

**LAND AT NORTHFIELDS LANE,
ALDINGBOURNE, FONTWELL PO20 3UH**

PROPOSED RESIDENTIAL DEVELOPMENT

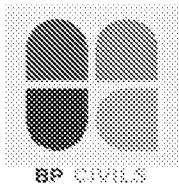
Flood Risk Assessment & Drainage Strategy

Prepared on Behalf of

Mr Edward and Mrs Claire Rees

D2312/FRA1.1

September 2024



DOCUMENT CONTROL

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Proposed Residential Development

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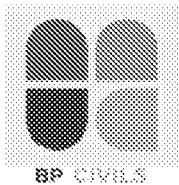
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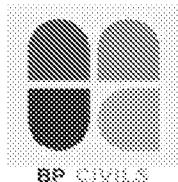
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DRAWINGS

- PL100** Site Location Plan
- PL200** Topographic Survey and Contours
- PL300** Flood Zone Extents
- PL301** Surface Water Flood Risk Interpretation – Low Risk Scenarios
- PL302** Surface Water Flood Risk Interpretation – Medium Risk Scenarios
- PL303** Surface Water Flood Risk Interpretation – High Risk Scenarios
- PL400** Impermeable Area Assessment
- PL500** Proposed Drainage Strategy

APPENDICES

- Appendix A** Architectural Development Proposals
- Appendix B** Topographic Survey
- Appendix C** BGS Information & Records
- Appendix D** Southern Water Public Sewer Records
- Appendix E** Environment Agency Flood Risk Assessment Data
- Appendix F** Arun District Council Strategic Flood Risk Assessment Extract and Drainage Records
- Appendix G** Wallingford Greenfield Run-off Calculations
- Appendix H** Causeway Flow Hydraulic Calculations

1 INTRODUCTION

1.1 Background

1.1.1 BP Civils is instructed by Mr Edward and Mrs Claire Rees to prepare a flood risk assessment and drainage strategy to accompany a planning application for a single dwelling development at Land at Northfields Lane, Aldingbourne, Fontwell.

1.1.2 This report has been undertaken in accordance with National Planning Policy Framework (NPPF) and The Planning Practice Guidance Flood Risk and Coastal Change in addition to the use of SuDS for achieving sustainable development.

1.1.3 The proposed development will involve the construction of a single dwelling as demonstrated by the development proposals contained within **Appendix A**.

1.1.4 In preparing this report, BP Civils has referred to the following documents and information:

- Environment Agency Flood Maps for Planning
- Environment Agency Product 4 Data
- Long Term Flood Risk Maps for Rivers or the Sea, Surface Water and Reservoirs
- British Geological Survey (BGS) Information and Records
- Arun District Council Strategic Flood Risk Assessment
- Arun District Council and West Sussex County Council Drainage Records
- Southern Water Public Sewer Records

1.1.5 This report has been prepared to assess flood risk at the site, and to advise of any mitigation which may be required to ensure that the proposed development remains safe for its design life in accordance with current design standards.

1.1.6 This report has been prepared for the benefit of the named client only.

2 SITE LOCATION AND DESCRIPTION

- 2.1.1 A site location plan has been prepared (**PL100**) and is included within this report.
- 2.1.2 The site measures 3,934m² (0.39Ha) and is located on the eastern side of Northfields Lane.
- 2.1.3 The National Grid Reference is SU 93932 05832.
- 2.1.4 A topographic survey has been undertaken at the site by J. Brother & Partners, dated April 2024. The survey is contained within **Appendix B**.
- 2.1.5 The topographic survey identifies levels in the range of 12.05m and 12.69m AOD. The site is flat but demonstrates minimal fall towards the boundaries and surrounding watercourses.
- 2.1.6 Drawing **PL200** (Topographical Survey with Contours) has been prepared to demonstrate the general trends in topography at the site.
- 2.1.7 An unnamed ordinary watercourse is located adjacent to the eastern boundary of the site, which flows in a southerly direction. This watercourse has seen recent improvements undertaken downstream in relation to third-party developments, including clearance, regrading and reprofiling works of the open channel as well as culvert upgrade works.
- 2.1.8 An Environment Agency designated Main River is located along the western side of Northfields Lane, which flows in a southerly direction.
- 2.1.9 An unnamed ordinary watercourse is located along the eastern side of Northfields Lane, in addition to the Main River as referenced in 2.1.8. This also flows in a southerly direction. This watercourse diverts east, along the boundary of 'The Croft' and 'Orchard Cottage', linking with an unnamed ordinary watercourse referenced in 2.1.7.

3 GROUND CONDITIONS

- 3.1.1 Site-specific intrusive geotechnical investigation has not been undertaken at the site.
- 3.1.2 In the absence of such information, reference has been made to the BGS Geology of Britain Viewer to establish an understanding of the anticipated underlying geology at the site.
- 3.1.3 The BGS Geology of Britain Viewer identifies a bedrock geology consisting of 'London Clay Formation – Clay, silt and sand.'



Figure 1. Geology of Britain Viewer – Bedrock Geology (BGS)

- 3.1.4 The BGS Geology of Britain Viewer identifies superficial geology consisting of 'Head – Clay, silt, sand and gravel.'

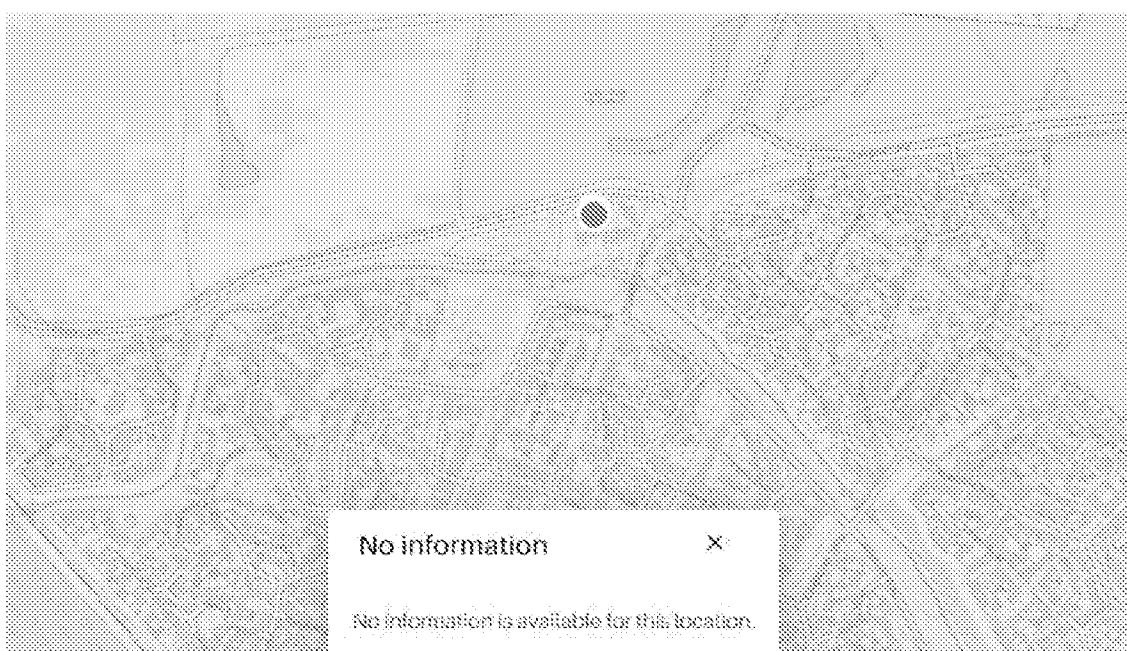


Figure 2. Geology of Britain Viewer – Superficial Deposits (BGS)

3.1.5 Historic borehole records from the Single Onshore Boreholes Index (SOBI) on the BGS website have also been reviewed in the absence of site-specific intrusive geotechnical investigation.

3.1.6 There are no historic boreholes within the immediate vicinity of the site, with the nearest being approximately 240m south-east of the south-eastern boundary of the site. This historic borehole is shown to be in a different geological classification than the site (as established in 3.1.3 and 3.1.4).

