



Consulting Civil Engineers

Flood Risk Assessment

LUSH Unit A1 & A2 Fleets Corner Business Park, Nuffield Road, Poole BH17 0LA

Rev -

Reference **C1898**

Date **17.01.2024**

| Revision | Status | Description | Date | Issued | Checked |
|-----------------|---------------|---------------------|-------------|---------------|----------------|
| - | Final v1 | Issued for Approval | 17.01.25 | RH | RH |
| | | | | | |
| | | | | | |

1 SITE AND DEVELOPMENT OVERVIEW

| DEVELOPMENT DESCRIPTION | EXISTING (PRE-DEVELOPMENT) | PROPOSED (POST-DEVELOPMENT) |
|--|--|--|
| Site Use | Existing Dwelling (report ref: existing site coverage) | Minor extensions to the existing dwelling |
| Development Use | Residential (report ref: existing site use) | Residential (report ref: proposed site use) |
| Use Design Life | | 100 years |
| Number of Dwellings | 1 | 1 |
| EA Vulnerability Classification | More Vulnerable (ref: existing site vulnerability) | More Vulnerable (ref: proposed site vulnerability) |
| Development Class | | Minor |
| County Planning Authority | West Sussex County Council (ref: Country Council) | |
| District Planning Authority | Arun District Council (ADC) | |
| Local Sewer Authority | Southern Water (ref: Local Sewer Authority) | |

| SITE CATCHMENT CHARACTERISTICS | DESCRIPTION | SOURCE |
|-----------------------------------|---|---|
| River Management Catchment | Arun and Western Streams Management Catchment (report ref: River Basin Catchment) | https://environment.data.gov.uk/ |
| Nearest EA Main River | Aldingbourne Rife (northern and eastern boundary) (report ref: EA Main River) | https://environment.data.gov.uk/ |

| KEY FLOOD RISK AND DATA SOURCES | DATA TYPE | SOURCE |
|---|---|---|
| EA Fluvial and Tidal Planning Data | UK Government Flood Maps for Planning (ref: FMP) | https://flood-map-for-planning.service.gov.uk/ |
| EA Surface Water Data | DEFRA Risk of Flooding from Surface Water Sources GIS Data (ref: RoFSW) | https://environment.data.gov.uk/DefraDataDownload/?Mode=rofsw |
| EA Long term Flood Risk | UK Government Long term Flood Risk Maps (ref: LTFRM) | https://www.gov.uk/check-long-term-flood-risk |
| Environment Agency Product 4/5 Data | EA Product 5 and 6 data (report ref: EA Product Data) | EA Detailed Flood Model |
| Historic Flood Risk Data | DEFRA Historic Flood Outlines GIS Data | https://environment.data.gov.uk/DefraDataDownload/?mapService=EA/HistoricFloodMap&Mode=spatial |
| Strategic Flood Risk Assessment Data | Arun District Council (ref SFRA) | Council Website |
| Local Flood Risk Assessment Data | (refer to SFRA) | Council Website |
| Topographic Information | DEFRA Opensource LIDAR Data | https://environment.data.gov.uk/DefraDataDownload/?Mode=survey |

| DESIGNATION | FLOOD RISK DESIGNATION | NOTE |
|---|---------------------------------|---|
| EA/LLFA Designated Flood Zone | Flood Zone 3 – High Risk | *Designation based on highest flood risk between River, Sea or Surface Water - Refer Section 1: Table 2 |
| Sea Flood Risk Present | High | Refer Section 1: Table 2 |
| Surface Water Flood Risk Present | Low | Refer Section 1: Table 2 |

TABLE OF CONTENTS

| | | |
|---|---|----|
| 1 | Site and Development Overview..... | 2 |
| | Table of Contents | 3 |
| 2 | Introduction..... | 4 |
| | Development Proposals | 4 |
| | Flood Risk Assessment Scope | 4 |
| | Flood Risk Vulnerability | 5 |
| 3 | Flood Risk Assessment Scope | 6 |
| | Sequential Test/Exception Test | 7 |
| | Environment Agency Flood Risk Designation | 8 |
| | Flood Zone | 8 |
| 4 | Local Features..... | 10 |
| | Nearest water bodies | 10 |
| | Topography..... | 10 |
| | Geology & Hydrogeology..... | 10 |
| | Flood Defences | 11 |
| 5 | Climate Change..... | 12 |
| | Increases in Sea and Tidal Levels..... | 12 |
| 6 | Sources of Flood Risk..... | 13 |
| | Tidal (Sea) | 13 |
| | Historical, Sewers and Drainage | 14 |
| | Groundwater | 15 |
| | Reservoir..... | 17 |
| | Residual Risks | 18 |
| 7 | Building Material Mitigations | 19 |
| 8 | Flood Mitigation Measures | 20 |
| 9 | Conclusion | 21 |
| | Appendix 1 – Architectural Proposals | 22 |
| | Appendix 2 – EA Data | 23 |

2 INTRODUCTION

- 2.1 The following report is a Phase 1 Flood Risk Assessment (FRA) for the development proposals at 27 Aldwick Avenue, Bognor Regis PO21 3AQ (see site location map, Figure 1).
- 2.2 This assessment is required under the National Planning Policy Framework (NPPF) and Local and District Councils given the location, scale and associated flood risks.

