ID: 7)	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	Yes	Yes	Yes	Yes	Yes
Zone 2	Yes	Yes	Exception test required	Yes	Yes
Zone 3a	Exception test required	Yes	No	Exception test required	Yes
Zone 3b 'Functional Floodplain'	Exception test required	Yes	No	No	No

Key: Yes: Development is appropriate, No: Development should not be permitted.

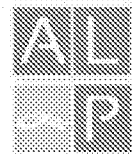
- 4.32. Therefore, within the context of a site specific FRA, the site passes the Sequential Test with respect to NPPF and is suitable for the type of development proposed.

Flood Risk Summary

- 4.33. A summary of the risk of flooding from all sources is provided in **Figure 9** below.

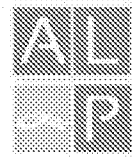
Figure 9 – Flood Risk Summary

Source of Flooding	High	Medium	Low	Comments
Tidal			✓	Site is elevated and inland.
Fluvial		✓		Site is located within Flood Zone 1, 2 and 3. However, proposed development will be located away from Flood Zones 2 and 3 which will mitigate the effects of fluvial flooding.
Pluvial		✓		Site is affected by pluvial flooding. Proposed development will be located away from extent of pluvial flooding on elevated ground above surrounding landform, which will mitigate the effects of pluvial flooding. The proposed development will be an opportunity to intercept overland flow providing control and slowing such flows, which should reduce the extent of pluvial flooding.
Groundwater		✓		Intrusive investigations are planned; the results of which will enable a technical



				solution to be determined in order to mitigate any effects of groundwater flooding.
Sewers			✓	On-site foul water sewers are at a lower elevation to the proposed development. Therefore this should mitigate the risk of sewer flooding should this be present.
Reservoirs, canals and other artificial sources			✓	EA, SFRA mapping does not indicate the Site to be at risk.

- 4.34. Based upon the above information, the Site is deemed to be at **LOW RISK OF FLOODING**. The Illustrative Masterplan is therefore in full accordance with National and Local planning policy concerning Flood Risk and as such is suitable for residential development.



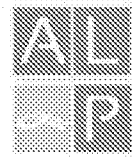
5.0 Surface Water Drainage

Introduction

- 5.1. This chapter provides details on the surface drainage strategy and includes measures to drain the proposed development site.

Overall Strategy

- 5.2. The proposed drainage strategy has been designed to exceed the requirements of the NPPF by providing a comprehensive drainage system which embraces the SuDS philosophy and key principles. The utilisation of Sustainable Drainage Systems (SuDS) not only provides the benefit of controlling waters at source and online treatment of collected surface water but also allows enhanced aesthetics through improved landscaping, biodiversity, and ecological opportunities.
- 5.3. These features offer a holistic treatment train and management system to the benefit of new residents, members of the wider community, downstream receptors and the environment.
- 5.4. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. Changes to land uses can have significant downstream impacts where existing drainage systems may not have sufficient capacity for any additional surface water flow.
- 5.5. A surface water management strategy is therefore required to manage and reduce the flood risk posed by the surface water runoff from the site. The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates to the pre-development scenario, unless specific off-site arrangements are made and result in the same net effect.
- 5.6. Sustainable water management measures (SuDS) should be introduced to control the surface water runoff from the proposed development site therefore, managing the flood risk to the site and surrounding areas from the surface water runoff.
- 5.7. The Construction Industry Research and Information Association, CIRIA's C690 states the following:
- **Prevention** – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing surfaces)
 - **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting)
 - **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one or several soakaways for the entire site)
 - **Regional Control** – management of runoff from several sites, typically in a detention basin or wetland.



- 5.8. The SuDS Manual 2015 (C753) provides best practice guidance on the planning, design, construction, operation and maintenance of SuDS. This document provides guidance to ensure that SuDS are planned and designed to maximise the opportunities and benefits of surface water management.
- 5.9. The four main categories of benefits that can be achieved by SuDS, referred to as the four pillars of SuDS design, are:
- **Water quantity** – control the quantity of runoff to support the management of flood risk, and maintain and protect the natural water cycle;
 - **Water quality** – manage the quality of the runoff to prevent pollution
 - **Amenity** – create and sustain better places for people
 - **Biodiversity** – create and sustain better places for nature.
- 5.10. Supplemental to CIRIA guidance, Document H of the Building Regulations 2015 sets out three possible options to discharge surface water runoff. Rainwater shall discharge to one of the following, listed in order of priority:
- An adequate soakaway or some other adequate infiltration system; or where that is not reasonably practicable,
 - A watercourse; or where that is not reasonably practicable
 - A sewer.
- 5.11. As infiltration has yet to be proven to be a viable method of disposal, the surface water drainage proposals will be designed to attenuate runoff with controlled discharge to the Barnham Rife. This drainage strategy will not rely on infiltration to ensure the drainage strategy will be robust, however benefits of infiltration, even shallow, are not ruled out subject to further testing.
- 5.12. Implementation of SuDS will ensure that flood risk downstream is not increased due to the proposed development. These features will also provide positive improvements to the quality of surface water runoff.
- 5.13. The following SuDS components are deemed applicable to the Site:
- Pervious surfacing systems – structural surfaces that allow water to penetrate into a granular layer thus providing storage and treatment, e.g. pervious paving.
 - Conveyance systems – components that convey flows to downstream storage systems, e.g. swales and filter drains.
 - Storage systems – components that control flow, and possibly volumes, by storing water and releasing it slowly, e.g. geocellular units, attenuation basins and wetlands.
 - Treatment systems – components that remove or facilitate the degradation of contaminants present in runoff, e.g. filter strips and proprietary treatment systems.



Pre and Post Development Areas/Rates

- 5.14. To quantify any potential increase in surface water runoff, the existing Greenfield/Pre-Development runoff rate from the Site must be determined. The rates of runoff have been determined using the current 'industry best practice' guidelines as outlined in the Interim Code of Practice for SuDS. The recommended methodology for sites up to 50 hectares in area is the ICP SuDS method.
- 5.15. An assessment of existing surface water runoff has been undertaken, to determine the potential surface water options and attenuation requirements for the site utilising the following parameters.
- Average Annual Rainfall (SAAR): 761mm
 - Soil: 0.400
 - Region No.: 7
- 5.16. Whilst the overall site area of 15.1 hectares (ha), the developable area is reduced to 9.83ha with the residual area continuing to convey surface water to Barnham Rife. See the A326-11 Catchment Plan in **Appendix 1**. The calculated Greenfield run off discharge rates and volumes are as presented in **Figure 10**. The corresponding runoff outputs created within MicroDrainage can be found within **Appendix 3**.

Figure 10 – Pre-Development Runoff Rates/Volumes

Annual Probability	Greenfield/Pre-Development Runoff Rate for 9.83ha (l/s)	Greenfield/Pre-Development Volume 360 minute storm
1 in 1 year event	31.7	770.56
1 in 2 year event	32.8	934.93
QBar	37.3	944.17
1 in 30 year event	84.5	1797.16
1 in 100 year event	118.9	2451.38

- 5.17. Based on the Illustrative Masterplan, it has been conservatively estimated that the impermeable surfaces will be approximately 65% of the site area. Depending upon how future Reserved Matters Site Layouts evolve, this percentage typically reduces slightly to around 55-60%.
- 5.18. The use of 65% therefore provides for a robust assessment which allows for fluctuations in residential density and future urban creep of up to 10% in accordance with The SuDS Manual (CIRIA 753).
- 5.19. The overall Post developed area amounts to approximately 9.83 hectares (ha), of which 6.39ha has been calculated as being impermeable.
- 5.20. In order to comply with best practice as stipulated in EA Report SC030219 'Rainfall Runoff Management for Developments', proposed discharge rates should be restricted to one of two methods for all storms up to and including the 1 in a 100 year storm event plus a 40% allowance for climate change.



1. Variable Greenfield discharge rates

- 5.21. This would require traditional on-site attenuation to hold back flows controlled by a complex control device, such as multiple vortex control devices. Discharge rates would be set so as not to exceed the pre-development 1in1, 1in30 and 1in100 year runoff rates set out in **Figure 10** based upon the appropriate catchment area.
- 5.22. In addition to this onsite attenuation, consideration of Long Term Storage would also be necessary given the increase in discharge volume generated by the proposed development, over and above that pre-development. This storage would need to be release into the surrounding watercourse at a low rate of 2.0 l/s/ha. This would normally be controlled by a secondary attenuation area and supplemental control device.
- 5.23. The Long Term Storage (LTS) requirement under this scenario would be based upon the EA/DEFRA Report SC030219: Rainfall Runoff Management for Development.