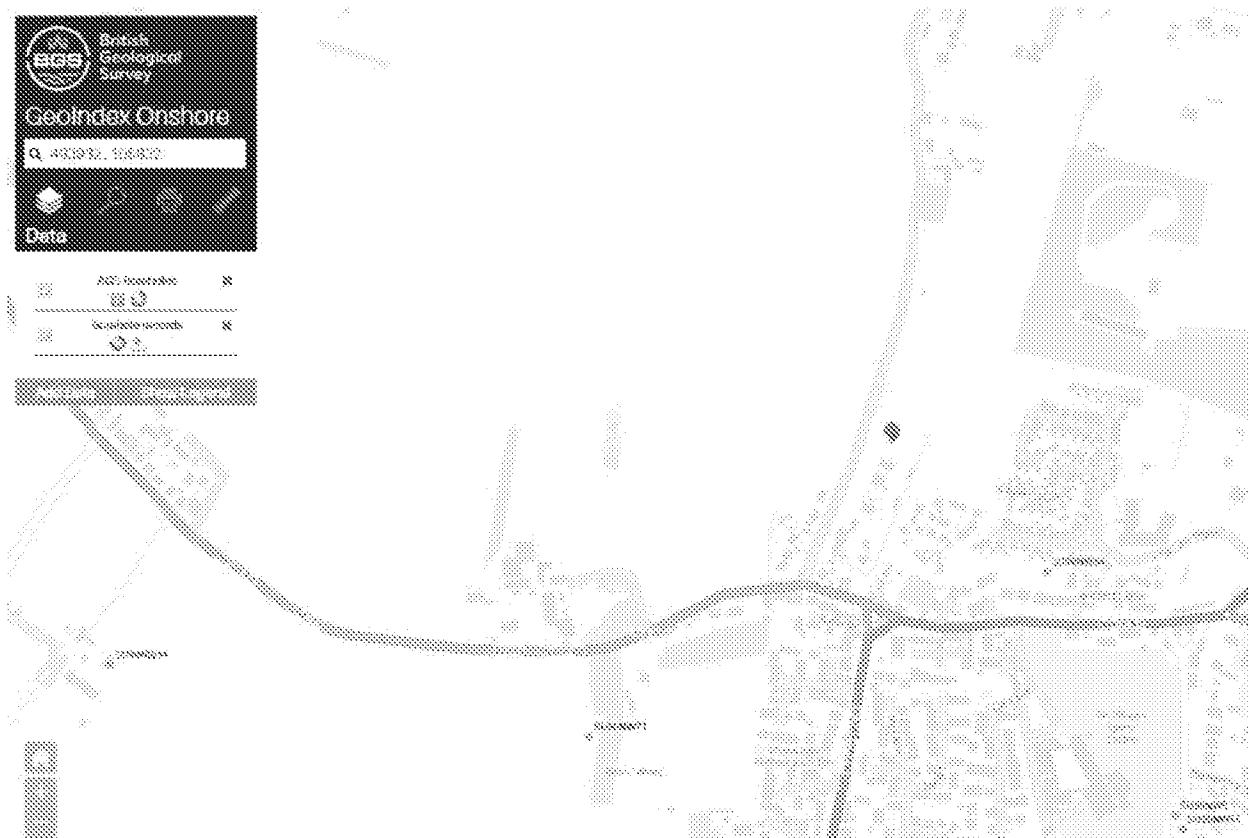


Figure 3. Historic Borehole Locations (BGS)

3.1.7 The nearest historic borehole which falls within the same geological classification as at the site is located c. 540m south-west of the site, as demonstrated in Figure 4.

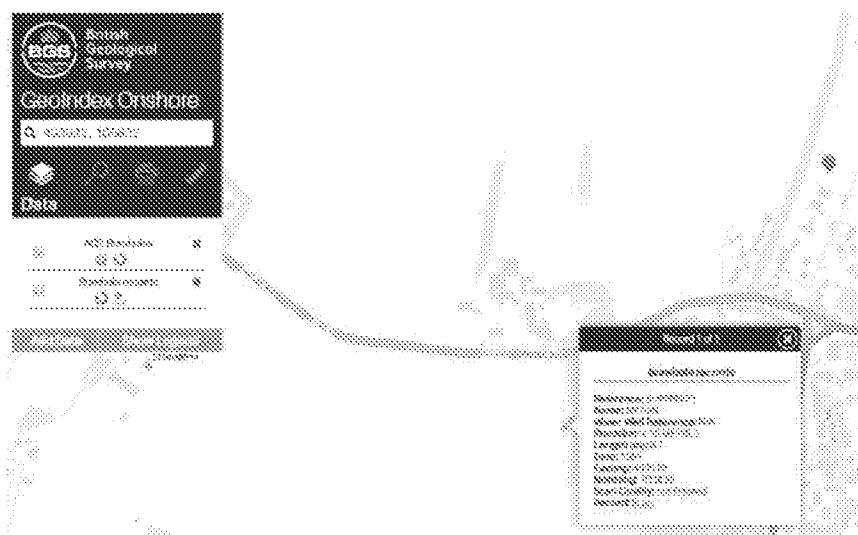


Figure 4. Historic Borehole Locations (BGS)

- 3.1.8 This borehole (SU90NW71) has a recorded depth of 6.70m, whilst the recorded geology is consistent with the expectation in view of the anticipated geology identified by the BGS Geology of Britain Viewer.
- 3.1.9 The historic borehole records confirm 'Head Gravel; to depths of up to 4.40m below ground level, in addition to 'London Clay' at 5.70m to 6.70m below ground level. 'Raised Beach Deposits' were also encountered at depths in the range of 4.40m to 5.70m below ground level.
- 3.1.10 Groundwater was encountered at a depth of 3.40m below ground level, with the surface level recorded as 11.60m AOD, which is c. 400mm lower than the lowest lying areas of the site. It is noted that the works were undertaken in August, when groundwater levels are not expected to be at their peak.
- 3.1.11 A copy of the BGS borehole records reviewed can be found within **Appendix C**.

3.2 **Groundwater**

- 3.2.1 Winter groundwater monitoring has not been undertaken at the site.
- 3.2.2 In acknowledgement of nearby development within the immediate vicinity of the site, it is noted that information relating to groundwater investigation is publicly available on the Arun District Council Planning Portal, which has been referred to. It is acknowledged, however, that this information cannot be relied upon in the design of site-specific drainage proposals for the development for which this flood risk assessment and drainage strategy has been prepared in relation to, although provides steer.
- 3.2.3 It is noted that groundwater was recorded at depths in the range of 600mm to 800mm below ground level within the immediate vicinity of the site.
- 3.2.4 BP Civils has previously undertaken works in relation to Land Rear of Green Gables, Northfields Lane (AL/121/21/PL). Arun District Council's Drainage Officers comments in relation to that application stated '*The applicant's Engineers have offered to undertake groundwater monitoring and infiltration testing on site in anticipation of a standard request for this from ourselves. In this case, as we have a wealth of data from both the Taylor Wimpey site and the neighbouring development at Stanwick, we do not believe that it is necessary for further site investigations. This decision is based upon the number of groundwater monitoring points and infiltration tests we would expect for the large scale developments in the district (per house/block of houses).*'
- 3.2.5 In consultation with Arun District Council's Drainage Officers in relation to BP Civils earlier works within the immediate vicinity of the site, it was stated that '*Groundwater has a significant contribution to flooding on this area.*'
- 3.2.6 Groundwater mapping contained within the Arun District Council Strategic Flood Risk Assessment identifies the site as falling within an area of 'High' groundwater flood risk ($\geq 75\%$).
- 3.2.7 Mapping managed by MAGIC (magic.defra.gov.uk) provides geographic information concerning the natural environment from across government. This mapping tool has been referred to in order to confirm aquifer designations, as well as whether the site is located within any groundwater source protection zones, groundwater vulnerability zones, drinking water protected areas or drinking water safeguard zones.

3.2.8 The site falls within an area designated as an 'Unproductive' bedrock aquifer, and a 'Secondary A / Secondary (Undifferentiated)' Superficial Drift Aquifer.

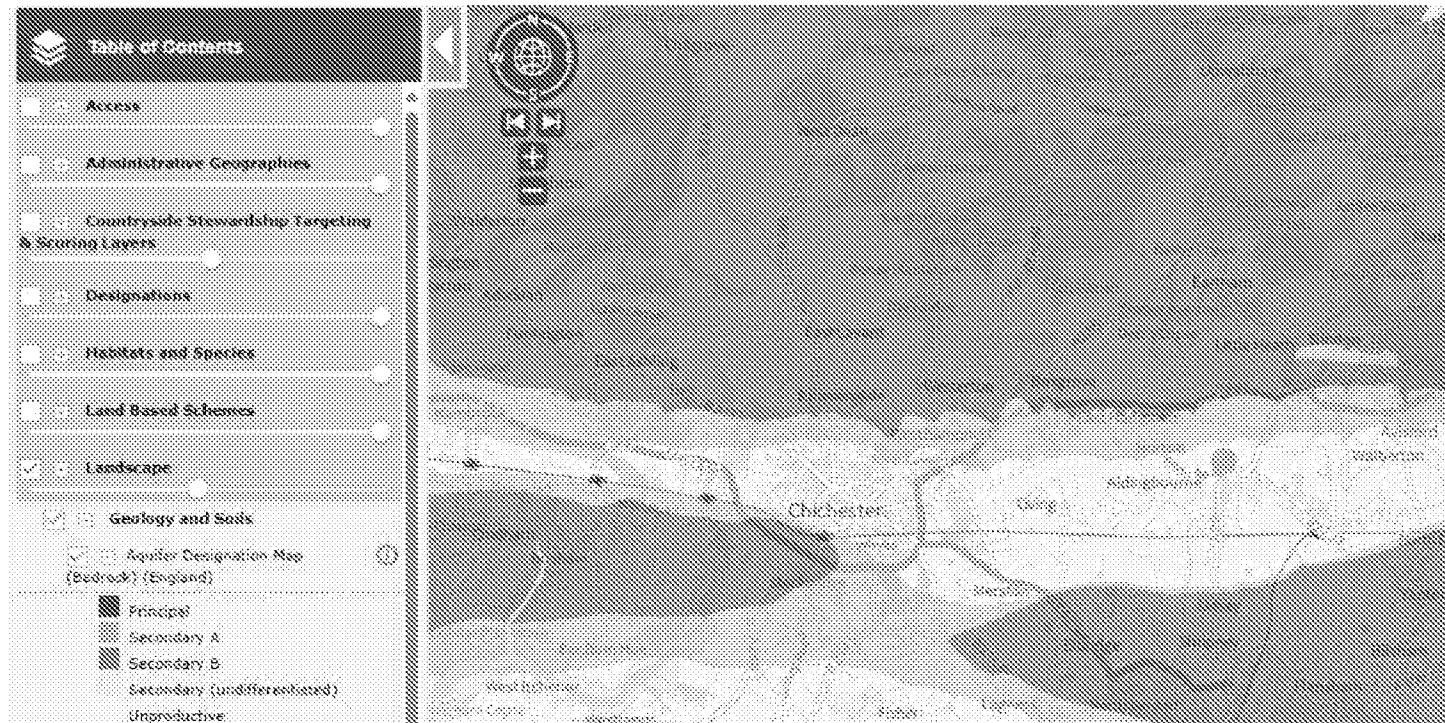


Figure 5. Bedrock Aquifer Designation Map (DEFRA)