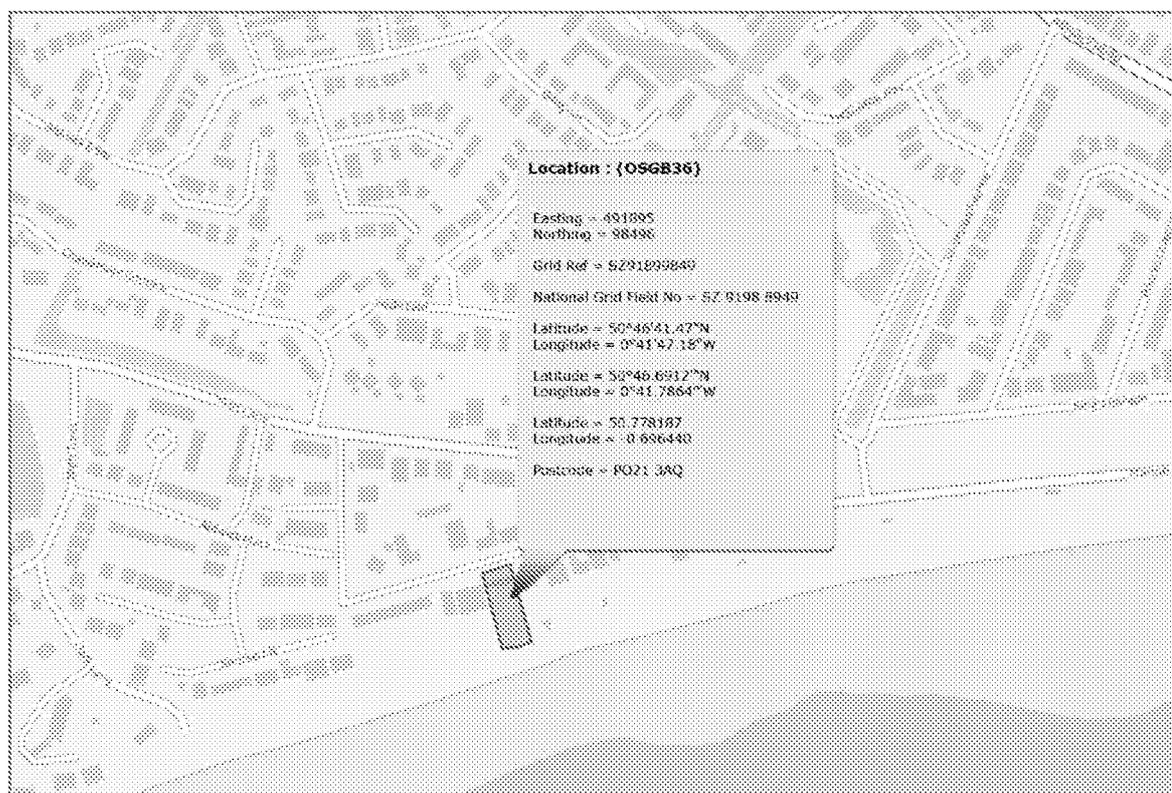


Figure 1 - Site Location Plan (site bordered red) Source: Location Map

- 2.3 This FRA has been written in general accordance with the National Planning Policy Framework (NPPF) and its Technical Guidance, Environment Agency (EA) Standing Advice, LFRMS, County SFRA and associated guidance. This FRA has relied upon publicly available information and data provided from the EA (where relevant). The interpretation of this data has been undertaken with the understand of its accuracy and to a detail deemed suitable for this development type, location and relevant flood risk.

DEVELOPMENT PROPOSALS

- 2.4 The development proposals are for extensions and renovations to the existing dwelling, mainly comprising works to the first floor, extending the first floor to add additional bedrooms. Architectural proposals are included in Appendix 1.
- 2.5 The works are an 'Extension of the Existing Use' and therefore will be assessed under the EAs Standing Guidance for Minor Extensions.

FLOOD RISK ASSESSMENT SCOPE

- 2.6 The purpose of this FRA is to inform the feasibility and appropriateness of the proposals and to ensure the development proposals incorporate flood resilient measures appropriate to its flood risk.
- 2.7 It should be noted, where up to date flood risk or climate change models are not available, best efforts have been made to assess these risks and extrapolate the available data where necessary. However, this approach may require

further detailed modelling if deemed necessary by the reviewing authorities. Detailed hydraulic modelling is deemed outside the scope of this report.

FLOOD RISK VULNERABILITY

- 2.8 This FRA has been undertaken with due regard to the statutory requirements of the NPPF and with reference to the Planning Practice Guidance (PPG) in relation to development and flood risk. This FRA has been undertaken to inform on the current flood risk to the site. Therefore, this FRA aims to ensure that the development proposals consider the site-specific flood risk and to avoid inappropriate development in areas potentially at risk of flooding.
- 2.9 Annex 3 of the NPPF Flood Risk Vulnerability Classification provides guidance on assigning development vulnerability. A summary of this information is provided in Table 1.

Table 1 – Extract from Annex 3 of the National Planning Policy Framework and Table 2: Flood risk vulnerability classification of PPG detailing Flood Risk Vulnerability Classification by use. (Existing Site Classification is Shaded Gray, Proposed Site specific classification shaded blue).

| ESSENTIAL INFRASTRUCTURE | HIGHLY VULNERABLE | MORE VULNERABLE | LESS VULNERABLE | WATER-COMPATIBLE |
|---|---|--|---|--|
| Essential transport infrastructure | Police and ambulance stations; fire stations and telecom installations | Hospitals | Police, ambulance and fire stations which are not required to be operational during flooding. | Flood control infrastructure. |
| Essential utility infrastructure which has to be located in a flood risk area for operational reasons | Emergency dispersal points. | Residential institutions such as residential care homes, prisons and hostels. | Buildings used for commercial purposes and of a non-residential nature | Water transmission infrastructure and pumping stations. |
| Wind turbines. | Basement dwellings. | Buildings used for dwelling houses and sleeping, drinking establishments | Land and buildings used for agriculture and forestry. | Sewage transmission infrastructure and pumping stations. |
| Solar farms. | Caravans, mobile homes and park homes intended for permanent residential use. | Non-residential uses for health services, nurseries and educational uses | Waste treatment (except landfill* and hazardous waste facilities). | Sand and gravel working. |
| | Installations requiring hazardous substances consent. | Landfill* and sites used for waste management facilities for hazardous waste. | Minerals working and processing (except for sand and gravel working). | Docks, marinas and wharves and Navigation facilities. |
| | | Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan. | Water treatment and Sewage treatment works which do not need to remain operational during times of flood. | Ministry of Defence installations. |

- 2.10 The site is presently considered 'More Vulnerable' in accordance with Table 1 and the NPPF.
- 2.11 The development proposals are considered 'More Vulnerable' and an extension of the existing use.

3 FLOOD RISK ASSESSMENT SCOPE

- 3.1 Flood risk as defined by the NPPF, is a combination of the probability and the potential consequences of flooding. Areas at risk of flooding are those at risk of flooding from any source, now or in the future. Sources include rivers and the sea, direct rainfall on the ground surface, rising groundwater, overwhelmed sewers and drainage systems, reservoirs, canals and lakes and other artificial sources. Flood risk also accounts for the interactions between these different sources. This term is key to the application of the presumption in favour of sustainable development in paragraph 11 of the National Planning Policy Framework (NPPF).
- 3.2 The NPPF requires flood risk to be considered on all sites, however more detailed site-specific FRA's are required when one or more of the following criteria apply to the site:
- Where a site is affected by the **Design Flood Event** (DFE) from any source (typically the 1% AEP) for all proposals of any new development (including minor development and change of use); or
 - Greater than 1 ha in size and located in Flood Zone 1; or
 - Located in Flood Zone 1 where there are critical drainage problems or within a designated Critical Drainage Area (CDA) as notified to the LPA by the Environment Agency; or
 - Subject to a change of use to a higher vulnerability classification which may be subject to other sources of flooding; or
 - A Major planning application (i.e. more than 10 residential dwellings).
- 3.3 The NPPF designates that the '**Design Flood Event**' (DFE) is used to assess the suitability of a development proposal against the criteria of the NPPF. The design flood, is a flood event of a given annual flood probability, but is generally taken as:
- River flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year), typically shown as Flood Zone 3a as designated on the EA's Flood Map for Planning; or
 - Tidal flooding with a 0.5% annual probability (1 in 200 chance each year), typically shown as Flood Zone 3a as designated on the EA's Flood Map for Planning; or
 - Surface water flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year), typically shown as the Medium Risk of Surface Water flooding as designated on the EA's Long Term Flood Risk mapping,
- 3.4 In addition to assessing present day risk, the DFE also must be assessed to include and appropriate allowance for climate change (refer to Section 4.8 for climate change allowances) based on the site's geographical location, vulnerability and design life.
- 3.5 For this FRA, the worst case DFE (whether this be from tidal, river or surface water sources), has been used to steer the recommendations of this report. Consideration of extreme events above that of the DFE have not been considered further beyond identifying these as residual risks.
- 3.6 Table 1 of the NPPF provides definitions of the Flood Zones, from low to high probability of river and sea flooding and in regard to surface water flood risk. These Flood Zone Classification for the purpose of this FRA are:
- Flood Zone 1 - land assessed as having a less than a 1 in 1,000 annual probability (<0.1%);
 - Flood Zone 2 - land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river (1% – 0.1%), 1:100 year or greater of surface water flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year;
 - Flood Zone 3 - land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year. Flood Zone 3b is land have greater than 1 in 20 to 1 in 30 year annual probability of flooding.