2. QBar Greenfield discharge rate

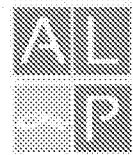
- 5.24. Alternatively, all discharge flows could be restricted to QBar. This would negate the requirement for Long Term Storage and again flows would be attenuated on site and discharged utilising an onsite control device, such as a vortex control device. This normally requires a greater volume of attenuation.
- 5.25. For the purposes of this report and to provide a robust analysis, all attenuation requirements have been calculated utilising all discharge flows restricted to QBar, as this is normally the worst case scenario. **Appendix 3** establishes the calculation of QBar as being 37.3 litres/second.
- 5.26. The use of QBar gives a value for the average annual peak runoff rate, this provides a comprehensive SuDS scheme with the volume runoff being reduced for intense storms. However, either method described above is viable and will be investigated further during detailed design.
- 5.27. With the above in mind, and having assessed limiting the offsite discharge rate to QBar, the anticipated attenuation volumes for a 100 year storm with a 40% allowance for climate change are as follows:

Figure 11 – Calculated Attenuation Volumes based upon QBar

Catchment	Catchment Area (ha)	Impermeable Area (ha)	QBAR (l/s)	Attenuation Volume Required (m ³)
1	9.83	6.39	37.3	4227 - 6070

Surface Water Proposals

- 5.28. It is proposed to provide a network of trapped gullies, pipes and Sustainable Drainage (SuDS) features to collect the surface water runoff from impermeable areas such as roads, roofs and driveways. The traditional system will work in combination with such features as permeable paving, roadside swales and basins in tandem with existing on-site drainage ditches to provide attenuation storage and high-quality water benefits.



- 5.29. The layout of boundary ditches are unaffected and therefore existing outfall points will remain as is, with new headwalls being constructed within the Site as required.
- 5.30. Drawing A326-50 Overall Site Drainage Strategy provides an overview to the proposals, a copy of which is included within **Appendix 3**.
- 5.31. The banks of the SuDS basins will be designed in accordance with the SuDS Manual C753 in respect to having a maximum gradient of 1 in 4 and an appropriate freeboard above the maximum water level. This allows landscaping of both wetland and wildflower mixes to provide an appropriate landscape context in the vicinity of the features through the provision of an aquatic shelf.
- 5.32. The proposals utilise Source Control techniques (such as swales, granular strips and permeable paving) which assist with the reduction of larger attenuation storage features. This should be embraced and investigated as the project progresses.
- 5.33. Open SuDS features will be designed so as not to compromise the safety of residents, visitors and their property. Generally open boundaries are provided, and perimeter planting could be utilised to define the extents of the features.
- 5.34. Proposed discharge rates will be restricted to QBAR for all storm events up to and including the 1 in 100 year storm event plus 40% allowance for climate change. This would negate the requirement for Long Term Storage and flows would be attenuated on site and discharged utilising an on-site flow control device such as a Hydrobrake.
- 5.35. All conveyance systems will be designed to cater for the 1:30 year storm event, in accordance with industry standard, with all attenuation features designed to allow for the 1 in 100 year storm event plus 40% climate change allowance.
- 5.36. The proposals draw reference to the DEFRA document Sustainable Drainage Systems, Non-statutory technical standards for sustainable drainage systems March 2015, as well as CIRIA C753 The SuDS Manual.
- 5.37. This proposal identifies the principal components of the surface water strategy and is subject to further detailed localised investigations as part of the subsequent Reserved Matters applications. These assumptions are subject to evolution as the design develops.
- 5.38. The attenuation basins will be lined to provide the ability to create localised permanent bodies of water which adds landscaping and biodiversity opportunities to the scheme. The liners also protect against the ingress of groundwater.

Site Access Road

- 5.39. In order to facilitate access, a new estate road is proposed from Marshall Close into the development. This road will cross the Barham Rife and its associated Flood Zones 2 and 3. Supplemental hydrological assessments are currently underway to assess prevailing flood levels within the Rife in association with the Environment Agency given its status as a Main River.



- 5.40. Results from Waterman Group are expected shortly, wherein agreement can be sought on the type of structure required (clear span or culvert section) together with its corresponding soffit level and freeboard criteria from which a final design solution can develop as the project progresses. Any structure placed within 8m of the top of riverbank is a restricted activity which requires separate Flood Defence Consent by the Environment Agency.

Exceedance Flood Routing

- 5.41. Flows in excess of the above design storms, which may flood from the network for storms in excess of the 1 in 100 year storm plus 40% climate change, will be kept within the internal road network, until such time as they can be directed into adjacent landscaping areas. This ensures that no onsite or offsite residential units are afforded an increased level of protection from flood waters until such time as the rain events become significant.

Water Quality Improvements

- 5.42. CIRIA report C753 The SuDS Manual outlines the methodology for assessing water quality risks associated with new development. This is a simple index approach which provides a high level scoping analysis of the land usage and gives guidelines for appropriate treatment stages.
- 5.43. This process identifies features necessary to provide adequate substance removal in line with Environment Agency requirements. This is a three step process of Allocation, Mitigation and Review.
- 5.44. Surfaces generating runoff are 'graded' on their potential to contribute to various harmful pollutants and gives each surface a risk of pollution from each element. An extract of Table 26.2 within the SuDS Manual is set out.

Figure 12 – Extract from Table 26.2 SuDS Manual

Land Use	Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons
Residential Roofs	Very Low	0.2	0.2	0.05
Other Roofs	Low	0.3	0.2-0.8	0.05
Low traffic residential roads and non-residential parking with infrequent change.	Low	0.5	0.4	0.4
Commercial yard, parking with frequent change, other roads,	Medium	0.7	0.6	0.7
Sites with heavy pollution	High	0.8	0.8	0.9

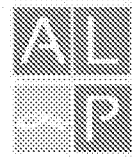


- 5.45. The use of non-mechanical features decreases the requirements for maintenance and increase natural biodiversity. That said, the SuDS Manual does not remove the possibility of utilising separators, so long as they are considered in partnership with a comprehensive overall SuDS regime.
- 5.46. Without adequate treatment, the pollutants would cause damage if they were to enter the watercourse or water table in large volumes. The use of SuDS features to slow down and degrade these pollutants is critical to the provision of an acceptable discharge.
- 5.47. The respective cleansing abilities of common SuDS features are given by corresponding mitigation indices within the SuDS Manual. An extract of Table 26.3 is set out below.

Figure 13 – Extract from Table 26.3 SuDS Manual

Type of SuDS component	Total Suspended Solids	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter Drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable Paving	0.7	0.6	0.7
Detention Basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8

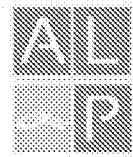
- 5.48. The individual pollution indices are totalled, with the first SuDS component utilising its full value and subsequent downstream SuDS features acting with 50% efficiency. This provides a realistic strategy which mimics the reduced cleansing effectiveness as the concentration of a pollutant decreases along the SuDS train.
- 5.49. In line with Environment Agency guidance, before the design phase is concluded, the proposals are reviewed and analysed in order to identify potential shortcomings and to ensure that adequate volume of SuDS features are provided to mitigate the risk of pollution from each source.
- 5.50. Surface water arising from highways or driveways should be provided with two trains of treatment prior to leaving the site in line with national guidance.
- 5.51. Rainwater falling on the permeable paving flows into the underlying granular layers. This effectively traps suspended solids and filters pollutants from the water. This will be directed to the swales and the basin. The drainage strategy provides a level of treatment in advance of discharging from the Site. This can be demonstrated using the Simple Index Approach outlined within CIRIA C753. The most significant pollutant load will arise from roadways and driveways and similar within the Site. These have an identified pollutant hazard level of 'Low' as set out in **Figure 12**.



- 5.52. Under this designation, Table 26.3 of the SuDS Manual requires pollutant indices of 0.5 for Total Suspended Solids (TSS), 0.4 for Metals, and 0.4 for Liquid Hydrocarbons. By reference to **Figure 13**, the provision of permeable paving, swales and basin within the drainage strategy exceeds the maximum anticipated pollutant hazard indices.