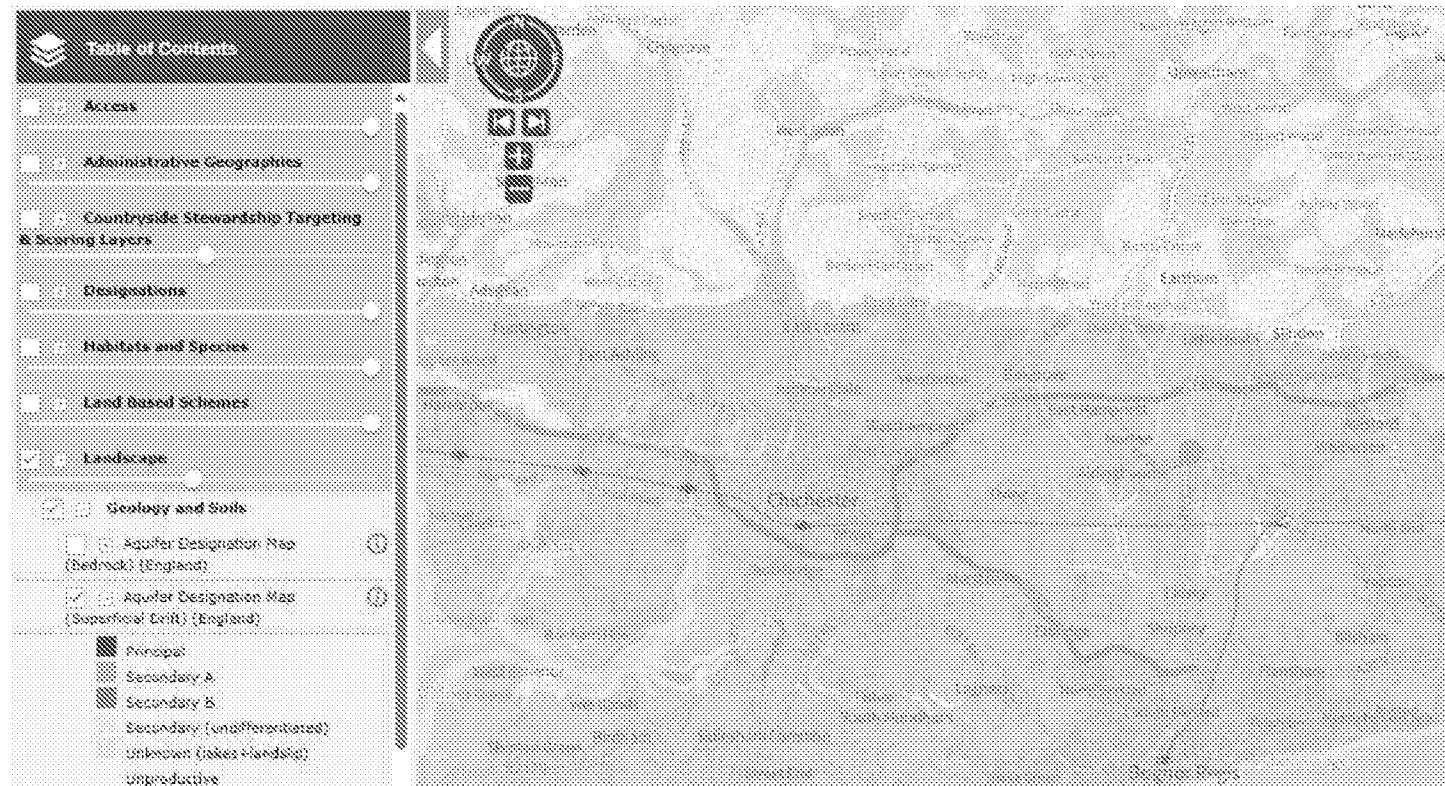


Figure 6. Superficial Drift Aquifer Designation Map (DEFRA)

3.2.9 The site in falls within a 'Low' groundwater vulnerability zone.



Figure 7. Groundwater Vulnerability Map (DEFRA)

3.2.10 The site is not indicated as within or in the vicinity of any drinking water protected areas, drinking water safeguard zones or source protection zones.



Figure 8. Drinking Water Protected Areas, Drinking Water Safeguard Zones and Source Protection Zone Maps (DEFRA)

4 EXISTING DRAINAGE

4.1 Surface Water

- 4.1.1 The site is not currently served by any formal surface water drainage infrastructure.
- 4.1.2 Existing greenfield run-off follows the natural topography of the site, with the site draining naturally.
- 4.1.3 There are existing ordinary watercourses located adjacent to the eastern and western boundaries of the site; both flowing in a southerly direction.
- 4.1.4 Improvement works have been undertaken in relation to the ordinary watercourse adjacent to the eastern boundary of the site, specifically downstream of the site in view of recent third-party development works.
- 4.1.5 There is also an Environment Agency designated Main River located immediate to the west of Northfields Lane, also flowing in a southerly direction.
- 4.1.6 An assessment of greenfield run-off rates has been undertaken which has established the following greenfield run-off rates, relative to the site area of 3,934m² (0.39Ha):
 - QBAR = 0.79 l/s
 - 1 in 2-Year = 0.67 l/s
 - 1 in 30-Year = 1.82 l/s
 - 1 in 100-Year = 2.52 l/s
 - 1 in 200-Year = 2.95 l/s

- 4.1.7 The local wastewater authority is Southern Water, providing sewerage services within the area. Public sewer records have been obtained from Southern Water, as contained within **Appendix D**.
- 4.1.8 There are no public surface water sewers located within the immediate vicinity of the site.
- 4.1.9 The nearest public surface water sewer is located c. 208m south of the south-eastern extent of the site, located in the carriageway of B2233, with a recorded depth of 960mm.

4.2 Foul Water

- 4.2.1 The site is not currently served by any formal foul water drainage infrastructure.
- 4.2.2 Southern Water's public sewer records identify a 150mm dia. public foul water sewer in Northfields Lane, flowing in a southerly direction. The nearest manhole (8801) has a recorded depth of 1.40m (IL of 10.47m AOD).

4.3 Highway Drainage

- 4.3.1 Northfields Lane drains 'over the edge' to the adjacent verge(s) with run-off also being captured by the ordinary watercourse/Main River either side of the lane.

5 PROBABILITY

5.1 Sources of Information

5.1.1 The NPPF requires that all sources of flooding are considered being tidal, fluvial, pluvial, groundwater, sewers and man-made reservoirs/canals.

5.1.2 The likelihood of the site flooding has been established by reviewing the following information:

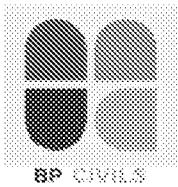
- Environment Agency Flood Maps for Planning
- Long-Term Flood Risk Map for Rivers or the Sea
- Long-Term Flood Risk Map for Surface Water
- Long-Term Flood Risk Map for Reservoirs
- Consultation with the Environment Agency (Flood Risk Assessment Data)
- Arun District Council Strategic Flood Risk Assessment

5.2 Flood Maps and Modelling

5.2.1 Flood Maps for Planning identifies that the site largely occupies Flood Zone 1, although areas towards the eastern/south-eastern boundary, the southern boundary and the western boundary occupy Flood Zone 2. Areas at the north-western corner of the site are identified as marginally encroaching Flood Zone 3, whilst areas adjacent to the western boundary are also in close proximity to Flood Zone 3.

5.2.2 The Arun District Council Strategic Flood Risk Assessment identifies the extents of Flood Zone 3 to be classified at Flood Zone 3a.

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment



Agency. (Not separately distinguished from Zone 3a on the Flood Map)



Figure 9. Flood Maps for Planning (Gov.uk)

5.2.3 BP Civils has obtained flood risk assessment data (formerly 'Product 4') from the Environment Agency in view of the flood zone classifications within the vicinity of the site.