3.7 Following an assessment from the various sources of flood risk for the DFE, this site-specific FRA has applied the key principles for decision making when flood risk is a consideration and includes in order of importance:

1. **Avoid** – This is to physically locating the development proposals to areas of lowest flood risk within the site and/or determined how to vertically place the proposals to such that more vulnerable uses are positioned above the design flood level (such as raising floor levels or placing more vulnerable uses on upper levels). Developers should refer to the BS 85500:2012-Flood resistant and resilient construction. Guide to improving the flood performance of buildings for applicable strategies);
2. **Control** - Planning authorities and developers can investigate measures to control the risk of flooding affecting the site (this may be through flood defences, flood gates, flood storage or other engineered solutions such as SUDS). This is rarely applied at the site level and is mostly address through strategic and county level flood defence strategies. At this site level, typically this will be through applying a Water Exclusion or Water Entry strategy when design a building or space.
3. **Mitigate** – Is the use of flood resistance and resilience measures to address any residual risks remaining after the use of the avoidance and control measures described above. Passive measures should be prioritised over active measures as they are likely to be more effective and more reliable. Flood Resilience is an approach to building design which aims to reduce flood damage and speed recovery and reoccupation following a flood. It uses a combination of flood resistance and recovery measures (referred to here as resilience measures), and is described in the industry-developed CIRIA Property Flood Resilience Code of Practice, which provides advice for both new-build and retrofit.
4. **Managing Residual Risk** – this will usually involve ensuring either safe access and egress is available from the site in a DFE, Flood Warning Systems/Evacuation Plans are in place, safe refuge is on site during a DFE, the building is designed to account for flood loadings etc.
5. **Flood Risk is not increased elsewhere** – assuming all the above items can be address, it is critical that the development does not increase flood risk elsewhere as a result. Typically this is addressed by ensuring flood waters are not displaced (in surface water or river flood affected areas, the loss of floodplain storage is less likely to be a concern in areas benefitting from appropriate flood risk management infrastructure or where the source of flood risk is **solely** tidal.) or appropriate hydraulic modelling is provided in support of an application to demonstrate that flood risk is not increased outside of a site (such as through on site flood compensation or detailed site specific hydraulic modelling).

3.8 It should be noted, where up-to date flood risk or climate change models are not available, best efforts have been made to assess these risks and extrapolate the available data where necessary. However, this approach may require further detailed modelling if deemed necessary by the reviewing authorities. Detailed hydraulic modelling is deemed outside the scope of this report.

SEQUENTIAL TEST/EXCEPTION TEST

3.9 For the purpose of this assessment, the application of the Sequential Test has been broken down into three levels. Passing the Sequential Test at the strategic level is a weighting of the risks versus benefit of a development against a wider criterion (such as meeting other sustainability targets, housing needs or other strategic planning goals) than just purely avoiding flood risk issues. However, the Sequential Test can also be applied at the site level, where development is steered towards lower areas of flood risk within a site boundary, and is much more objective in its assessment. For the purpose of this FRA, the assessment 'Level' of the Sequential Test is considered to be:

Level 1 - At the high-level, this test is first implemented by local planning authorities (LPA) at the strategic planning scale. The Sequential Test is applied to steer local planning policy by directing particularly vulnerable new developments (e.g., residential, hospitals, mobile homes etc.) outside of the floodplain and for designating new land uses and future development areas.

Level 2 - At the second instance, the Sequential Test is implemented for a specific development at the request of the LPA to assess other sites within an area defined by the LPA, this type of Sequential Test is present where there is a significant conflict between a proposed development and flood risk.

Level 3 - The third instance is where the Sequential Test is applied with the confines of the site, namely by steering development proposals to **avoid** areas of flood risk within a site itself.

3.10 Application of the first and second level of the Sequential Test is deemed outside the scope of this report.

ENVIRONMENT AGENCY FLOOD RISK DESIGNATION

3.11 Table 2 below presents a helpful guide in identifying the suitability of a site prior to applying Level 1 and 2 of the Sequential Tests and identifies when the Exception Test is required.

Table 2 - The Sequential Test: Flood Risk Vulnerability and Flood Zone 'Compatibility' Table as specified by NPPF. Shaded cells denote the proposed re-development. Please note: ✓ means development is appropriate; x means the development should not be permitted and should be subject to a full sequential test. Refer to Table 2 for selected Flood Zone Designation

| FLOOD RISK VULNERABILITY CLASSIFICATION | ESSENTIAL INFRASTRUCTURE | WATER COMPATIBLE | HIGHLY VULNERABLE | MORE VULNERABLE | LESS VULNERABLE |
|---|--------------------------|------------------|-------------------------|-------------------------|-----------------|
| Zone 1 | ✓ | ✓ | ✓ | ✓ | ✓ |
| Zone 2 | ✓ | ✓ | Exception Test Required | ✓ | ✓ |
| Zone 3a | Exception Test Required | ✓ | x | Exception Test Required | ✓ |
| Zone 3b | Exception Test Required | ✓ | x | x | x |
| Functional Floodplain | Exception Test Required | ✓ | x | x | x |

3.12 Based on the principles above, a development of this nature is considered appropriate and acceptable and full application of the Sequential Test is not deemed necessary at this time (as per the EAs Standing Advice). Therefore, this FRA presents the findings of the Exception Test and recommendations for incorporation of flood resilient measures to improve long term flood resilience of the proposals.

3.13 The following sections undertakes further analysis of the data available from the Local and District Council and EA data sets relating to flooding from several sources.

3.14 Table 3 summarises the sites primary flood risk classifications and the source for the DFE. This designation is based on the EA's Flood Map for Planning (extract provided in Figure 2) and the EA's Long Term Flood Risk Maps (LTFRM): Risk of Flooding from Surface Water (RoFSW) (extract provided in Figure 3).

3.15 Based on the EA's Flood Maps for Planning data, the primary flood risk to the site is from the English Channel to the south and is purely tidal in nature. The site is not affected by either fluvial or surface water flooding and is therefore not investigated further within this FRA.

Table 3 - Summarises the overall Flood Zone designation based on the highest rated flood risk from either rivers and sea or surface water.

| FLOOD ZONE AND SOURCE IDENTIFICATION SUMMARY | | | |
|--|--------------------------------|--------------------------|--|
| | FLOOD ZONES AFFECTING THE SITE | | DOMINANT SOURCE FOR THE DESIGN FLOOD EVENT (DFE) |
| | Flood Zone 2 (medium risk) | Flood Zone 3 (high risk) | Source |
| River | No | No | Tidal Flooding |
| Sea | Yes (Partial) | Yes (Partial) | |
| Surface Water | No | No | |

**Flood Zone Designation for assessment is based on the highest flood risk from river, sea or surface water flooding taken from EA's Flood Map for Planning and EA's LTFRM:RoFSW*

4 LOCAL FEATURES

NEAREST WATER BODIES

- 4.1 The site borders the English Channel along its southern boundary. There is no other major water courses located within 500m of the site.