SuDS Maintenance Strategy

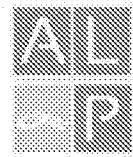
- 5.53. For the water treatment effects of SuDS features to remain effective, a comprehensive maintenance strategy should be implemented.
- 5.54. During construction, maintenance of SuDS features should be undertaken by the Contractor. Upon completion, the assets should be passed over to the Management Company, statutory authority, or community group commissioned to maintain the features in perpetuity.
- 5.55. As part of the strategy, a regular maintenance regime will be created, which consists of several primary measures required to ensure the longevity of the system. These should be undertaken on a regular basis to ensure consistent performance. Typical maintenance activities consist of:
- Inspecting and reporting; relatively regular review of the condition identifying issues and providing resolutions. Periodic review from the maintenance contractor;
 - Litter and debris removal;
 - Grass trimming, overall cutting and localised strimming preventing blockages;
 - Weed and evasive plant control;
 - Shrub management;
 - Aquatic and shoreline vegetation management;
 - Sweeping pervious surfaces; and
 - Oil removal from proprietary systems.
- 5.56. A remedial maintenance schedule would be recommended as part of the handover of the SuDS features, remedial maintenance is required to provide repairs to the system and monitor long term damage ensuring the system remains consistently productive. the schedule could consist of;
- Structure rehabilitation and repair;
 - Infiltration surface rehabilitation;
 - Scarifying to remove “Thatch”;
 - Spiking or Tining the soil, which assists with aeration;
 - Air pressure treatment.
- 5.57. The maintenance schedule contents and timing will depend upon multiple factors including usage, contents of water utilising the system, location and biology. To this end, it is suggested that the schedule be finalised as part of detailed design; ensuring the most comprehensive maintenance schedule is incorporated for the phase in hand.



- 5.58. Community outreach can be undertaken as part of the development, which will raise awareness on the importance of SuDS to both flood risk and water quality in the local area. Imparting the new residents with knowledge on the risks associated with pollution to the surface water drainage system is key, as is the direct effect their actions may have on water quality and biodiversity in the area.

Adoption and Ownership

- 5.59. The drainage system is designed to the appropriate standards including the new Sewerage Sector Guidance (SSG), the Building Regulations and the requirement of the National Planning Policy Framework
- 5.60. The intention of adoption and ownership of drainage and SuDS is as follows:
- Above ground attenuation (i.e. swales and basins) and surface water sewers within development parcels to be offered for adoption to Southern Water under the Section 104 process of the Water Industry Act.
 - Surface water highway drains, gullies and leads within adopted roads to be maintained by the Highway Authority.
 - SuDS features serving single properties, for example, permeable paved driveways to single dwellings, will be owned and maintained by the owner of that property.
- 5.61. Suitable adoption and maintenance regimes for SuDS should be submitted in support of the Reserved Matters application.



6.0 Foul Water Drainage

Introduction

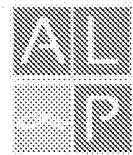
- 6.1. This chapter provides details on the proposed foul water drainage strategy and measures to convey effluent.

Overall Strategy

- 6.2. Due to the topography of the site and location of the existing foul sewer point of connection, wastewater from the Site can flow entirely by gravity to the receiving public sewer.
- 6.3. Southern Water has identified that there is currently inadequate capacity within the foul sewerage network to accommodate the foul water flows. Discussions are ongoing with Southern Water regarding the extent of additional off-site sewers or improvements to existing sewers that will be required to provide sufficient capacity to service the development.
- 6.4. Clarification on historic foul sewer flooding events should be sought from Southern Water.
- 6.5. Notwithstanding this, the delivery of the proposed on-site foul water sewers will be designed in collaboration with Southern Water as approving body in accordance with the new Sewerage Sector Guidance (SSG) and will be offered to Southern Water for adoption under S104 Agreement of the Water Industry Act. The connection to the existing public sewer system will be made via a S106 Agreement of the Water Industry Act with Southern Water as part of the overall adoption process.

Adoption and Ownership

- 6.6. The drainage system is designed to the appropriate standards including the new Sewerage Sector Guidance (SSG), the Building Regulations and British Standards.
- 6.7. Foul water sewers within the development are to be offered for adoption to Southern Water under the Section 104 process of the Water Industry Act 1991.



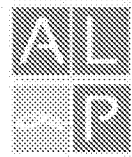
7.0 Development Suitability

Introduction

- 7.1. This chapter assesses the suitability of the development proposals in the context of on and off-site vulnerability.

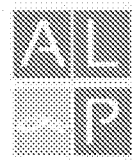
Assessment

- 7.2. This site-specific Flood Risk Assessment demonstrates that the Development satisfies the requirements of NPPF and can be justified in the proposed location by:
- meeting the criteria set out in NPPF;
 - assessing the risk posed to the site from flood events;
 - assessing the risk posed to the site from the site storm water generation and the site storm water runoff management; and
 - assessing the risk the site poses to increase in flooding elsewhere.
- 7.3. Specifically, it has demonstrated:
- There are Ordinary Watercourses in the form of unnamed field ditches within the site which flow into the Main River, named the Barnham Rife will not present a residual risk of flooding to the site greater than that of the existing.
 - The detailed Fluvial flood map, for fluvial sources, provided by the GOV.UK's Flood Map for Planning indicate that the site area is predominantly located within Flood Zone 1. Parts of the site are located within Flood Zones 2 and 3 adjacent to the Main River, the Barnham Rife. Proposed development will be located wholly within Flood Zone 1.
 - Intrusive ground investigations are planned to gather further information in respect of groundwater. Once the results of the investigations are received, measures can be determined to ensure the site is designed robustly against groundwater flooding if necessary.
 - That a detailed review of available data indicates a low risk from secondary flooding sources, such as sewers, reservoirs or canal.
 - The attenuation basins in combination with source control techniques and other site controls such as swales will ensure that the proposed development will not pose an increase in flooding elsewhere.
 - Through the provision of a positive drainage network attributed to the Development, pluvial flooding to offsite receptors will be reduced.
 - Exceedance flows can be safely accommodated within the Development.



Conclusion

- 7.4. The proposed surface water drainage strategy will manage the flood risk posed by uncontrolled surface water runoff from the Site. Any increase in surface water run-off can be managed using SuDS source control techniques as well as attenuation features to provide storage in extreme storm events.
- 7.5. The above provides the minimum of two treatment stages which is in accordance with the recommendations of CIRIA C753.
- 7.6. All surface water drainage systems will be designed to restrict discharge rates to greenfield QBAR runoff rate and store the balance of water for all events up to and including the 1 in 100 year event including allowance for a 40% increase in rainfall intensities as a result of climate change and urban creep.
- 7.7. The proposed foul water drainage strategy presents a robust, viable method of conveyance of effluent to the public sewerage system.
- 7.8. Overall, the Site should not be precluded on flood risk grounds as the Development will not be at risk from existing sources and will not result in an increase in flooding downstream.



Appendices



Appendix 1 - Plans

Illustrative Masterplan

Catchment Plan A326-11

Topographic Survey

Southern Water Sewer Asset Plan



Site
LAND SOUTH OF
BARNHAM STATION

Drawing
Illustrative site layout plan

Scale
1:2000@A3

Date
18.11.20

Drawing ref 1311.03

0 20 40 60 80 100m
1:2000@A3

KEY

Site boundary



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This drawing should not be reproduced without consent.

GENERAL NOTES:

1. Do not scale.
2. This drawing is to be read in conjunction with and checked against all other drawings, Engineering details, Specification and any structural, Geotechnical or other specialist document provided.
3. Any anomaly or contradiction between any of the above is to be reported to the Engineer.
4. All proposals shown are indicative pending confirmation of site layout proposals.
5. QBAR Calculated using ICP SuDs. SAAR = 768, SOIL = 400

KEY:

- Catchment Area Boundary
- Overall Site Boundary

P2	21.10	SITE BOUNDARY UPDATE	LPA	LPA
P1	20.10	FIRST ISSUE	CG	LPA
Rev		Description	Drawn	Checked

AL ABLEY LETCHFORD PARTNERSHIP
Consulting Engineers

3 Tealgate, Charnham Park
Hungerford, Berkshire RG17 0YT
www.alpce.co.uk Tel: 01488 684390

Client

GLEESON STRATEGIC LAND

Project

LAND SOUTH OF BARNHAM STATION, BARNHAM

Title

CATCHMENT PLAN

Status

Scale	Date	Project	Client
1:500 @ A0	OCT 2020	CG	LPA
Drawn by	Reviewed	Project	Client
A326-011	P2		

[illegible]

[illegible]

[illegible]

GENERAL NOTES

Interpretation of the information provided by a utility survey and obituary plans, excavation work should be undertaken with extreme caution and in accordance with HSE Guidance - H5247 Avoiding Danger from Underground Services

Utilities may continue outside of the survey area. Any paint marks outside of the area are for investigative purposes only and may not represent the full extent of the sub-surface utilities.

Technology – an assumed route (ASR) is recorded. All assumed service routes (ASR) have been highlighted with a background yellow colour for visual enhancement.

Drawings – sewer and manhole details shown on this drawing have been obtained by observation and measurement from the surface and as such cannot be **guaranteed**.

Vertical & Horizontal Position – Vertical position (depth) is indicative of the top of the manhole and is recorded as (Level), e.g. (1.256) – (depth to top of service) and should not be taken as exact, as this could be the surround to the service rather than the service itself. Where depth information from the technology is unclear, depth is not shown. Drains and pipelines may have been detected using geophysics and the depth indicated to the centre of the drain (depth to centre). Horizontal position is indicative of the centre of the manhole and should not be taken as exact.