5.2.4 The flood risk assessment data provided by the Environment Agency is taken from the following two models:

- Aldingbourne Catchment Modelling (2015) – Defended Fluvial, Undefended Fluvial Scenarios
- Aldingbourne Updated Climate Change Allowances (2016) – Defended Climate Change Fluvial, Undefended Climate Change Fluvial

5.2.5 The Modelled Flood Outlines (Defended and Undefended Fluvial) mapping contained within the flood risk assessment data provided by the Environment Agency identifies that the site is susceptible to flooding in the 0.1% AEP fluvial defended and undefended scenarios (Flood Zone 2). This mapping also identifies minor encroachment within the 1% AEP fluvial defended and undefended extents (Flood Zone 3).

5.2.6 The Modelled Flood Outlines (Climate Change Defended and Undefended) mapping also contained within the flood risk assessment data provided by the Environment Agency identifies susceptibility in the 1% AEP + 35%, 45% and 105% climate change defended and undefended scenarios. There are increased extents of the site which are captured in relation to the 1% AEP + 105% climate change

undefended scenario, extending from the east/south-east of the site.

5.2.7 Modelled flood levels have been provided by the Environment Agency, taken from the Aldingbourne Modelling Study (Defended Only) (2015) by JBA Consulting, plus updated climate change allowances (2016). These modelled flood levels are provided, below:

Table 1: Water Levels: Fluvial Undefended

Node Ref.	NGR		Modelled Flood Levels in Metres AOD						
	Defended Scenario		Undefended Scenario						
	Eastings	Northings	5%	1%	1% +CC (35%)	1% +CC (45%)	1% +CC (105%)	0.1%	
1	493910	105863	-	-	12.43	12.51	12.68	-	
2	493894	105823	-	-	12.26	12.32	12.46	-	
3	493824	105835	-	-	-	-	12.51	-	
4	493950	105825	-	-	-	-	12.47	-	
5	493980	105839	-	-	-	-	12.71	-	
6	493962	105796	-	-	-	-	12.47	-	

Table 2: Water Levels: Fluvial Defended

Node Ref.	NGR		Modelled Flood Levels in Metres AOD						
	Defended Scenario		Undefended Scenario						
	Eastings	Northings	5%	1%	1% +CC (35%)	1% +CC (45%)	1% +CC (105%)	0.1%	
1	493910	105863	-	12.10	12.17	12.17	12.68	12.63	
2	493894	105823	-	-	-	-	12.46	12.41	
3	493824	105835	-	-	-	-	12.51	-	
4	493950	105825	-	-	-	-	12.47	12.44	
5	493980	105839	-	-	-	-	12.71	-	
6	493962	105796	-	-	-	-	12.44	12.39	

5.2.8 The 'peak' modelled flood level provided for the site is 12.71m AOD, relating to the 1% + 105% CC defended and undefended scenarios.

5.2.9 The Long-Term Flood Risk Map for Rivers or the Sea identifies the extents of Flood Zone 2 at the site as being at 'Medium' risk of flooding from such sources. All remaining areas of the site are not identified as being at risk of flooding from such sources. Areas on Northfields Lane within the vicinity of the Main River, on the western side of Northfields Lane, are identified as being at 'High' risk of flooding from such sources.



Figure 10. Long-Term Flood Risk Map – Rivers or the Sea (Gov.uk)

5.2.10 The Long-Term Flood Risk Map for Surface Water identifies central areas of the site as being at 'Very Low' risk of surface water flooding. Extents towards the eastern/north-eastern boundaries of the site are identified as being at 'Low' risk of surface water flooding, with extents along the western boundary identified as being at 'High' / 'Medium' risk of surface water flooding. The extents identified as being at increased risk of surface water flooding along the western boundary of the site correspond with the presence of the ordinary watercourse in this location.

5.2.11 Drawings **PL301**, **PL302** and **PL303** have also been prepared to better demonstrate the extents of the site and surrounding areas identified as being at risk of surface water flooding.

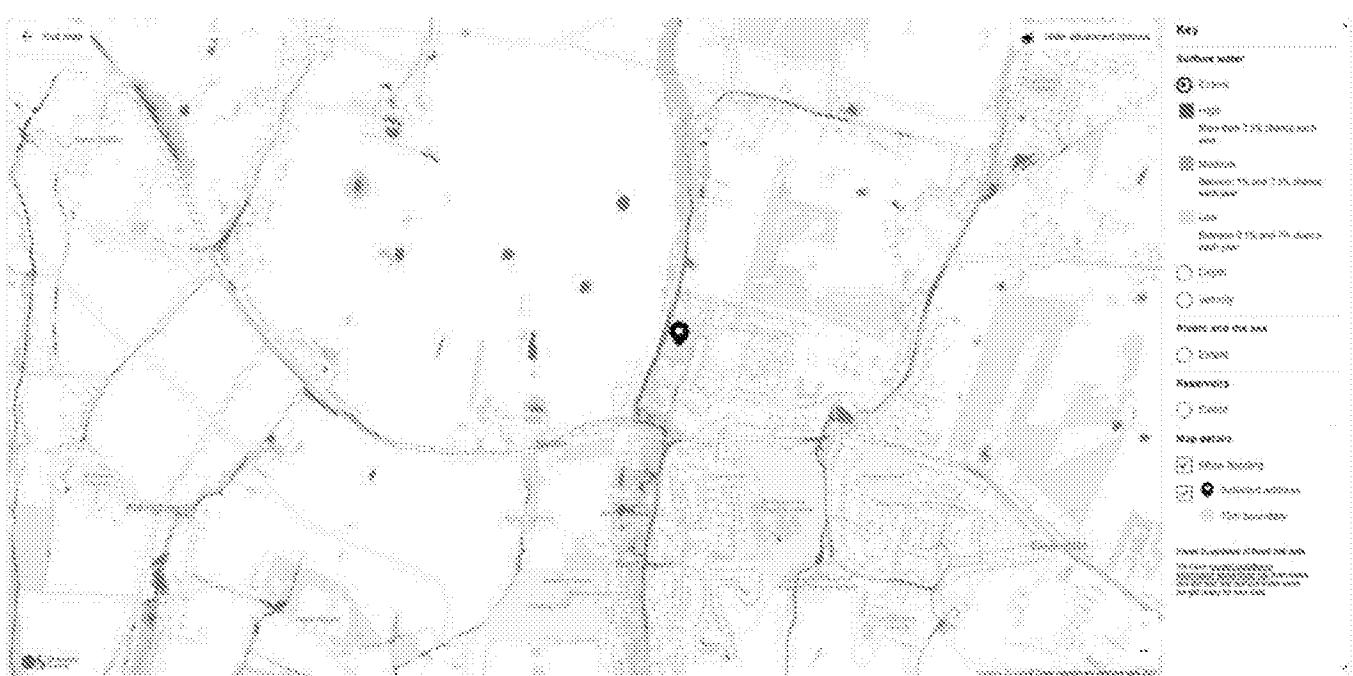
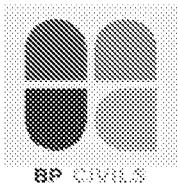


Figure 12. Long-Term Flood Risk Map – Surface Water (Gov.uk)



5.2.12 The anticipated depths of surface water flooding have also been assessed, in relation to the extents identified as being at risk of surface water flooding.

5.2.13 In 'High' risk scenarios, the anticipated depths of surface water flooding are stated in the range of '30cm to 90cm', however are confined to areas off-site, relating to the ordinary watercourse adjacent to the western boundary of the site. This is likely identifying water that would be contained within the channel of the watercourse, in view of its surveyed depth.