TOPOGRAPHY

- 4.2 The site is relatively flat, the existing dwelling sits at approximately 5.70m AOD. The shingle beach is slightly raised along its southern boundary, reaching a crest level of around 6.3m. This review is based on 1m LIDAR grid data.
- 4.3 Figure 4 below provides long and cross-sectional data through the site demonstrating an approximation of existing site levels based on the available LIDAR information.

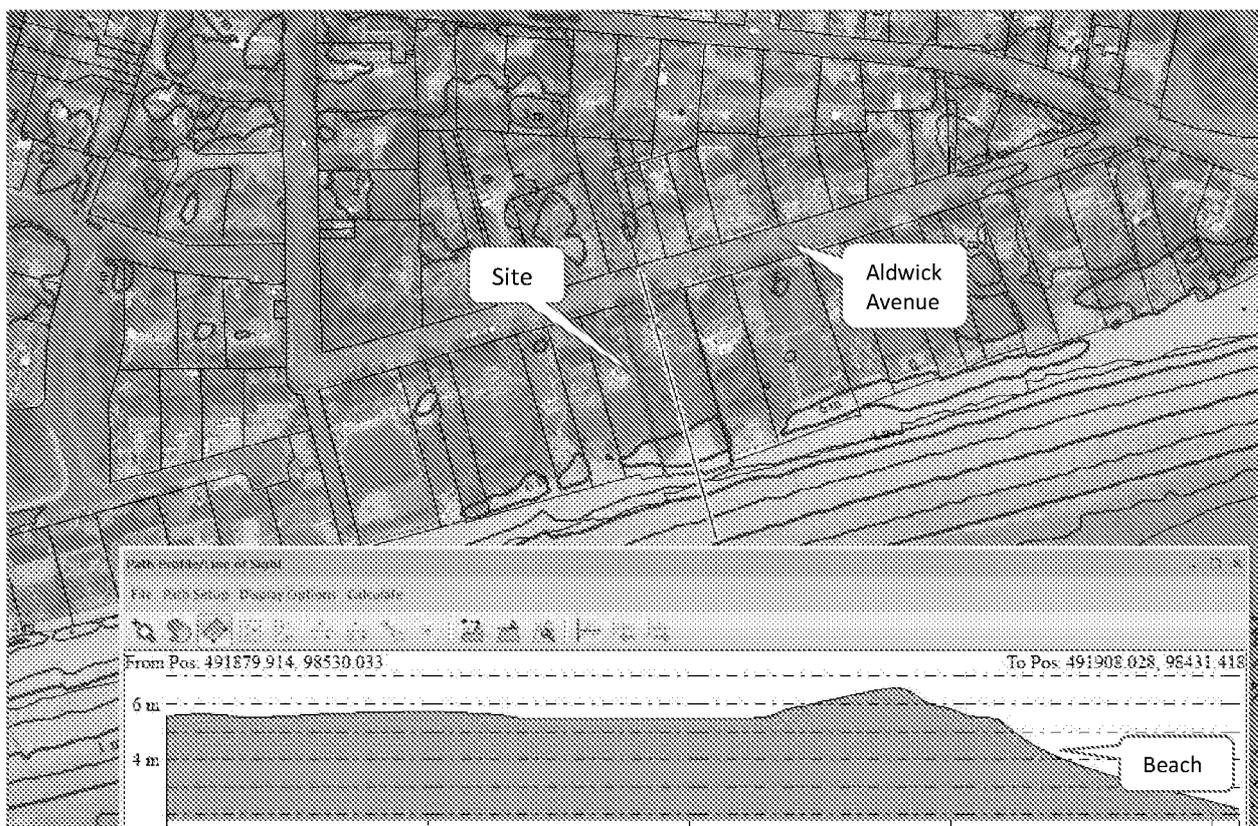


Figure 4 -- Top: Terrain profile (North to South), Bottom: East to West (source: DEFRA Lidar Data 1m)

GEOLOGY & HYDROGEOLOGY

- 4.4 The online British Geological Survey (BGS) (Figure 5) shows the site to be underlain by 1:50 000 scale bedrock geology description: London Clay Formation - Clay, silt and sand. River Terrace Deposits - Sand, silt and clay Superficial deposits recorded.

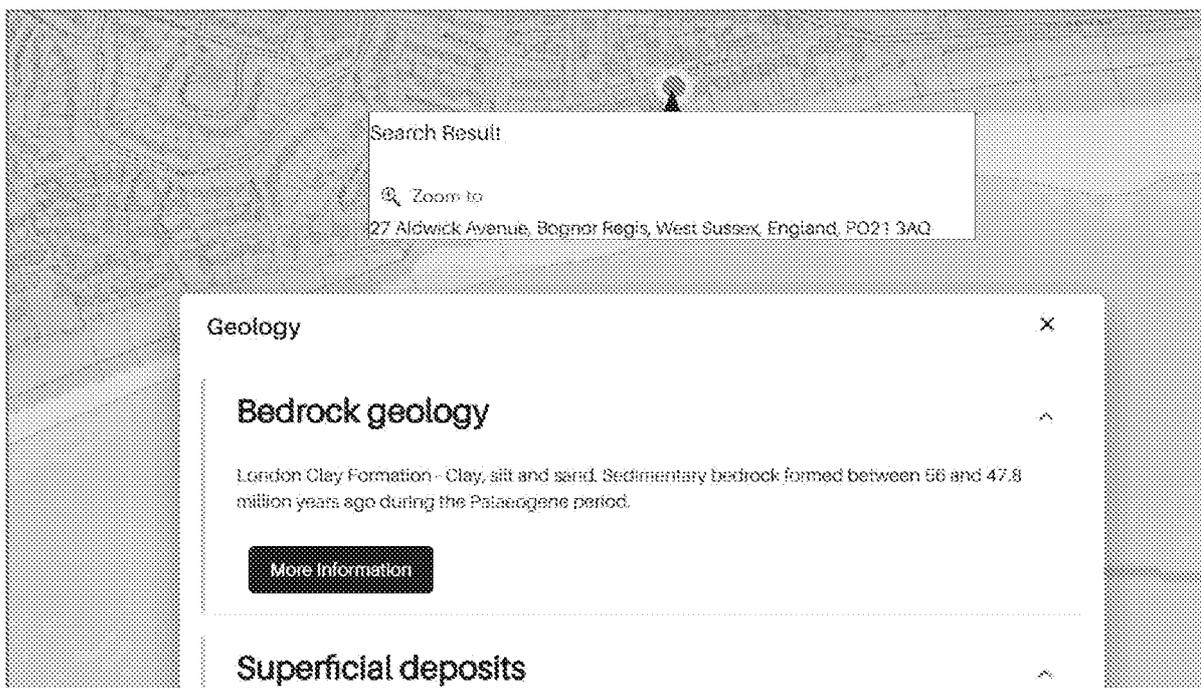


Figure 5 extract from BGS Bedrock and Superficial Deposits Mapping (source: BGS)

4.5 Table 4 below present a summary of the site hydrogeological classifications and considerations.

Table 4 - Summary of Hydrogeology Classifications (source Magic Map, BGS) – applicable classification shaded Blue

| HYDROGEOLOGY CLASSIFICATIONS | | | |
|--|-----------|-------------|--------------|
| Aquifer Designation (Bedrock) | Principle | Secondary | Unproductive |
| Aquifer Designation (Superficial) | Principle | Secondary | Unproductive |
| Groundwater Vulnerability | High | Medium | Low |
| Located within Source Protection Zone | Yes | No | N/A |
| Soluble Rock Risk | Present | Not Present | N/A |

4.6 The BGS GeoIndex: Borehole Records provides publicly available borehole data at locations around England. These can provide general information relating to groundwater and can provide greater insight into site specific ground conditions. The closest BGS Borehole record at BGS ID: 16054838 : BGS Reference: SZ99NW45 approximately 300 to the east, shows standing groundwater level approximately 6.4m below ground level.