Warning: Biodegradable paints are used to mark-out the position of the utilities. Markings may become illegible quickly depending on ground, weather and traffic conditions. No warranty is given in respect of the durability of the paint markings and that they are a complete representation of the sub-surface utilities, therefore, this drawing should be used as the primary reference for the survey results.

This drawing does not provide an absolute representation of the sub-surface. Utilities have been detected using non-invasive technologies only and the performance can be adversely affected by ground, weather and site conditions outside of SUNDI's control, therefore, some of the information may not be accurate. Users must take reasonable endeavours to detect all utilities. It does not warrant that 100% detection will be achieved and that appropriate depth penetration of the technologies SUNDI uses will not be greater than wet metres.

SHEET LAYOUT

Sheet 07

Rev	Notes	Drawn	Date
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Notes:

Survey is referenced to OS Grid and Level Datum.

sumo SUMO SERVICES Ltd
8 HAYWARD BUSINESS CENTRE
NEWLANE
LIVERPOOL

Survey
Services

HAMPSHIRE
PO9 2NL
TEL: 0845 456 1104
www.sumoservices.com

Title: Topographical Survey

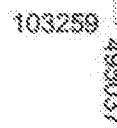
Client: Gleeson Strategic Land

Tars Farm, Church Lane, Barnham

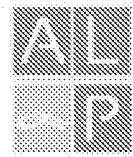
Date Completed:	31/07/2020	Post Code:	PO22 0DB
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Surveyed:	DJ, DG	Scale: 1/250 (A0 Sheet)
Drawn:	DM	
Checked:	DJ, SG	

Job No:	Dwg No:	Rev:
SOR017713	05	

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SEWER RECORDS



Appendix 2 - LLFA Developer Checklist



Surface Water Drainage Proposal Checklist

This 'Surface Water Drainage Proposals Checklist' has been designed to clearly define Arun District Council's and Chichester District Council's expectations and requirements for any surface water drainage proposals, submitted for appraisal by the council's Engineers, during the planning process.

Please be aware that it is in your interest to provide all of the requested information, as this will allow the council's Engineers to quickly and efficiently review your proposals. The omission of any requested information may lead to delays in the planning process.

This document will be of help to any applicant, or drainage consultant, preparing to submit a 'Discharge of Conditions Application' relating to surface water drainage conditions. Alternatively, it can also be used earlier in the planning process, if the applicant wishes to avoid pre-commencement conditions relating to surface water drainage. The Town and Country Planning Regulations now require pre-commencement conditions to have the prior agreement of the applicant regarding their wording and use. Therefore, if you wish to avoid pre-commencement conditions, in relation to surface water drainage, you will need to submit proposals that provide the information requested in this checklist and also align with the requirements of the following documents:

West Sussex Policy for the Management of Surface Water (WSCC)

'Supplementary Requirements for Surface Water Drainage Proposals'. (Arun DC)

'Supplementary Requirements for Surface Water Drainage Proposals'. (Chichester DC)

By submitting all of the information requested by this checklist you will enable the council's Engineers to determine whether your proposals follow the hierarchy for sustainable drainage and will adequately drain the site.

Please be aware that it will be difficult for the council's Engineers to undertake a timely assessment of your application if you fail to provide any of the information requested.

Surface Water Drainage Proposal Checklist

Ground Investigation Results			
Results Required	Results Provided?		
Winter groundwater monitoring results (Please refer to guidance note 1 below)	Yes	No	☒
Period of winter groundwater monitoring Note 1	From	OCT 2020	
	To	MARCH 2021	
Maximum recorded groundwater level	T.B.C. mAOD mBGL		
Winter infiltration test results Note 2	Yes	No	☒
Date of winter infiltration testing	T.B.C.		
Details of the location and depth of the infiltration testing Note 3	Yes	No	☒
Minimum infiltration rate Note 4	T.B.C. m/s		

Guidance Notes

1. A full winters groundwater monitoring should be undertaken, (October to March inclusive) to enable the peak annual groundwater levels to be established. The extent of winter monitoring for developments of less than 5 properties should be discussed with the council's Engineers.
2. Infiltration testing should be undertaken during the wet winter months (typically January) and in line with BRE365, or a similar approved method. Tests should be repeated 3x, to replicate saturated ground conditions. Please note that infiltration testing is to be carried out at a time and depth agreed with the Councils engineers.
3. Infiltration testing should be undertaken at the location and depth of any proposed infiltration structures. This must be above the maximum recorded groundwater level in that vicinity.
4. The minimum infiltration rate obtained at the location and depth of the proposed infiltration structures should be used to inform the design of the structures.

Proposed Method of Surface Water Disposal			
Infiltration	Yes	☒	No
On-site, via soak-away structures	Yes	☒	No
If on-site infiltration is not to be used, has justification for this been provided? Note 5	Yes	☐	No
Attenuation (on-site) with a restricted discharge to a watercourse on, or adjacent to, the site	Yes	☒	No
Attenuation (on-site) with a restricted discharge to a surface water sewer on, or adjacent to, the site	Yes	☐	No
Attenuation (on-site) with a restricted discharge to a foul water sewer on, or adjacent to, the site	Yes	☐	No

Guidance Notes

5. If on-site infiltration is not being used to drain the site you will need to provide evidence that demonstrates on-site infiltration is unviable.

IF POSSIBLE
- BUT
NOT
RELIED
UPON
AT THIS
STAGE

Drainage Design: Supporting Calculations					
Calculations Required			Calculations Provided?		
Infiltration Structures	Half-drain time for 10 year event (plus climate change allowance)	Yes		No	X
		Hours			
	Half-drain time for 100 year event (plus climate change allowance)	Yes		No	X
		Hours			
	Calculations demonstrating that the 1 in 100 year event, plus climate change allowance can be accommodated on-site. Note 7	Yes		No	X
Attenuation and Subsequent Restricted Discharge	Lowest base level of infiltration structure	mAOD mBGL			
	Has the design sought to provide treatment of potential contaminants? E.g. hydrocarbons.	Yes		No	X
	Pre-development run-off rate calculations	Yes	X	No	
Attenuation and Subsequent Restricted Discharge	Proposed discharge rate Note 6	QBAR 37.3 l/s 37.3 l/s			
	Calculations demonstrating that the 1 in 100 year event, plus climate change allowance can be accommodated on-site. Note 7	Yes	X	No	
	Has the design sought to provide treatment of potential contaminants? E.g. hydrocarbons.	Yes	X	No	
	If your proposed scheme incorporates any impermeable lined attenuation features we require calculations to demonstrate that appropriate resistance to floatation (due to groundwater levels) is catered for in the design	Yes	X	No	
	If you propose discharging into or altering an ordinary watercourse; have you sought Ordinary Watercourse/Land Drainage Consent? Note 8	Yes		No	X
	If discharging to a watercourse, piped system or the sea, has the proposed drainage network been modelled against predicted top water levels for the 1 in 100 year storm event plus climate change allowance, within the existing system? Note 9	Yes		No	TBC

Guidance Notes

- Any proposed discharge rate must be less than, or equal to, the pre-development rate. Greenfield sites must use the mean flow rate (Qbar) and be based upon the area occupied by the development, ignoring significant open spaces. Please note that the minimum acceptable discharge rate is 2l/s when using formal flow control devices, unless otherwise agreed. Additionally, if you are developing a brownfield site, we expect you to provide fully detailed plans of the existing surface water drainage arrangements on site, including impermeable areas, gullies, outfalls, pipes & diameters, manholes, etc. We generally seek 50% betterment in terms of run off from brownfield sites.
- The appropriate factor of safety from the table below must be applied to your calculations to ensure your design is fully in accordance with CIRIA R156/ CIRIA C753.

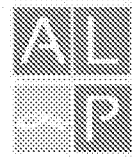
Factor of Safety Table						
Size of Area to be Drained	Consequences of failure					
	No damage or inconvenience		Minor inconvenience, e.g. surface water on car park		Damage to buildings or structures or roads.	
	Cv=1.0	Cv=0.75	Cv=1.0	Cv=0.75	Cv=1.0	Cv=0.75
<100 m ²	1.5	2	2	3	10	13
100m ² to 1000m ²	1.5	2	3	4	10	13
>1000m ²	1.5	2	5	6.5	10	13

8. Ordinary Watercourse/Land Drainage Consent will need to be sought, ideally in parallel with planning permission, if you propose discharging into, culverting or altering a watercourse.
9. Modelling is required to ensure that problems, such as surcharged outfalls, are addressed.