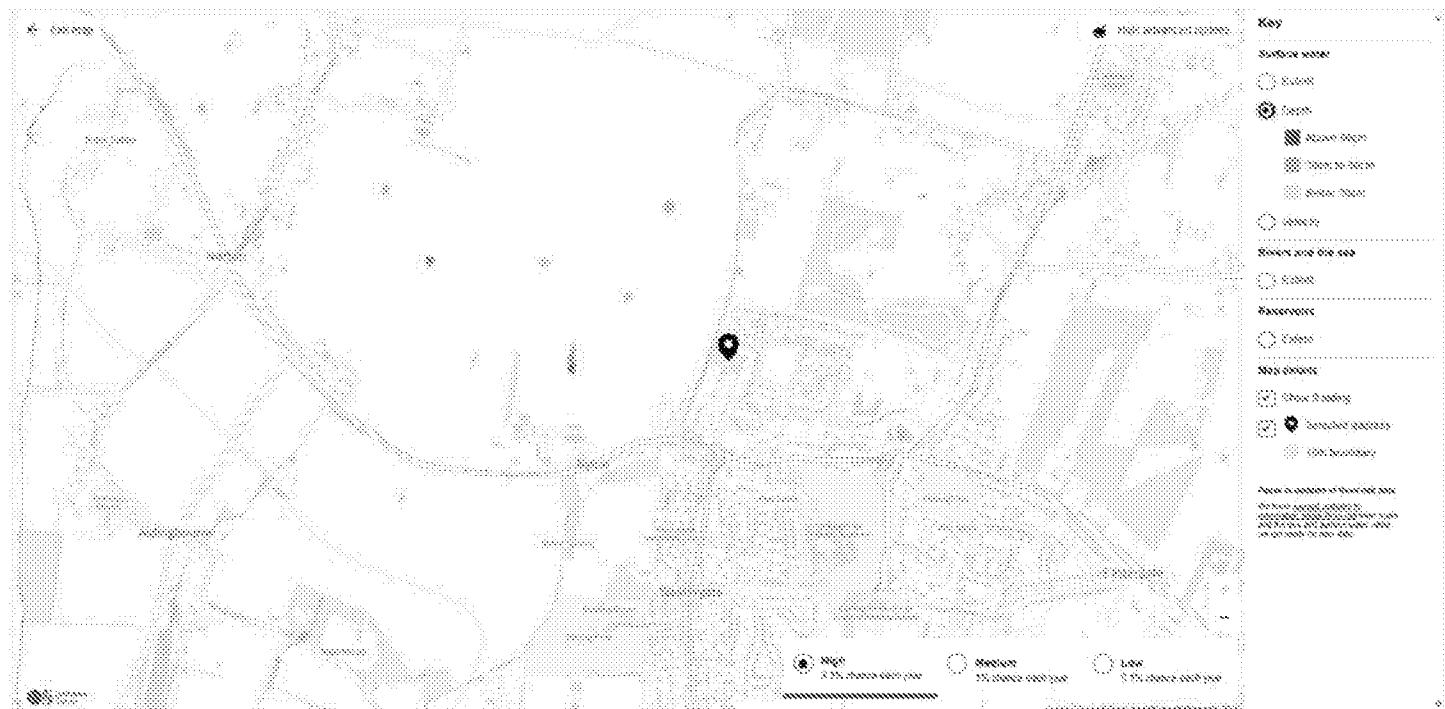


Figure 13. Long-Term Flood Risk Map – Surface Water, High Risk Depths (Gov.uk)

5.2.14 In 'Medium' risk scenarios, the anticipated depths are also indicated in the range of '30cm to 90cm'. Again, these extents and depths are associated with off-site areas, relating to the ordinary watercourse adjacent to the western boundary, where such depths would be contained within the channel of the watercourse.



Figure 14. Long-Term Flood Risk Map – Surface Water, Medium Risk Depths (Gov.uk)

5.2.15 In 'Low' risk scenarios, the on-site extents identified as being susceptible to surface water flooding have associated depths of 'Below 30cm'. These extents correspond with lower-lying levels of the site, at or near the north-eastern and eastern extents of the site. Anticipated flood depths on Northfields Lane in 'Low' risk scenarios are identified in the range of '30cm to 90cm'.



Figure 15. Long-Term Flood Risk Map – Surface Water, Low Risk Depths (Gov.uk)

5.2.16 The Long-Term Flood Risk Map for Reservoirs does not identify the site as being at risk of flooding from such sources.

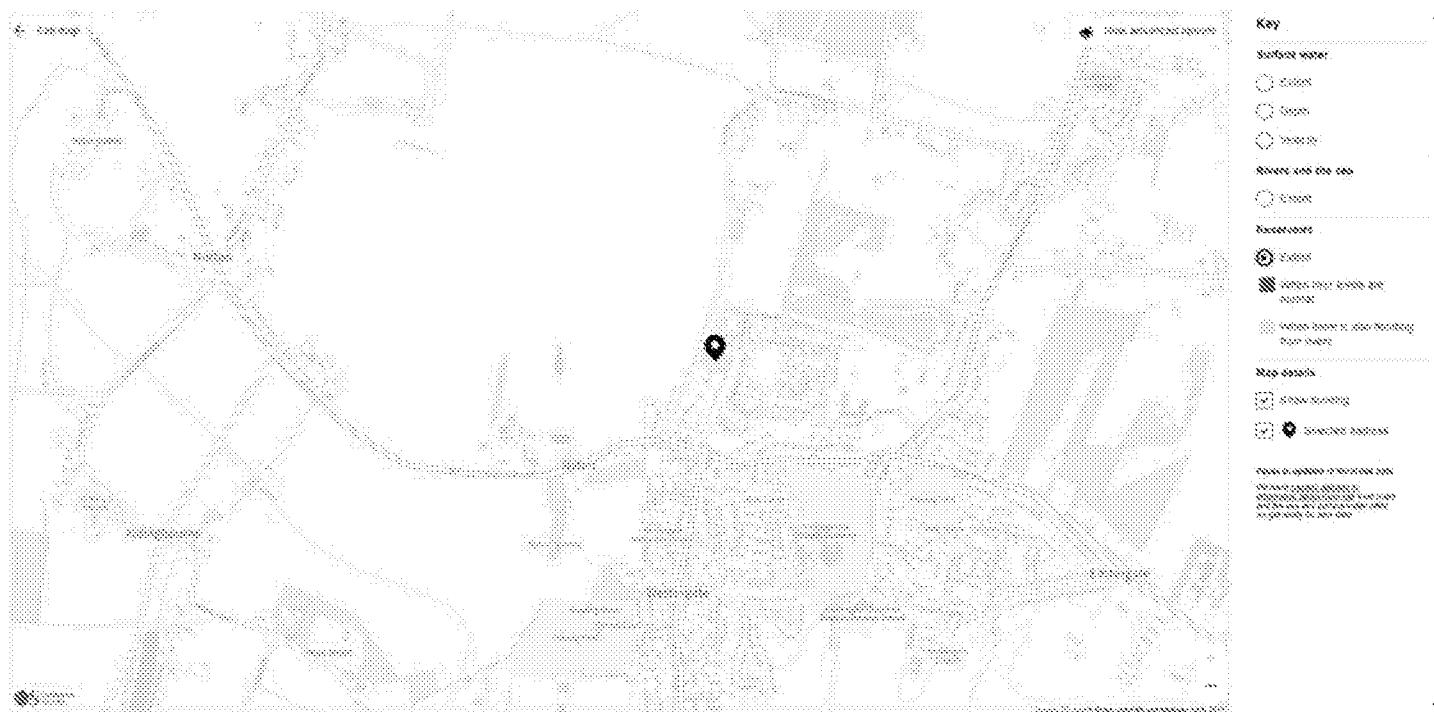


Figure 16. Long-Term Flood Risk Map – Reservoirs (Gov.uk)

5.3 Strategic Flood Risk Assessment

5.3.1 Arun District Council has a published Strategic Flood Risk Assessment, dated November 2016.

5.3.2 The Strategic Flood Risk Assessment confirms 'significant' events of groundwater flooding affected Northfields Lane in 2014.

5.3.3 Mapping contained within the Strategic Flood Risk Assessment identifies the following:

- The Strategic Flood Risk Assessment Flood Zone mapping is inconsistent with other mapping identified from other sources; the confirmed extents of Flood Zone 2 are instead identified as Flood Zone 3, which is incorrect.
- The Strategic Flood Risk Assessment Climate Change mapping is also inconsistent with the Environment Agency's flood risk assessment data mapping.
- The Strategic Flood Risk Assessment Watercourses mapping incorrectly identifies the Environment Agency Main River as an ordinary watercourse.
- The Strategic Flood Risk Assessment Surface Water Flood Risk mapping is consistent with surface water flood mapping reviewed from other sources.
- The Strategic Flood Risk Assessment Areas Susceptible to Groundwater mapping identifies the site as being at 'High' risk of groundwater flooding ($\geq 75\%$).
- The Strategic Flood Risk Assessment Flood Warning Areas mapping does not identify the site as falling within a flood warning area.
- The Strategic Flood Risk Assessment Historic Flooding Records mapping identifies historic surface water flooding on Northfields Lane, to the south of the site. Additionally, this identifies an alternative 'Historic flood outline' which captures Northfields Lane/Nyton Road and Westergate Street. This historic flood outline corresponds with data provided by the Environment Agency within the flood risk assessment data. The flood event is recorded by the Environment Agency as occurring in November 1960.

5.3.4 In view of the site's flood zone classification, a Sequential Test is required. This has been prepared by Domusea Developments.

5.3.5 Extracts and mapping from the Arun District Council Strategic Flood Risk Assessment can be found within **Appendix F**.

5.4 Historic Flooding

5.4.1 Flooding has been identified affecting Northfields Lane, Nyton Road and the wider area, historically.

5.4.2 Historic flood mapping contained within Arun District Council's Strategic Flood Risk Assessment identifies historic surface water flooding, in addition to an historic flood outline which corresponds with an event in November 1960 recorded by the Environment Agency.

5.4.3 Arun District Council's Drainage Officers have previously informed BP Civils that 'Groundwater has a significant contribution to flooding in this area.'

5.5 Lidsey Surface Water Management Plan

- 5.5.1 The site falls within the area covered by the Lidsey Surface Water Management Plan; falling within Southern Water's Lidsey Wastewater Treatment Works (WwTW) Catchment.
- 5.5.2 The Lidsey SWMP makes reference to historic groundwater flooding within the area.
- 5.5.3 The SWMP details '*Historical issues surrounding the land drainage system but many improvements have now been carried out*'. The SWMP is dated 2014, and since this date additional improvement works have been undertaken within the area (including culvert works to the rear of properties on the eastern side of Northfields Lane).
- 5.5.4 It is also stated in the SWMP that the issues relating to flooding are exacerbated when the Main River overtops and exceedance flows overload the adjacent ordinary watercourse network, or when groundwater flooding occurs.