4.7 However, the BGS data should be taken as only indicative and should not be relied upon for detailed design of surface water management systems and during construction. Details of groundwater levels and soil permeability are unknown and should be confirmed. The design permeability should be investigated further for the purpose of surface water management on the site.

FLOOD DEFENCES

4.8 The Environment Agency releases a range of flood asset information as Open Data through their AIMS Defence (Spatial Flood Defences) GIS mapping. They are the only comprehensive and up-to-date group of datasets in England that show flood defences currently owned, managed or inspected by the EA. Based on the EA and SFRA data, the site is protected the shingle beach (which is maintained by the local authority), and may provide some nominal protection in an extreme event.

5 CLIMATE CHANGE

- 5.1 In 2022, the EA issued updated guidance on the impacts of climate change on flood risk in the UKCP18 to support the NPPF. This guidance sets out that peak rainfall intensity, sea level, peak river flow; offshore wind speed and extreme wave heights are all expected to increase in the future because of climate change.
- 5.2 The guidance acknowledges that in relation to certain factors there is considerable uncertainty with respect to the absolute level of change that is likely to occur. As such, in these instances, the guidance provides estimates of possible changes that reflect a range of different emission scenarios (Table 5).

Table 5 - Extract from NPPF designating Flood Risk Climate Change Allowances by Flood Zone and Use. The developments required climate change probability scenario is highlighted blue

| FLOOD ZONE | ESSENTIAL INFRASTRUCTURE | HIGHLY VULNERABLE | MORE VULNERABLE | LESS VULNERABLE | WATER COMPTABLE |
|------------|------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------|
| 1/2 | Higher Central and Upper End | Higher Central and Upper End | Central and Higher Central | Central | None of these allowances |
| 3a | Upper End | Development should not be permitted | Higher Central and Upper End | Central and Higher Central | Central |
| 3b | Upper End | Development should not be permitted | Development should not be permitted | Development should not be permitted | Central |

INCREASES IN SEA AND TIDAL LEVELS

- 5.3 There are a range of allowances for each river basin district and epoch for sea level rise. They are set out in *Table 1: sea level allowances by river basin district for each epoch in mm for each year (based on a 1981 to 2000 baseline) – the total sea level rise for each epoch is in brackets of the NPPF: Flood risk assessments: climate change allowances* and are based on percentiles. A percentile describes the proportion of possible scenarios that fall below an allowance level.
- 5.4 The allowances in the NPPF account for slow land movement. This is due to ‘glacial isostatic adjustment’ from the release of pressure at the end of the last ice age. The northern part of the UK is slowly rising, and the southern part is slowly sinking. This is why net sea level rise is less for the north-west and north-east than the rest of the country.
- 5.5 For flood risk assessments and strategic flood risk assessments, sites should assess both the higher central and upper end allowances for more vulnerable developments.
- 5.6 The Sea and Tidal Sea level increases for the site based on the geographic region are summarised in Table 6:

Table 6 – information taken from Table 1 (NPPF): sea level allowances for river basin district for each epoch in mm for each year (based on a 1981 to 2000 baseline) – the total sea level rise for each epoch is in brackets

| Area of England | Allowance | 2000 to 2035 (mm) | 2036 to 2065 (mm) | 2066 to 2095 (mm) | 2096 to 2125 (mm) |
|-----------------|----------------|-------------------|-------------------|-------------------|-------------------|
| South East | Higher Central | 5.7 (200) | 8.7 (261) | 11.6 (348) | 13.1 (393) |
| | Upper End | 6.9 (242) | 11.3 (339) | 15.8 (474) | 18.2 (546) |

- 5.7 Based on the area of England the site is located within, the design flood level should account for the whole design life of the proposals to 2125. The available modelling data from the EA has been completed to 2121, and therefore an additional 4 years of sea level rise should be included.

6 SOURCES OF FLOOD RISK

6.1 To assist the implementation of the Governments NPPF, the EA has undertaken national scale flood risk mapping. This mapping considers a range of sources including flooding from rivers, sea, surface water and reservoir breach. Furthermore, each Council produces a Strategic (county scale) Flood Risk Assessments (SFRA) that aim to specifically identify local flood risk issues (such as critical drainage areas and local groundwater flooding).

6.2 The following section reviews both the EA data as well as the relevant information available from the SFRA.

TIDAL (SEA)

6.3 The SFRA have undertaken fluvial and tidal modelling within the district and includes Flood Zone Future Flood Zone up to the 2111 (Figure 6 below). This shows that the site and dwelling will be affected by flooding into the future.

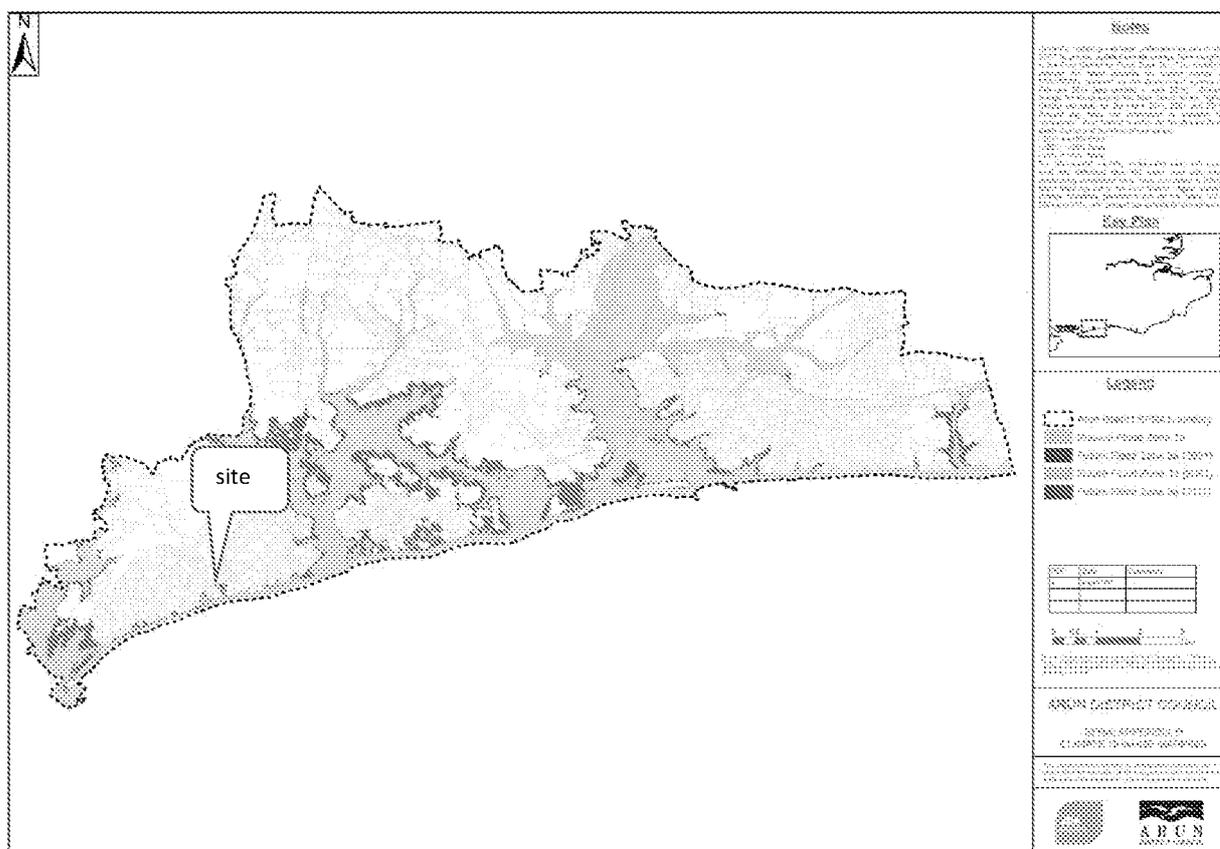


Figure 6 – SFRA Climate Change Flood Mapping (source Environment Agency Flood Maps)