Plans/Drawings/Diagrams				
Required	Provided?			
Plan detailing the location of groundwater monitoring and infiltration testing	Yes		No	X
Detailed drainage layout plan ^{Note 10}	Yes	X	No	
Construction detail plans ^{Note 11}	Yes		No	X
Exceedance flow route plans ^{Note 12}	Yes		No	X
Impermeable area plan	Yes	X	No	
If ground levels are being raised $\geq 300\text{mm}$ above existing levels and is unavoidable, have fully detailed plans been provided, together with drainage proposals, to address any potential drainage related issues.	Yes		No	X

Guidance Notes

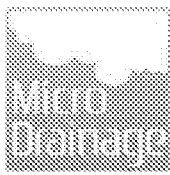
10. Drainage layout plans should include:
 - All surface water drainage pipes labelled with; diameters, pipe materials, falls and invert levels.
 - All infiltrating and attenuating structures (including permeable paving) labelled with; dimensions, invert and cover levels.
 - All manholes labelled with; cover levels, invert levels, cover types detailed.
 - All silt traps clearly labelled with sump depths.
 - Control structures with outflow rates and invert levels.
 - Proposed/existing levels of any areas subject to ground raising, together with suitable measures/detailed drawings for the associated management of surface water runoff. Please note that ground raising should be avoided unless there are exceptional circumstances.
11. Site specific construction detail plans should be supplied if your proposed drainage scheme includes any of the following elements: pipe bed and surround; infiltrating structures; attenuating structures; manholes; catch-pits/silt traps; control devices; permeable paving; headwalls.
12. Unless specifically requested by the council's drainage engineers 'Exceedance Flow Route Plans' are only required for developments of more than 5 residential properties or more than 0.5ha of commercial development.

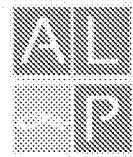


Appendix 3 - Drainage Strategy

Drainage Strategy Plan

Microdrainage Calculations

Abley Letchford Partnership Ltd		Page 1																								
Search House Charnham Lane Hungerford RG17 0EY	Land south of Barnham Station Barnham																									
Date 16/10/2020 15:57 File	Designed by CGraham Checked by LAbley																									
XP Solutions		Source Control 2020.1																								
<u>ICP SUDS Mean Annual Flood</u> Input <table> <tr> <td>Return Period (years)</td> <td>2</td> <td>Soil</td> <td>0.400</td> </tr> <tr> <td>Area (ha)</td> <td>9.830</td> <td>Urban</td> <td>0.000</td> </tr> <tr> <td>SAAR (mm)</td> <td>768</td> <td>Region Number</td> <td>Region 7</td> </tr> </table> Results l/s <table> <tr> <td>QBAR Rural</td> <td>37.3</td> </tr> <tr> <td>QBAR Urban</td> <td>37.3</td> </tr> <tr> <td>Q2 years</td> <td>32.8</td> </tr> <tr> <td>Q1 year</td> <td>31.7</td> </tr> <tr> <td>Q30 years</td> <td>84.5</td> </tr> <tr> <td>Q100 years</td> <td>118.9</td> </tr> </table>			Return Period (years)	2	Soil	0.400	Area (ha)	9.830	Urban	0.000	SAAR (mm)	768	Region Number	Region 7	QBAR Rural	37.3	QBAR Urban	37.3	Q2 years	32.8	Q1 year	31.7	Q30 years	84.5	Q100 years	118.9
Return Period (years)	2	Soil	0.400																							
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Q30 years	84.5																									
Q100 years	118.9																									
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Appendix 4 - Environment Agency Data

EA Product Data

Franklin Neathercoat
Abley Letchford Partnership
3 Tealgate
Charnham Park
Hungerford
RG17 0YT

Our ref: SSD179693
Date: 18/08/2020

Dear Franklin Neathercoat,

Enquiry Regarding Product 4 for Flood Risk Assessment for Tars Farm, Barnham, PO22.

Thank you for your enquiry which was received on 16 July 2020.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004. The information is attached.

The information on Flood Zones in the area relating to this address is as follows:

The site is in an area located within Flood Zone 1, 2 & 3 as shown on our Flood Map for Planning (Rivers and Sea).

Note - This information relates to the area that the above named property is in and is not specific to the property itself as it is influenced by factors such as the height of door steps, air bricks or the height of surrounding walls. We do not have access to this information and is not currently used in our flood modelling.

Flood Zone definitions can be found at www.gov.uk/guidance/flood-risk-and-coastal-change#Table-1-Flood-Zones

Flood Defences

There are no formal raised flood defences in the vicinity of the site.

Model Information

The model used was the Aldingbourne Flood Risk Mapping study which was completed by JBA Consulting in 2015, with updated climate change allowances, completed in 2016.

Flood History

The site was flooded in 1987 (Flood Event Code: 7713). The source of the flooding was the local drainage network.

Please note our records are not comprehensive and may not include all events. I recommend contacting the Lead Local Flood Authority, **West Sussex County Council** or the Local Authority, **Arun District Council** for a more comprehensive flood history check.

FRA advisory text

Name	Product 4
Description	Detailed Flood Risk Assessment Map for Tars Farm, Barnham, PO22.
Licence	<u>Open Government Licence</u>
Information Warning - OS background mapping	<i>The mapping of features provided as a background in this product is © Ordnance Survey. It is provided to give context to this product. The Open Government Licence does not apply to this background mapping. You are granted a non-exclusive, royalty free, revocable licence solely to view the Licensed Data for non-commercial purposes for the period during which the Environment Agency makes it available. You are not permitted to copy, sub-license, distribute, sell or otherwise make available the Licensed Data to third parties in any form. Third party rights to enforce the terms of this licence shall be reserved to OS.</i>
Attribution	Contains Environment Agency information © Environment Agency and/or database rights. Contains Ordnance Survey data © Crown copyright 2020 Ordnance Survey 100024198.

Data Available Online

Many of our flood datasets are available online:

- Flood Map For Planning ([Flood Zone 2](#), [Flood Zone 3](#), [Flood Storage Areas](#), [Flood Defences](#), [Areas Benefiting from Defences](#))
- [Risk of Flooding from Rivers and Sea](#)
- [Historic Flood Map](#)
- [Current Flood Warnings](#)

Please get in touch if you have any further queries or contact us within two months if you'd like us to review the information we have sent.

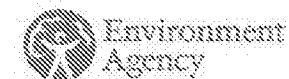
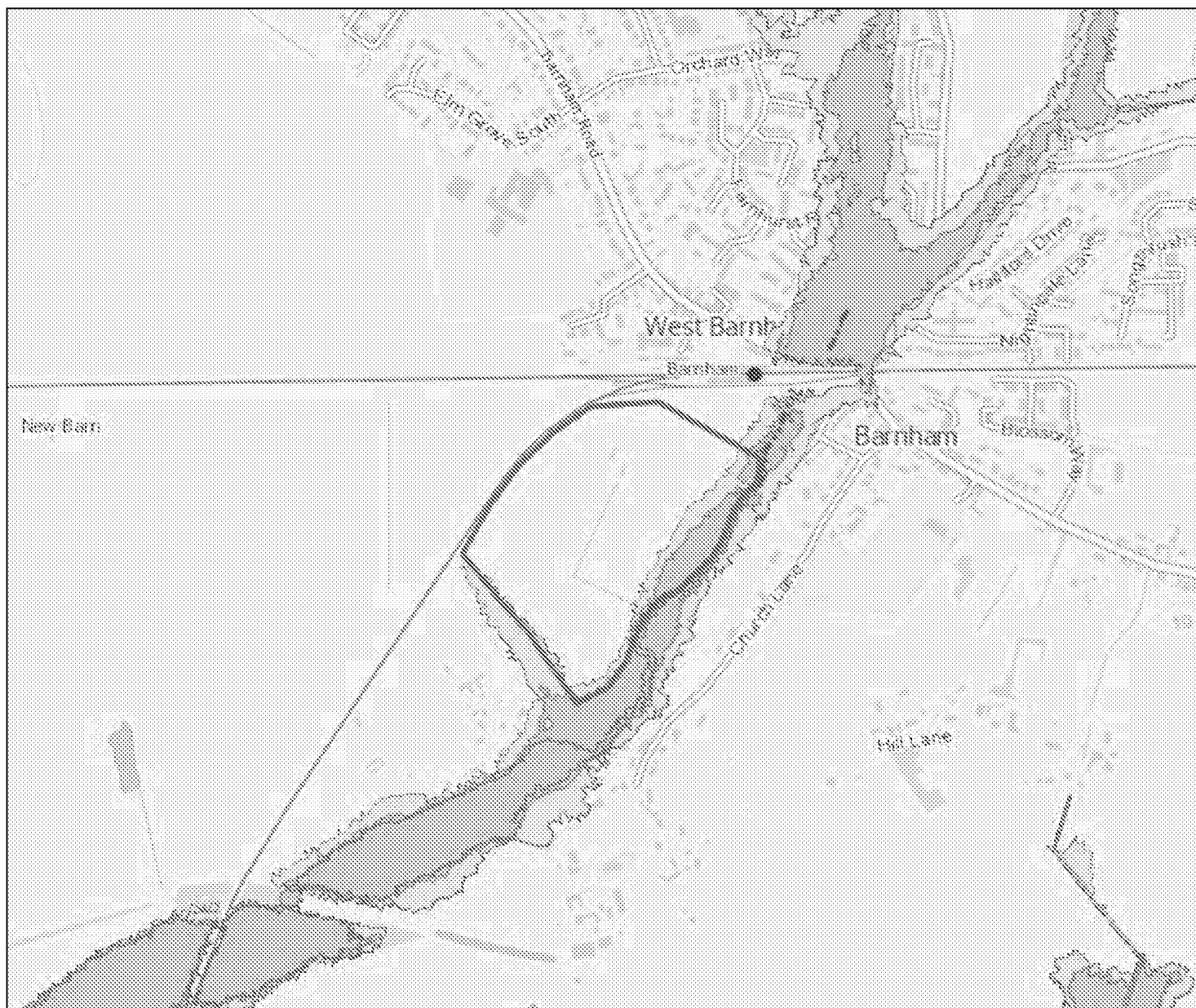
Yours sincerely,