5.6 Summary of Flood Risk

5.6.1 The potential sources of flooding are:

Source of Flooding	Level of Risk
Rivers and Coastal	<p>Medium</p> <p>Flood Maps for Planning identifies that the site largely occupies Flood Zone 1, although areas towards the eastern/south-eastern boundary, the southern boundary and the western boundary occupy Flood Zone 2. Areas at the north-western corner of the site are identified as marginally encroaching Flood Zone 3, whilst areas adjacent to the western boundary are also in close proximity to Flood Zone 3.</p> <p>The Long-Term Flood Risk Map for Rivers or the Sea identifies the extents of the site deemed to be at risk of flooding from such sources as being at 'Medium' risk.</p>
Surface Water	<p>Very Low to Low</p> <p>The Long-Term Flood Risk Map for Surface Water indicates the site as being at 'Very Low' to 'Low' risk of surface water flooding.</p> <p>Extents off-site, but within the immediate vicinity of the site, are identified as being at increased risk of surface water flooding ('Medium' to 'High' risk) although seemingly relating to the presence of the ordinary watercourse along the western boundary of the site in view of the anticipated depths of flooding as per the Long-Term Flood Risk Maps for Surface Water.</p>
Groundwater	<p>High</p> <p>Groundwater is identified as contributing heavily towards flooding in this location, with mapping contained within Arun District Council's Strategic Flood Risk Assessment suggesting the site is heavily susceptible to groundwater flooding. Historic flooding linked to groundwater has also been recorded nearby. Groundwater is also understood to impact upon the Main River on Northfields Lane which can, and has, overtopped placing increased pressure on the surrounding land drainage network.</p>

Sewers	Low <p>It is understood that the local drainage network (ordinary watercourse) discharges to the Southern Water public sewer network on Nyton Road.</p> <p>There are no known instances of sewer flooding within the vicinity of the site, therefore the risk of sewer flooding is deemed to be 'Low'.</p>
Artificial Sources	None <p>The site is not shown to be at risk of flooding due to artificial sources.</p>

5.6.2 The site is most susceptible to groundwater flooding of all the sources of potential flood risk assessed. It is acknowledged that groundwater issues impact upon flooding from other sources. The Main River in Northfields Lane is impacted by fluctuating groundwater levels, and if/when this overtops, this has a detrimental impact upon the ordinary watercourse network which provides land drainage functionality within the vicinity of the site.

5.6.3 The drainage system for the proposed development shall be designed to provide capacity up to the design event and consider potential exceedance routes, as so not to increase the risk of flooding on site, or off site. The constraints associated with the risks of flooding from the sources assessed shall also be considered in preparing a suitable drainage system.

6 PROPOSED DEVELOPMENT

6.1 Description of Development

6.1.1 The proposed development will involve the construction of a single residential property as demonstrated by the development proposals contained within **Appendix A**.

6.1.2 Although areas of the site are identified as encroaching within Flood Zone 3, with further extents identified falling within Flood Zone 2, the proposed dwelling will be located within Flood Zone 1.

6.1.3 The type of development proposed falls within the "More Vulnerable" flood risk vulnerability classification (Annex 3: Flood risk vulnerability classification, NPPF) and is appropriate in Flood Zones 1 and 2 (Flood Risk and Coastal Change Table 2). The Exception Test is required within Flood Zone 3a, where the proposed access will cross into the site.

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone 1	✓	✗	✗	✗	✗
Flood Zone 2	✓	Exception Test Required	✗	✗	✗
Flood Zone 3a†	Exception Test Required †	✗	Exception Test Required	✗	✓
Flood Zone 3b*	Exceptions Test Required *	✗	✗	✗	✗*

✓ = Development is appropriate
 ✗ = Development should not be permitted

6.1.4 The proposed development will result in the introduction of new impermeable areas at the site; however SuDS measures will be used where possible in order to prevent any increase in the rate of run-off generated by the site.

6.1.5 The post-development impermeable/hardstanding area has been determined to be 240m² (0.024Ha).

6.1.6 The use of SuDS methods and techniques, where site conditions and constraints allow, will be utilised to assist in the management of surface water run-off generated by the proposed development, whilst adhering to the SuDS hierarchy as stated within Building Regulations (Part H) and The SuDS Manual (C753).

6.1.7 The specific surface water and foul water drainage proposals are detailed in **Section 8** of this report.

7 SEQUENTIAL AND EXCEPTION TESTS

7.1 Sequential Test

7.1.1 The site falls predominantly within Flood Zone 1, although extents of the site area identified as falling within Flood Zone 2, whilst the proposed access location will require traversing an area identified as falling within Flood Zone 3.

7.1.2 The site has been set out sequentially as so to position the proposed dwelling within the extents of the site identified as being in Flood Zone 1.

7.1.3 A Sequential Test has been undertaken by Domusea Developments which has concluded that there are no suitable alternative sites available which are at a lower risk of flooding (i.e. fully located within Flood Zone 1).

7.2 Exception Test

7.2.1 Table 3 within paragraph 067 of Flood Risk and Coastal Change confirms that developments classified as "More Vulnerable" require an Exception Test for Flood Zone 3a. Parts of the proposed development site fall within Flood Zone 3a, specifically at the north-western extent of the site, whilst the proposed access location off of Northfields Lane will require traversing an area identified as being in Flood Zone 3a. The proposed dwelling will, however, be located in Flood Zone 1.

7.2.2 Paragraph 164 of NPPF confirms that the Exception Test should be informed by a strategic or site-specific flood risk assessment, and that two parts of the test apply. Both elements of the Exception Test should be satisfied for development to be allocated or permitted;

- i. The development would provide wider sustainability benefits to the community that outweigh flood risk, and;
- ii. The development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

7.2.3 At present, Arun District Council is unable to demonstrate that it is able to fulfil its 5 Year Housing Land Supply, meaning that the provision of this additional single dwelling will provide wider sustainability benefits to the community.

7.2.4 In view of the risk(s) of flooding to the site, and the flood zone classification (Flood Zone 2 and 3) mitigation is proposed to ensure that the development is safe for its lifetime, without increasing flood risk elsewhere, and reducing flood risk overall. Full details of the mitigation proposed are detailed within Section 9 – 'Residual Risk and Mitigation.'

8 PROPOSED DRAINAGE STRATEGY

8.1 Surface Water

8.1.1 The SUDS Manual (CIRIA C753) and Building Regulations, Approved Document H (Drainage and Waste Disposal) set out a hierarchy of drainage methods to ensure that developments maximise the use of sustainable drainage techniques. The hierarchy favours infiltration methods of disposal over other methods such as watercourse and sewers, as detailed below:

- i. Utilise infiltration techniques
- ii. Attenuate rainwater in ponds or open water features for gradual release
- iii. Attenuate rainwater by storing in tanks or sealed water features for gradual release
- iv. Discharge rainwater direct to a watercourse
- v. Discharge rainwater to a surface water sewer/drain
- vi. Discharge rainwater to a combined sewer

SUDS Technique	Suitable	Comments
Living Roof	No	Not suitable in view the proposed development.
Basins and Ponds (such as Wetlands, Balancing Ponds, Detention Basins, Retention Ponds)	No	The proposed on-site arrangement is unlikely to allow the inclusion of such features, whilst also are not realistically in keeping with the size and scale of the proposed development, which involves the construction of a single dwelling.
Filter strips and swales	Yes	No initial constraints identified. The impacts of groundwater at shallow depths will need to be considered.
Infiltration Devices - Soakaways - Infiltration trenches and basins	No	Groundwater is acknowledged as being present at shallow depths and recent surrounding developments have identified that infiltration is not viable in part as a result of this.
Permeable surfaces and filter drains (such as gravelled areas and porous block paving)	Yes	Given the presence of shallow groundwater, such features could still be accommodated, albeit whilst being lined/tanked.

Tanked systems (such as oversized pipes or cellular tanks)	Yes	No initial constraints.
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8.1.2 Infiltration is not proposed as this is deemed to be unviable given the presence of shallow groundwater.

8.1.3 The proposed access drive will be of a 'free draining' gravel construction, serving its own area and in keeping with wider development on Northfields Lane.

8.1.4 The roof area will be served by a shallow cellular tank, with a controlled discharge to the watercourse network within the immediate vicinity of the site.

8.1.5 It is proposed that a tank measuring 5.00m x 5.00m x 0.400m will be introduced, providing a storage volume of 9.5m³.

8.1.6 Flows will be restricted to a maximum rate of 2.00 l/s in order to reduce the potential risk of blockage within the system.

8.1.7 Discharge to the adjacent watercourse will be subject to Ordinary Watercourse Consent from Arun District Council / West Sussex County Council.

8.1.8 The surface water drainage system has been designed to accommodate a 1 in 100-year storm event inclusive of allowances for the potential impacts of climate change (45%) as well as urban creep (10%).