6.4 However, Figure 7 below provides an extract from the EA's Product 5 and 6 data (file reference: AtoEH_T200_UKCP18_95_2121_UDef_h_Max) and shows the 1 in 200 year (0.5% AEP) 2121 flood extents. This data has therefore been used to analyse flood risk to the site and to determine a design flood level (DFL) as it is more up to date and includes tidal flood depths up 2121.

6.5 The undefended scenario has been used, as these present the worst scenario in terms of flooded depths.



Figure 7 - extract from the Product 5 and 6 (Chichester SFRA Modelling by JBA October 2022).

- 6.6 Based on the EA model data, the maximum design flood level (DFL) (including 72.8mm allowance for the additional 4 years from 2121 to 2125 not covered in the model) is 5.369mAOD (5.296mAOD + 0.0728mm).
- 6.7 Based on an approximate existing ground level of the dwelling of 5.7mAODq, and a DFL of 5.369mAOD, the dwelling will remain wholly unaffected by flooding in the 1 in 200 year event.
- 6.8 Therefore, the development proposals can be considered to follow the EA's Standing Advice for minor extensions and is not considered to increase flood risk within the site or external to the site.

HISTORICAL, SEWERS AND DRAINAGE

- 6.9 A common source of flooding is a result of sewer or other drainage infrastructure becoming surcharged and flooding. The SFRA does not directly present any records relating to historical flooding directly impacting the site, however, it does highlight that they can suffer from tide lock of rivers and any associated outfalls into these systems. This has been known in the past to cause flooding in a combined high tide/storm surge and rainfall event.
- 6.10 The EA have confirmed that there are no historical records of flooding affecting the site directly.
- 6.11 There have been no other noted flood events specifically at the site, however this does not directly indicate that the site has not flooded in the past or may flood in the future.
- 6.12 Therefore, it is considered the risk of sewer flooding to the site is considered low, if any new development flows include appropriate protective measures to manage runoff and not increase the risk of sewer flooding.

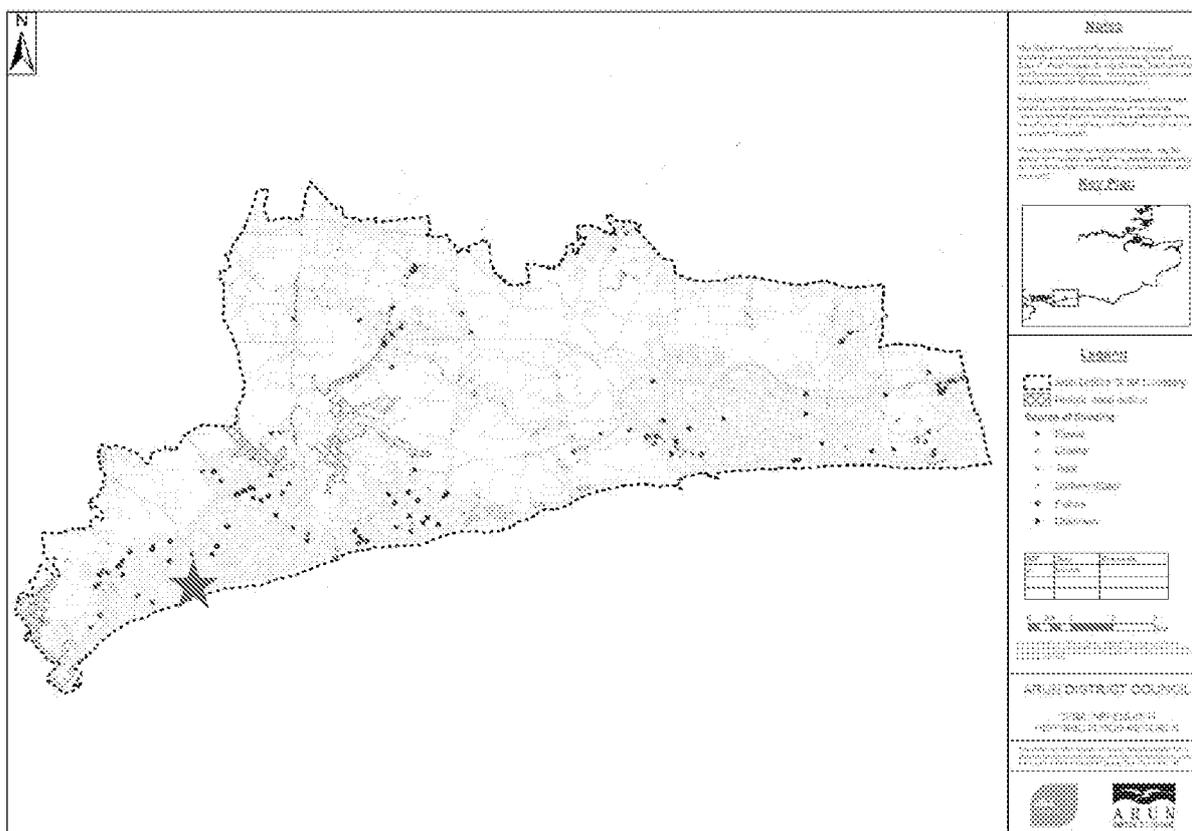


Figure 8 - extract from SFRA Appendix B - Historical Flooding (star marks approximate site location).

GROUNDWATER

- 6.13 Groundwater flooding is the emergence of groundwater at the ground surface or into subsurface voids arising as a result of:
- ⇒ abnormally high groundwater heads or flows;
 - ⇒ the introduction of an obstruction to groundwater flow; or
 - ⇒ the rebound of previously depressed groundwater levels.
- 6.14 Groundwater flooding usually occurs following a prolonged period of low intensity rainfall. As groundwater flow is much slower than surface flow, the flooding may not recede for long periods of time, typically weeks or even months. It is important to recognise the risk of groundwater flooding is typically highly variable and heavily dependent upon local geology, topography and weather conditions, as well as local abstraction regimes. Groundwater flooding is hard to predict and challenging to mitigate.
- 6.15 Groundwater susceptibility maps are typically designed for planners, identifying areas where groundwater flooding might be an issue. The computer models used to classify areas produces maps with a pixel size of approximately 50 metres. Because of this coarse resolution it is possible that the actual susceptibility at your property may be different due to small-scale variations in rock and soil type and local landscape. It's important to note that Susceptibility is not the same as risk. These maps show where there is the potential for groundwater flooding but do not give any indication of the probability that it will occur.
- 6.16 The SRFA, shows that the site is in an area where groundwater emergence risk is very low (<25%) (see Figure 9). In addition, BGS borehole data suggests groundwater levels may be as much as 6.4m below ground level, further suggesting the risk of groundwater emergence at the site is likely to be very low. However, it should be noted that groundwater depths so close to a tidal body can be influenced by change in tidal ranges.