Tom Lamboo

FCRM Officer, Partnership & Strategic Overview West Sussex, Solent and South Downs

Environment Agency, Guildbourne House, Chatsworth Road, Worthing, West Sussex, BN11 1LD

Flood Map for Planning (Rivers and Sea). Centred PO22. Created 18/08/2020.



1: 10,000

0 Metres 250



Flood Map for Planning (Rivers & Sea)

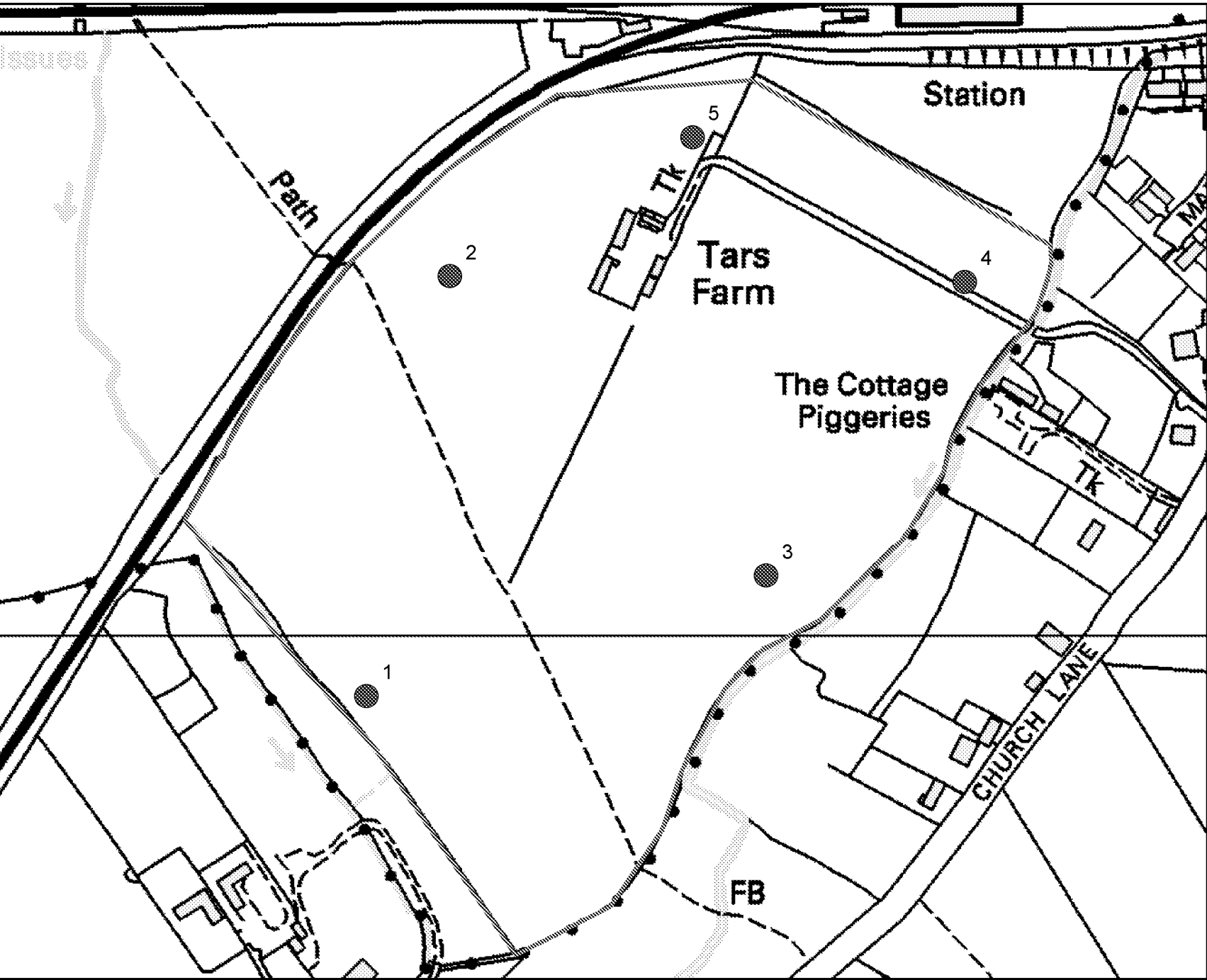
- Defences
- Flood Storage Areas
- Areas benefiting from flood defences
- Flood Zone 3
- Flood Zone 2

Flood Map Areas (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:

- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.





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Legend

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Site_Nodes

Site_Boundary

Scale: 1:3,000

00.050.1

Kilometers

Product 4 Flood Risk Data Requested by: Abley Letchford Partnership

Site: Tars Farm, Barnham, PO22

Table 1: Water Levels: Fluvial Undefended

Node Ref	NGR		Modelled Flood Levels in Metres AOD					
	Easting	Northing	Undefended Annual Exceedance Probability					
			5%	1%	1% +CC (35%)	1% +CC (45%)	1% +CC (105%)	0.1%
1	495499	103966	-	-	-	-	4.39	-
2	495546	104200	-	-	-	-	-	-
3	495723	104033	-	-	2.97	3.14	4.42	-
4	495834	104197	-	-	-	-	4.44	-
5	495681	104278	-	-	-	-	-	-

Table 2: Water Levels: Fluvial Defended

Node Ref	NGR		Modelled Flood Levels in Metres AOD					
	Easting	Northing	Defended Annual Exceedance Probability					
			5%	1%	1% +CC (35%)	1% +CC (45%)	1% +CC (105%)	0.1%
1	495499	103966	-	-	-	-	4.39	3.73
2	495546	104200	-	-	-	-	-	-
3	495723	104033	-	2.58	2.81	2.81	4.42	3.75
4	495834	104197	-	-	-	-	4.44	3.77
5	495681	104278	-	-	-	-	-	-

Table 3: Water Depths: Fluvial Undefended

Node Ref	NGR		Modelled Flood Depths in Metres					
	Easting	Northing	Undefended Annual Exceedance Probability					
			5%	1%	1% +CC (35%)	1% +CC (45%)	1% +CC (105%)	0.1%
1	495499	103966	-	-	-	-	0.67	-
2	495546	104200	-	-	-	-	-	-
3	495723	104033	-	-	0.75	0.91	2.19	-
4	495834	104197	-	-	-	-	1.26	-
5	495681	104278	-	-	-	-	-	-