8.1.9 The proposed surface water drainage arrangement is shown on drawing **PL500**.

8.2 Treatment

8.2.1 The use of permeable, free-draining gravel construction for the drive will ensure that the associated runoff will receive a level of treatment required by the SuDS manual, with hydrocarbons being filtered by the aggregate layer(s).

8.2.2 In accordance with the CIRIA SuDS Manual C753 regarding methods for managing pollution risks, the risk posed by surface water runoff to the receiving environment depends on the pollution hazard at the site (the source), SuDS treatment techniques (the pathway), and the sensitivity of the environment (the receptor).

8.2.3 The simple index approach considers whether SuDS techniques are appropriate for the site. The states that for SuDS components to deliver adequate treatment, the total pollution mitigation index for each contaminant type should equal or exceed the pollution hazard index.

8.2.4 The SuDS Manual outlines three categories of pollution hazard identification, which vary depending on proposed land use, which are as follows:

- Total Suspended Solids (TSS).
- Metals (M).
- Hydrocarbons (H).

8.2.5 In accordance with C753 Table 26.2, the proposed land uses at the site are categorised as follows:

- Residential Roofs – very low/TSS=0.2/M=0.2/H=0.05

- Individual property driveways – low / TSS=0.5/M=0.4/H=0.04

8.2.6 In accordance with C753 Table 26.3, the values of SuDS Mitigation indices are provided for permeable paving:

- Permeable Gravel Drive – TSS=0.7/M=0.6/H=0.7

8.2.7 As the pollution hazard index does not exceed any pollution mitigation index for any contaminant type, the proposed SuDS methods will provide sufficient treatment for the proposed development.

8.3 Foul Water Drainage

8.3.1 It is proposed that the new dwelling will discharge to Southern Water's public foul water sewer located in Northfields Lane.

8.3.2 Post development, there will be an estimated increase in peak foul water flows of 0.046 l/s, based on Sewer Sector Guidance, Design and Construction Guidance (DCG) – Appendix C.

8.3.3 Recent changes to infrastructure and connection charges (OFWAT Charging Rules) place the onus on the sewerage undertaker to reinforce their network should there no longer be sufficient capacity to serve the new development. Funding for this is provided by revised charging arrangements for infrastructure and connection charges for each dwelling constructed comprising a Network Reinforcement Charge and Site-Specific Charges. The revised charging arrangement (funded by the developer) covers alterations to the Existing Sewer Network and the sewerage undertaker remains responsible for the cost of reinforcing their Strategic Assets. The developer is responsible for connecting the development to the public sewer network.

8.3.4 The proposed foul drainage arrangement is shown on drawing **PL500**.

8.4 Climate Change

8.4.1 Gov.uk provides guidance for local planning authorities preparing strategic flood risk assessments and developers and their agents preparing flood risk assessments for planning applications, and development consent orders for nationally significant infrastructure projects.

8.4.2 Climate change allowances are predictions of anticipated change for peak river flow, peak rainfall intensity, sea level rise and offshore wind speed and extreme wave height.

8.4.3 Allowance for climate change shall be provided in the undertaking of site-specific flood risk assessments where new development is proposed to minimise vulnerability and provide resilience to flooding and coastal change.

8.4.4 The 'Peak Rainfall Allowances Map' shows anticipated changes in peak rainfall intensity.

8.4.5 Based on the latest allowances, for the 3.3% annual exceedance rainfall event, an increase of 35% should be applied to peak rainfall in relation to the proposed development.

8.4.6 For the 1% annual exceedance rainfall event, an increase of 45% should be applied to peak rainfall in relation to the proposed development.

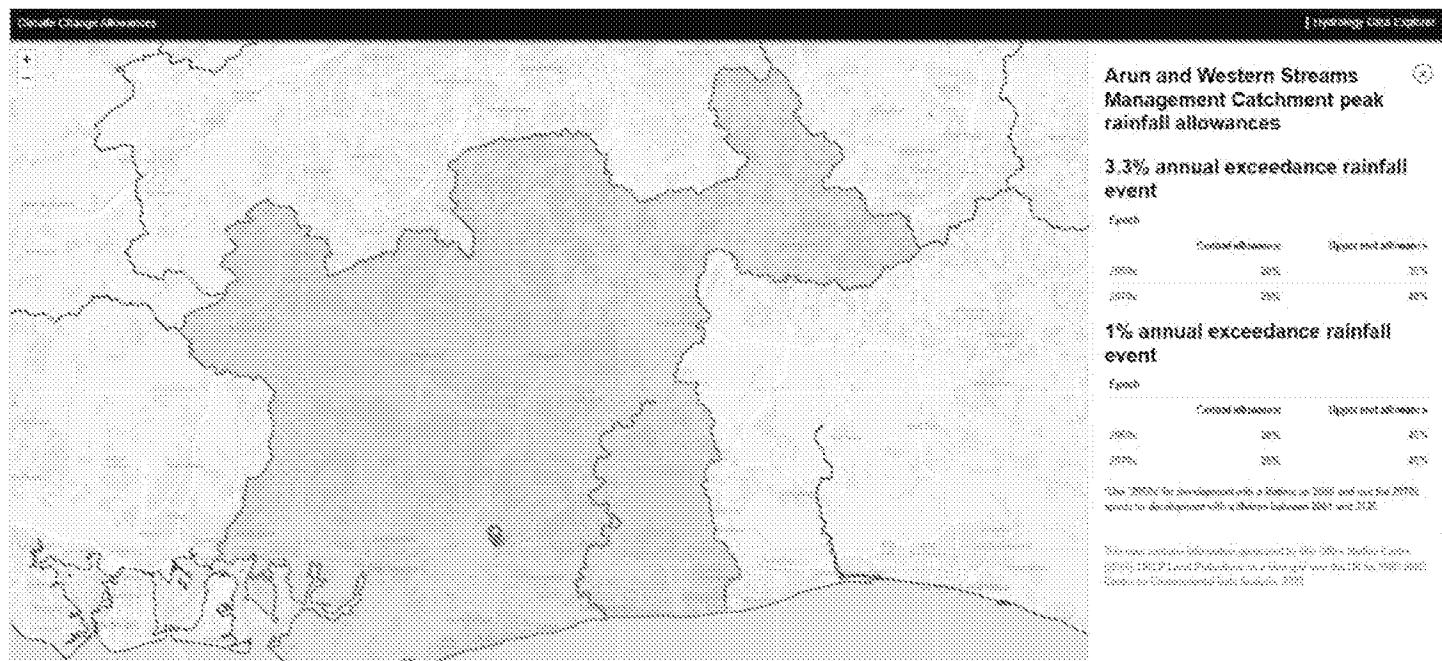


Figure 17. Climate Change Allowances – Peak Rainfall Allowances (Gov.uk)

8.5 Urban Creep

8.5.1 The West Sussex County Council Lead Local Flood Authority Policy for the Management of Surface Water confirms that requirement where allowances for urban creep is concerned.

8.5.2 In view of Table 5.2 ('Impermeable Area Allowances'), an allowance of 10% has been considered in relation to the proposed development.

9 RESIDUAL RISK AND MITIGATION

9.1 Residual Risk

9.1.1 The following residual risks have been identified in relation to the proposed development:

- i. Flooding of buildings within flood zones or within the vicinity of flood zones
- ii. Increased flow through the unnamed ordinary watercourses or the Main River as a result of climate change causing flooding to the site.
- iii. Blockage of the unnamed ordinary watercourses or the Main River as a result of debris or otherwise, causing flooding to the site.
- iv. Extreme rainfall events that exceed the design criteria used for the drainage system causing surface water flooding.
- v. Blockage/failure of the proposed drainage system causing flooding to the site.
- vi. Groundwater flooding to the site caused by groundwater levels exceeding the ground surface level.
- vii. Surface water flooding of proposed buildings

9.2 Mitigation

9.2.1 Consideration has been taken to the residual risks stated in Section 9.1, and the following mitigation measures are proposed:

- i. Various extents of the site are captured by different flood zones. Largely, the site is located in Flood Zone 1, although extents also fall within Flood Zone 2, with minor encroachment within Flood Zone 3 also identified. The site has been set out sequentially to ensure that the proposed dwelling is located within Flood Zone 1. The Environment Agency flood risk assessment data indicates a 'peak' modelled flood level of 12.71m AOD, relating to the 1% + 105% CC defended and undefended scenarios. It is proposed that the finished floor level of the proposed dwelling will be set 300mm above this level, at 13.01m AOD, to mitigate flood risk in such scenarios.
- ii. As referenced above, the Environment Agency flood risk assessment data identifies a 'peak' modelled flood level of 12.71m AOD in relation to the 1% + 105% CC defended and undefended scenarios. The proposed finished floor level of the proposed dwelling will be set 300mm above this level, at 13.01m AOD.