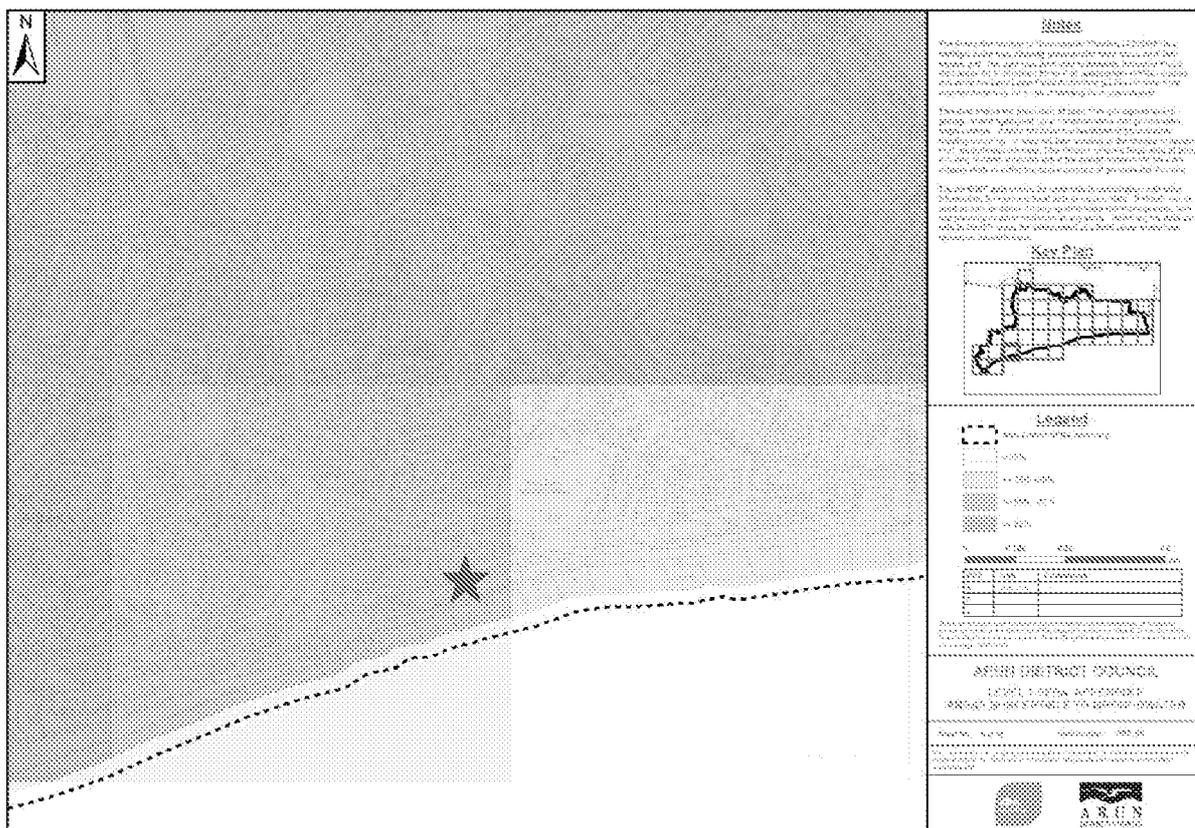


Figure 9 extract from ARUN Groundwater flood map risks (star marks approximate site location).

6.17 So, although information from the maps can be used to highlight an area at risk, it is not designed to be used as a sole indicator of groundwater flooding susceptibility and risk at individual properties. The BGS and SFRA recommend the following for assessing site specific risk:

1. Review BGS geological maps or and BGS (or site specific) borehole records for information on water strikes and groundwater levels. Where underlying geology of is sufficiently permeable, this may allow groundwater to rise more freely and frequently
2. Review the RoFSW mapping, should groundwater emerge at surface, its flow path can be estimated by looking at the RoFSW mapping. However, it should be noted that groundwater flows at surface are a lot lower than surface water runoff events, however groundwater flows may occur over a longer period. Therefore, the risk event assessed for the DFE for groundwater flooding is the high-risk surface water event (or the 1 in 30 year event).
3. Review historical records and SFRA mapping, for example, if a specific property has experienced groundwater related flood risk in the past. This is often the best indicator of site-specific risk for groundwater flooding and can carry the most weighting in assess risk.

6.18 Table 7 below provides a summary of groundwater flood risk indicators as advised by the BGS. It is considered that if any of these risk indicators are negative (or not present), then the overall risk of groundwater emergence is likely to be low. However, this would not mean that groundwater may not pose a risk to lower ground floor uses if groundwater is recorded within 1m of the lowest level of the building. In which, the building design should account for groundwater being present and account for this in the construction and waterproofing of the building.

Table 7 - Summary of groundwater flood risk indicators to the site

| GROUNDWATER FLOOD RISK SUMMARY | | |
|--|--|--------------|
| Data Source | Risk Indicator | Risk Present |
| BGS Geological Maps | Is the underlying geology permeable (such as gravels and sands) and may allow free flow of groundwater | Yes |
| BGS/Site Borehole Data | Is the depth to Groundwater less than 1m | No |
| Surface Water Flood Risk | Is there surface water flood risk present in the high-risk 1 in 30 year event. | No |
| Historical Records | Does the SFRA include any records of groundwater flooding occurring at the site | No |
| SUMMARY OF GROUNDWATER FLOOD RISK | | LOW |

Impacts of Climate Change

6.19 The potential effects of climate change on groundwater levels are uncertain. Greater seasonality in groundwater level fluctuation is a potential outcome under a pattern of higher winter rainfall and less summer rainfall. Broad predictions of the impacts of climate change on groundwater levels are difficult to make at the present time

RESERVOIR

6.20 Reservoir flooding is very different from other forms of flooding. It may happen with little, or no warning and evacuation will need to happen immediately. The likelihood of such flooding is difficult to estimate, but it is less likely than flooding from rivers or surface water. It may not be possible to seek refuge upstairs from floodwater as buildings could be unsafe or unstable due to the force of water from the reservoir breach or failure. The risk of inundation to the study area because of reservoir breach or failure of a number of reservoirs within the area was assessed as part of the National Inundation Reservoir Mapping (NIRIM) study. Several reservoirs are located within the study area. However, there are also reservoirs outside of the area whose inundation mapping is shown to affect the study area. Maps of the flood extent can be found on the Government’s Long term flood risk information website.

6.21 The EA has undertaken failure scenarios of the UK reservoirs and summarised these extents through their Long-Term Flood Risk Maps for Reservoir Flooding. Figure 10 shows that the site is at low-risk flooding from this source.