Table 4: Water Depths: Fluvial Defended

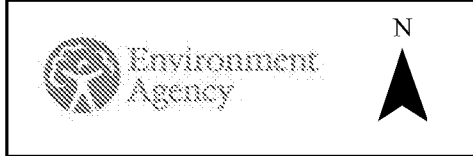
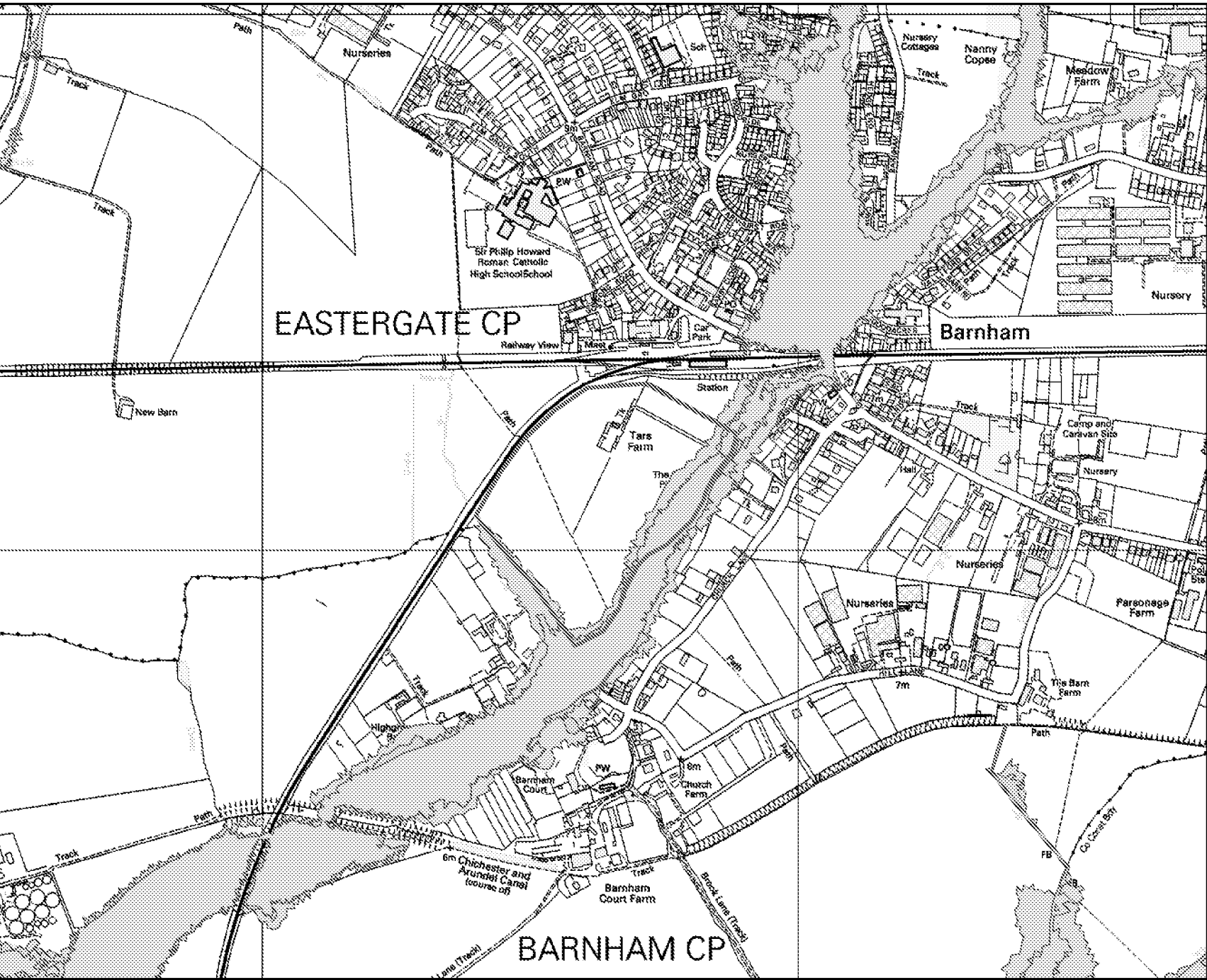
Node Ref	NGR		Modelled Flood Depths in Metres					
			Defended Annual Exceedance Probability					
	Eastings	Northings	5%	1%	1% +CC (35%)	1% +CC (45%)	1% +CC (105%)	0.1%
1	495499	103966	-	-	-	-	0.67	0.31
2	495546	104200	-	-	-	-	-	-
3	495723	104033	-	0.51	0.75	0.75	2.19	1.51
4	495834	104197	-	-	-	-	1.11	0.48
5	495681	104278	-	-	-	-	-	-

All levels taken from: Aldingbourne Flood Risk Mapping study (2015) (Defended only) with updated climate change allowances (2016)

Produced on: 18/08/2020

There is no additional information or health warnings for these levels/depths or the model from which they have been produced.

Office Address: Guildbourne House, Chatsworth Road, Worthing BN11 1LD.

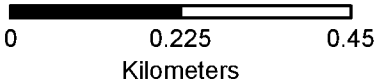


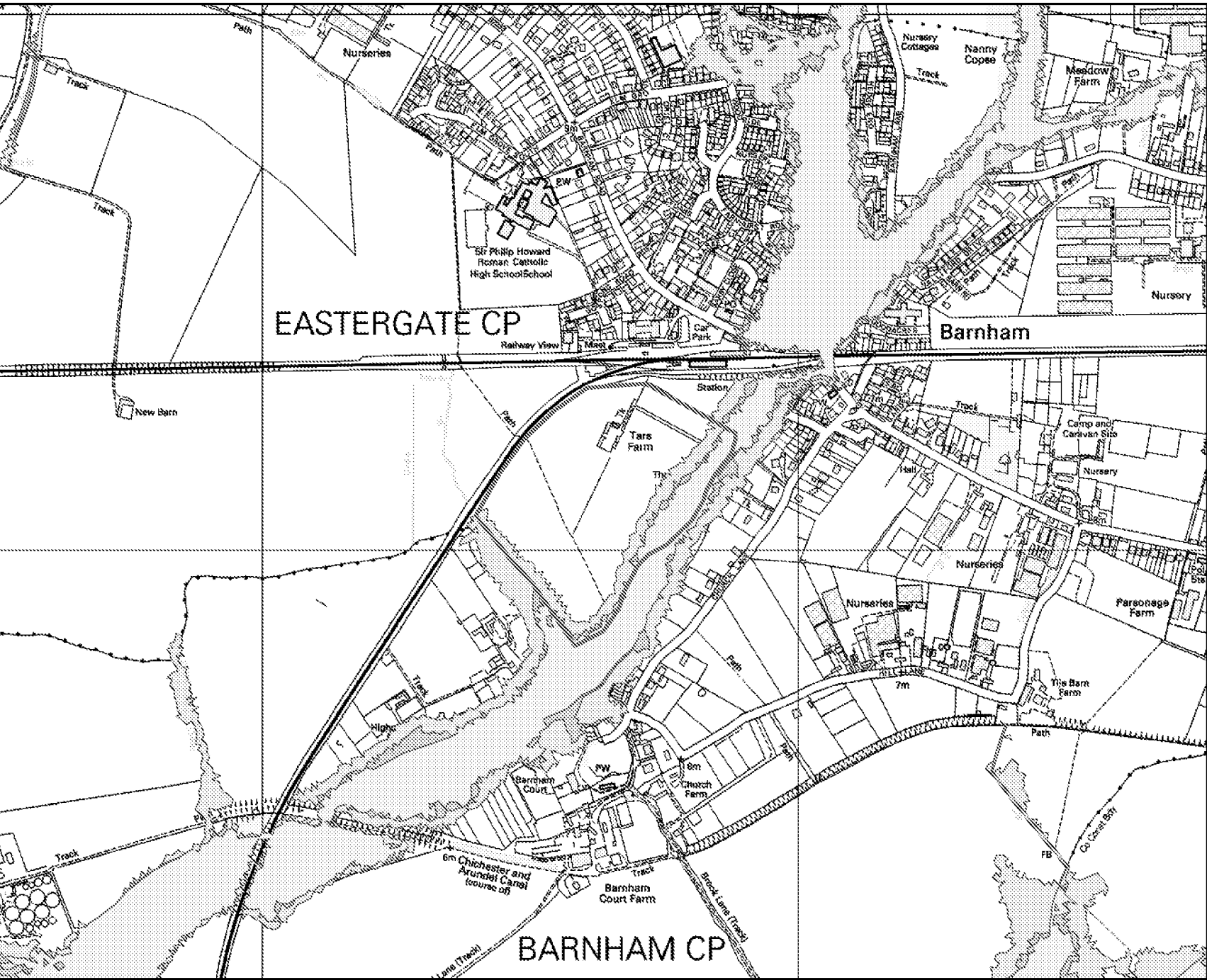
Legend

- Site_Boundary
- 1% AEP + 35% (Defended Fluvial)
- 1% AEP + 45% (Defended Fluvial)
- 1% AEP + 105% (Defended Fluvial)

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000







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Legend

-  Site_Boundary
-  1% AEP + 35% (Undefended Fluvial)
-  1% AEP + 45% (Undefended Fluvial)
-  1% AEP + 105% (Undefended Fluvial)