- iii. Recent development within the vicinity of the site has seen improvement works undertaken in relation to the existing land drainage system. This relates to the watercourse to the east of the site, downstream of the site. Known culvert improvement works have also been undertaken. The owner/occupier will have riparian duties to fulfil in relation to the adjacent watercourses to ensure that they are clear of obstruction and are able to effectively convey flows. The finished floor level of the proposed dwelling will be elevated in view of the modelled flood levels provided by the Environment Agency which will also help to mitigate potential flood risks associated with potential blockage of the local land drainage features. Section 11 – 'Maintenance' also confirms actions that shall be undertaken to mitigate the risk of blockage to the watercourse which could result in flooding, or an increased risk of flooding, at the site.
- iv. The proposed drainage system has been designed to capture run-off up to and including a 1 in 100-year storm, with allowances for climate change of up to 45% as well as urban creep (10%). Should a more severe rainfall event occur, there is potential for the drainage system to be exceeded. Exceedance flows would follow the natural topography of the site, broadly falling towards the boundaries of the site. This would see flows falling towards the watercourses adjacent to the site boundaries. Proposed drainage infrastructure should also be considered which can intercept run-off in an exceedance event, including gullies and channel drains.
- v. The proposed drainage system will attenuate and store run-off up to and including the design event. Blockage of the drainage system has the potential to cause flooding on the site. Surcharged flows will travel overland to the existing drainage system and watercourse, however maintenance measures proposed in Section 11 – 'Maintenance' will mitigate the risk of the system becoming blocked.
- vi. The site falls within an area identified as being at high risk of groundwater flooding, with historic flooding linked to groundwater having occurred within the vicinity of the site in the past. Should groundwater emerge on site, this would follow the natural topography of the site, mimicking the behaviours of surface water flooding. With the finished floor level to be elevated (to a level of 13.01m AOD), this will provide protection and resilience should flooding occur.
- vii. The risk of surface water flooding is to be mitigated through the raising of the finished floor level about existing ground level, but also elevated about the 'peak' modelled flood level established for the site, in view of the Environment Agency's flood risk assessment data.
- viii. Flood resilient construction methods are also suggested, to provide further mitigation and safeguarding in the event of flooding. Such measures may include:
 - o Flood doors and/or barriers (where flood doors cannot be installed)
 - o Anti-flood air bricks
 - o Non-return valves on foul and surface water connection points
 - o Raised electrics
 - o Kitchens and bathrooms (where located on the ground flood) to be installed using water resistant materials such as polymer boards and stainless steel
 - o Tiled floors where possible
 - o Closed cell insulation
 - o Raised appliances (including boilers and electricals)

10 FLOOD RISK MANAGEMENT

10.1 Safe Access and Egress

- 10.1.1 In order to access the site, persons will be required to traverse an area designated as Flood Zone 3 and/or Flood Zone 2.
- 10.1.2 It is not possible to provide a 'dry' route of escape in the event of flooding, and as such, this represents a residual risk.
- 10.1.3 Should flooding occur, and persons are unable to leave the site, it is demonstrated that occupants can remain 'safe' within the property – the finished floor level of the house is to be set 300mm above the 'peak' modelled flood level of 12.71m AOD for the 1% + 105% CC defended and undefended scenarios. The finished floor level will be set at 13.01m AOD. The ground floor levels would remain 'dry' above the modelled flood level, whilst the upper floor(s) of the dwelling could also be utilised until a time when potential flood levels reside and it is safe to leave the property. It is not anticipated that the potential flood depths would impede emergency vehicle access.

10.2 Flood Warning

- 10.2.1 The site is at risk of fluvial, groundwater and surface water flooding to varying degrees, therefore there is a need for a Flood Evacuation Plan.
- 10.2.2 It is recommended that the occupants of the proposed dwelling register for Flood Alerts and Flood Warnings via the Environment Agency, and that a Flood Plan is prepared.

11 MAINTENANCE

11.1 Proposed Maintenance Regime

11.1.1 Maintenance is required to ensure the long-term operational performance of the proposed surface water drainage system.

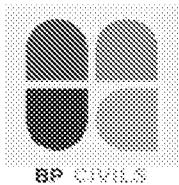
11.1.2 The drainage system has been designed to minimise maintenance requirements; however a number of key tasks will need to be undertaken so that the system remains in optimal condition. These operations are summarised in the table below, along with the required frequency of works.

Drainage System feature	Proposed maintenance / remedial works	Required frequency of works
Pipework	Jetting to clear blockages	As required
Catch Pits	Inspection and additional cleansing as required.	Annual
	Desilting	Year 1, Year 3, then every 5 years
Flow Control Chamber	Clean out chamber/sump	Monthly for first 3 months then twice annually
	Inspect flow control unit and remove debris	
Outfall (to Watercourse)	Inspection, vegetation clearance and additional clearing/cleansing of potential outfall blockages	At least once a year
	Desilting	Year 1, Year 3, then every 5 years
Unnamed Ordinary Watercourse		
Regular Maintenance	Remove litter/debris	Monthly, or as required
	Cut grass – may be to suit design parameters	Monthly, or as required
	Manage and/or cut back vegetation	Monthly, or as required
	Inspect inlets/outlets (i.e. culvert at upstream and downstream headwalls)	Monthly
	Inspect base for silt and remove as required	Twice annually
Occasional Maintenance	Reseed areas of poor grass coverage and/or vegetation growth	As required
Remedial Actions	Repair erosion or other damage	As required
	Remove silt from base	As required
	Re-level uneven surfaces to existing/design surface profile	As required

11.1.3 The responsibility of maintenance regime will rest with the owner/occupier of the dwelling, upon completion.

Accidental Spillages

11.1.4 It is not envisaged that any materials are to be stored onsite once the development has been completed, which could cause major spills and potential pollution issues within the drainage system. If



this situation alters in the future consultation with a specialist will be required in order to confirm if any upgrades to the existing system are necessary.

Future Alterations to the Development

11.1.5 Any future alterations to the foul and/or surface water drainage systems should be confirmed by a specialist.

12 OFFSITE IMPACTS

- 12.1.1 The proposed development will not result in any increase in run-off leaving the site, as flows are to be restricted when discharging to the adjacent watercourse. As a result, flood risk is not increased off-site.
- 12.1.2 Attenuation is to be provided to restrict the rate of run-off leaving the site.
- 12.1.3 Third party improvement works have been undertaken within the vicinity of the site in relation to the ordinary watercourse network downstream of the site.
- 12.1.4 Post-development foul water flows will contribute an increase within the public sewer network. It is expected that the foul sewer flow will be 0.046 l/s. The responsibility is on the sewerage undertaker, Southern Water, to ensure that capacity exists in order to support new development.
- 12.1.5 The effects of climate change have been considered in the design of the proposed surface water drainage system, to ensure there is no off-site impact, whilst urban creep and the potential for an increase in flows generated by the site has also been incorporated within the design considerations.

13 SUMMARY

- 13.1.1 This flood risk assessment has been prepared in view of information from the Environment Agency's Flood Maps for Planning; Long-term Flood Risk Maps; Arun District Council and West Sussex County Council drainage records; Southern Water drainage records and British Geological Survey records.
- 13.1.2 The proposed development will involve the construction of a single dwelling as demonstrated by the development proposals contained within **Appendix A**.
- 13.1.3 The site topographic survey identifies levels in the range of 12.05m and 12.69m AOD.
- 13.1.4 The site is largely located within Flood Zone 1, although extents are identified which fall within Flood Zone 2, with minor encroachment also evident in Flood Zone 3.
- 13.1.5 The site is identified as being at 'Very Low' risk of surface water flooding. Extents towards the eastern/north-eastern boundaries of the site are identified as being at 'Low' risk of surface water flooding, with extents along the western boundary identified as being at 'High' / 'Medium' risk of surface water flooding. The extents identified as being at increased risk of surface water flooding along the western boundary of the site correspond with the presence of the ordinary watercourse in this location.
- 13.1.6 There is a stated high risk of groundwater flooding at the site, with historic issues known locally associated with groundwater.
- 13.1.7 It is proposed that the access drive will be of a free-draining gravel construction.
- 13.1.8 The roof area will be served by a shallow cellular tank, with a controlled discharge to the watercourse network within the immediate vicinity of the site.
- 13.1.9 It is proposed that a tank measuring 5.00m x 5.00m x 0.400m will be introduced, providing a storage volume of 9.5m³.
- 13.1.10 Flows will be restricted to a maximum rate of 2.00 l/s in order to reduce the potential risk of blockage within the system.
- 13.1.11 Discharge to the adjacent watercourse will be subject to Ordinary Watercourse Consent from Arun District Council / West Sussex County Council.
- 13.1.12 The surface water drainage system has been designed to accommodate a 1 in 100-year storm event inclusive of allowances for the potential impacts of climate change (45%) as well as urban creep (10%).
- 13.1.13 In view of modelled flood level data provided by the Environment Agency, the finished floor level will be set at 13.01m AOD – 300mm above the 'peak' modelled flood level at the site of 12.71m AOD relating to the 1% + 105% CC defended and undefended scenarios.
- 13.1.14 Wastewater from the proposed development will discharge to Southern Water's public foul water sewer located in Northfields Lane.
- 13.1.15 The completion of the development will not increase flood risk on or off the site.
- 13.1.16 In conclusion, this development is suitable with regards to flood risk and surface water drainage.