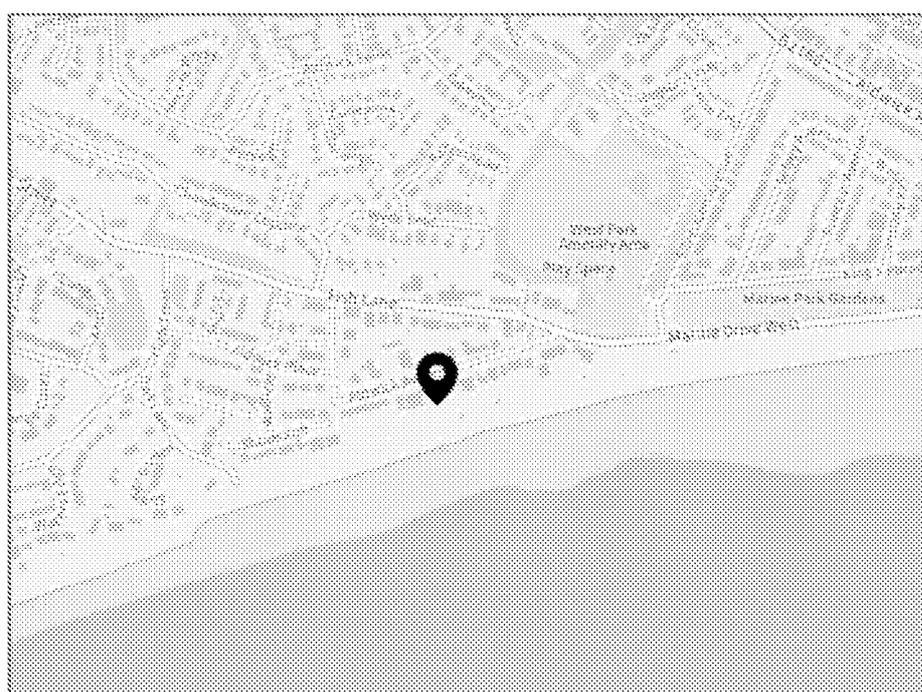


Figure 10 extract from EAs LTFRM Reservoir Flood Risk (cross hair marks approximate site location)

RESIDUAL RISKS

6.22 Residual risks are those remaining after applying the sequential approach to the location of development and taking mitigating actions. Examples of residual flood risk include:

- the failure of flood management infrastructure such as a breach of a raised flood defence, blockage of a surface water conveyance system, overtopping of an upstream storage area, or failure of a pumped drainage system;
- failure of a reservoir, or;
- a severe flood event that exceeds a flood management design standard, such as a flood that overtops a raised flood defence, or an intense rainfall event which the drainage system cannot cope with.

6.23 Given that the site is above the highest DFL, the primary risk to the site is residual failure of onsite drainage or an extreme exceedance event.

7 BUILDING MATERIAL MITIGATIONS

7.1 The national government produced guidance for improving the flood resilience of building in the Communities and Local Government (CLG) 2007 'Improving the Flood Performance of New Buildings' publication. This publication provides recommendations on how to protect buildings in the case of a flood event, and propose two scenarios based on maximum expected flooded depths, and provides an explanation between flood resistance and resilience measures, these are summarised below:

- ⇒ **Water exclusion strategy** is when the emphasis is placed on minimising water entry whilst maintaining structural integrity, and on using materials and construction techniques to facilitate drying and cleaning. This strategy is favoured when low flood water depths are involved (not more than 0.3m). According to the definitions adopted in this Guidance, this strategy can be considered as a resistance measure, but it is part of the aim to achieve overall building resilience
- ⇒ **Water entry strategy** is when the emphasis is placed on allowing water into the building, facilitating draining and consequent drying. Standard masonry buildings are at significant risk of structural damage if there is a water level difference between outside and inside of about 0.6m or more. This strategy is therefore favoured when high flood water depths are involved (greater than 0.6m) by utilising resilient materials, and construction methods.
- ⇒ **Flood resistant measures** are incorporated where it is considered feasible to prevent floodwater entering the building and take the form of flood barriers. Many flood resistant products/barriers are only suitable to typical maximum height being 0.68m, before the risk of structural damage is incurred. As this is a historic structure with limited scope for structural reinforcement.
- ⇒ **Flood resilient measures** are incorporated where it is accepted that, in severe flood events, water may enter parts of the building so it is necessary to ensure the building will remain useable after the floodwater has receded and the area has been cleaned. Therefore, materials should be incorporated that retain their structural integrity and have good drying and cleaning properties or are waterproof, and services and sockets etc. are located as high as practical to minimise flood damage.

7.2 Given the primary risk is related to surface water flooding most likely from an exceedance event or failure of onsite drainage, it is considered that some key principles of the **Water Exclusion Strategy** should be adopted for the buildings on the site. Some simple construction measures can greatly protect buildings during such an event without incurring large additional construction costs. Further detail can be found at <https://assets.publishing.service.gov.uk/> and within BS 85500:2012-Flood resistant and resilient construction. Guide to improving the flood performance of buildings for applicable strategies.

8 FLOOD MITIGATION MEASURES

- 8.1 The proposals allow the opportunity to improve flood resilience of the site by incorporating a number of flood mitigation measures, both through the incorporation of flood resilient building materials, surface water drainage improvements and signing up to the EA Flood Warning/Alert System.
- 8.2 Table 8 presents the key flood mitigation measures based the critical DFE on the NPPF and PPG decision making principles:

Table 8 - Key Decision Making principles and measures applied to avoid, control, mitigate, and manage flood risk

| DECISION MAKING: ORDER OF PRIORITY | PROPOSED MEASURES |
|--|--|
| 1. Avoid | The proposed works are shown to be sequentially located on land/above all modelled DFEs. Therefore, the proposals have been designed to avoid flooding of the dwelling for all DFEs and flood risk to the proposals is generally considered to be low. |
| 2. Control | Surface Water Drainage systems should be designed to accommodate the 1 in 100 year plus climate change DFE (where possible). |
| 3. Mitigate | Recommend that the developer incorporates the recommendations of BS 85500:2012-Flood resistant and resilient construction. Refer to Section 7 above for recommended Building Measures |
| 4. Manage residual flood risk | Users should sign up to EAs Flood Warning and Alert System |
| 5. Flood Risk is not increased elsewhere | Any new drainage should be designed in accordance with Building Regulations Part H, SuDS Manual and 'DCG' guidance, ensuring drainage proposals include an allowance for climate change; |

9 CONCLUSION

- 9.1 A review of flood risk from all sources, has been undertaken, and flood risk is considered low from all sources assessed (including Tidal, Fluvial, Surface Water, Groundwater and Sewer flood risk).
- 9.2 To assist in mitigating the present flood risk to the site's users based on the development proposals, several recommendations have been discussed, the core of these include:
- Where possible, retrofit the existing site drainage to cater for climate change impacts. Any new drainage should be designed in accordance with Building Regulations Part H, SuDS Manual and 'DCG' guidance, ensuring drainage proposals include an allowance for climate change;
 - Users sign up to the EA Flood Warning and Alert System;
 - Adopt the measures (as applicable) within Local Government (CLG) 2007 'Improving the Flood Performance of New Buildings' publication.
- 9.3 This report demonstrates that the proposals could be accommodated within the site by in accordance with the EA guidance, Council SFRA, and the NPPF. It is considered that as long as the development follows the advice presented in this report, that the development proposals may be considered appropriate at this location.

APPENDIX 1 – ARCHITECTURAL PROPOSALS

APPENDIX 2 – EA DATA