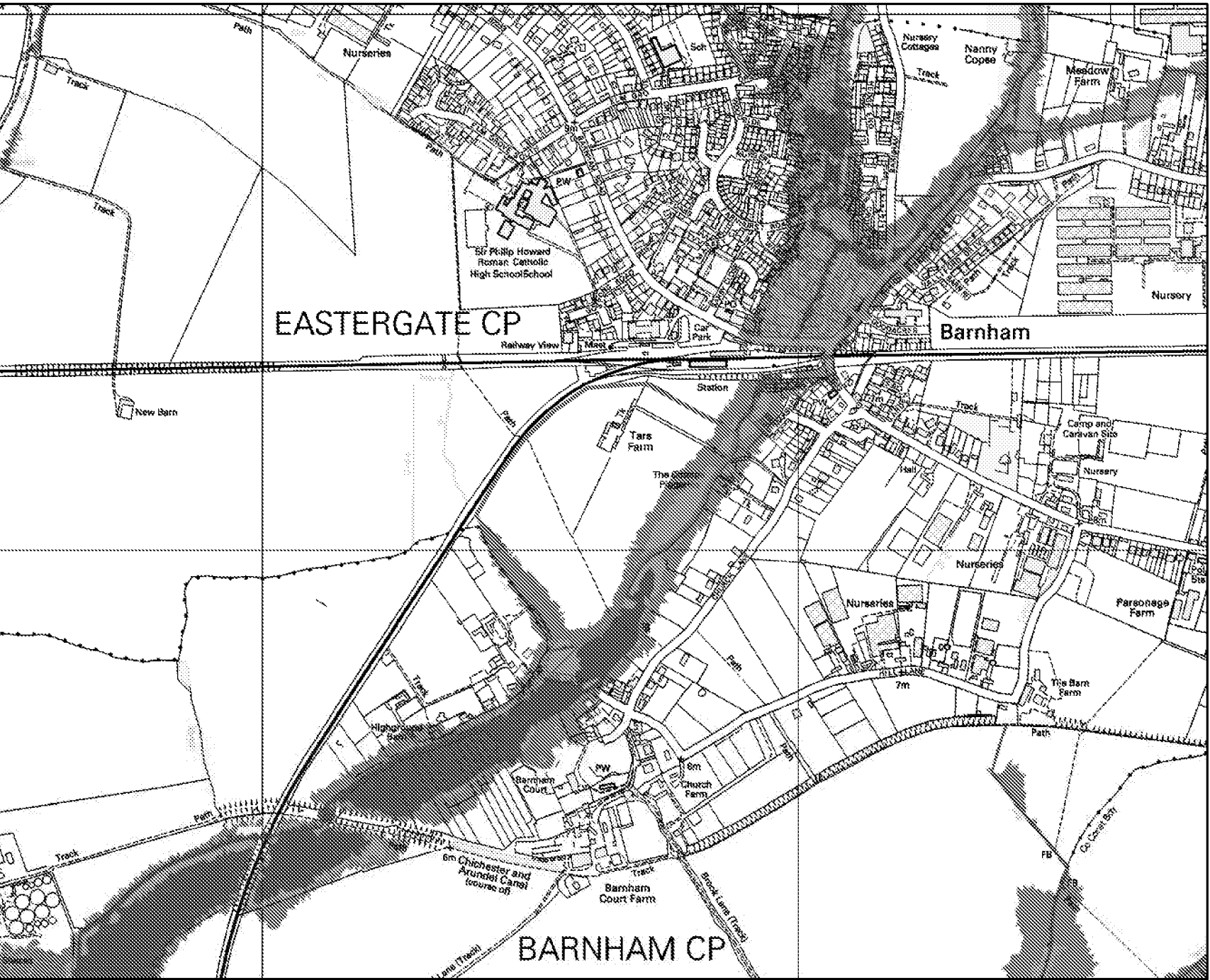
Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000



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Kilometers





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Legend

Site_Boundary

5% AEP (Defended Fluvial)

1% AEP (Defended Fluvial)

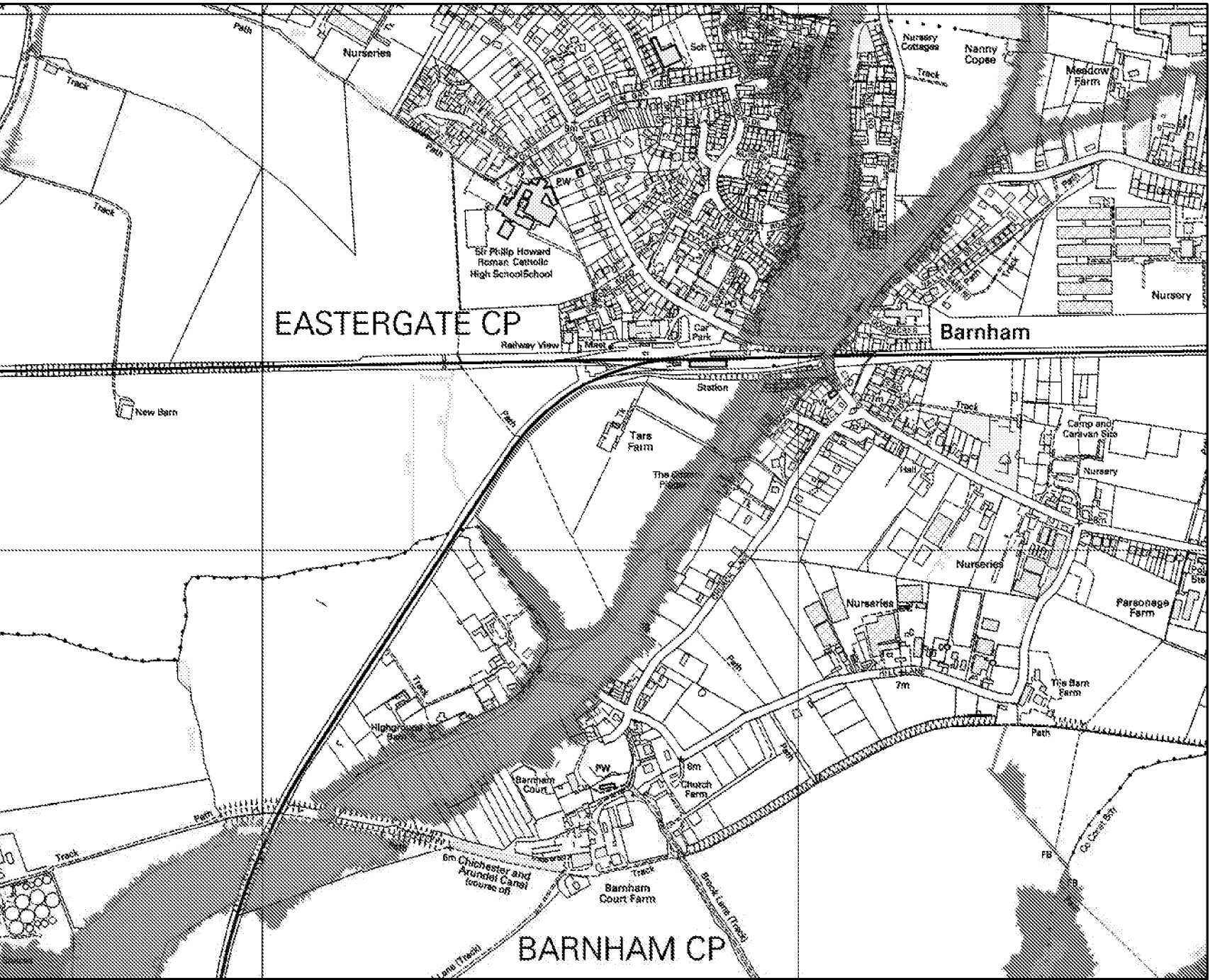
0.1% AEP (Defended Fluvial)

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000

00.2250.45

Kilometers





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Legend

 Site_Boundary

 1% AEP (Undefended Fluvial)

 0.1% AEP (Undefended Fluvial)

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000



00.2250.45

Kilometers

Recorded Flood Outlines. Centred PO22. Created 18/08/2020.

Legend

 All recorded flood outlines



Risk of flooding from Surface Water. Centred PO22. Created 18/08/2020.



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1: 10,000

0 Metres 250



Likelihood of flooding from Surface Water

- High ($\geq 3.3\%$)
- Medium (3.3% - 1%)
- Low (1% - 0.1%)
- Very Low

Likelihood of flooding from Surface Water

- High:** Greater than or equal to 3.3% (1 in 30) chance in any given year
- Medium:** Less than 3.3% (1 in 30) but greater than or equal to 1% (1 in 100) chance in any given year
- Low:** Less than 1% (1 in 100) but greater than or equal to 0.1% (1 in 1,000) chance in any given year
- Very Low:** Less than 0.1% (1 in 1,000) chance in any given year

This information is shown on the Risk of Flooding from Surface Water map on GOV.UK.

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Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). E-mail: enquires@environment-agency.gov.uk

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