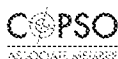




FloodSmart Plus

Site address	Little Meadow, Yapton, West Sussex, BN18 0JY
Site coordinates	497649 101823
Report prepared for	Ava Lettings Ltd 66 Flansham Lane Felpham Bognor Regis West Sussex PO22 6AH
Report reference	73344.01R2
Report status	FINAL
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Report author	Alexandra Sherred Consultant
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1. Executive summary

A review has been undertaken of national environmental data sets to assess the flood risk to the Site from all sources of flooding in accordance with The National Planning Policy Framework (NPPF) (2019) and National Planning Practice Guidance (NPPG) (2014). A site-specific flood risk assessment, to assess the flood risk to and from the development site, is provided within this concise interpretative report written by an experienced GeoSmart consultant. Baseline flood risk and residual risks that remain after the flood risk management and mitigation measures are implemented are summarised in the table below.

Site analysis

Source of Flood Risk	Baseline	After Analysis and Mitigation
River (fluvial) and Sea (coastal/tidal)	Negligible to Low	Very Low
Surface water (pluvial) flooding	Very Low	Very Low
Groundwater flooding	Low to Moderate	Low
Other flood risk factors present	No	N/A
Is any other further work recommended?	Yes	Yes (see below)

N/A = mitigation not required

The majority of the existing Site is greenfield including areas of open lawn and horse grazing, with an area of commercial development located in the northeast of the Site.

The Site is identified within Appendix 1.1 of Arun District Council's HELAA (2019) as a 'Deliverable Site' under reference HELAA 46 (Land East of Bilsham Road, Adjacent to Little Meadow, Yapton), which has a potential yield for 99 residential houses.

Development proposals comprise the construction of 81 dwellings, including associated access as well as an enlarged employment area and landscaped open park spaces.

Sustainable Drainage Scheme (SuDS) features are proposed to manage surface water runoff from the development, as well as providing amenity and ecological benefits.

Shallow ground level raising is proposed in the south western Site areas to avoid any risk of tidal flooding over the maximum lifespan of the development, this would also reduce the risk of groundwater emergence to a minimum. This ground level raising will ensure the Site is not located within future Flood Zone 3a, negating any requirements for the Sequential and Exceptions Tests.

The flood risks from all sources have been assessed as part of this report and are as follows:

- According to the Environment Agency's (EA) Flood Map for Planning Purposes, the entire Site is located within the present day Flood Zone 1 (Low Probability).

An area to the south west boundary of the Site is located adjacent to present day Flood Zone 2 (Medium Probability), but this would not affect the Site or access from the Site during a flood, as there are multiple alternative routes to and from the Site.

According to climate change maps included in the Arun District Council's SFRA (2008) and JFLOW data obtained from the data.gov portal, the Site is not affected by fluvial flooding.

The EA's modelled tidal flood data and mapping included within the updated SFRA (2016) confirms the Site is not affected by tidal flooding in the present day scenarios (with and without defences) and not affected by flooding in the future 'defended' tidal scenarios, however it is partly located within the undefended future tidal Flood Zone 3a extent.

Development proposals will include raising of ground levels in the southwest of the Site, this will remove the Site from the extent of future Flood Zone 3a and negates the requirement for the Sequential and Exceptions Tests.

- Modelled flood data obtained from the EA has been analysed, in line with the most up to date guidance on climate change (EA, 2020), to confirm a maximum "design" flood level at the Site. The data shows during the 1 in 200 year (present day) defended and undefended scenarios and future defended, the Site would not be flooded from tidal sources.

During a 1 in 200 year 2115 'undefended' tidal flood event, the defences protecting the area would have to fail, but if they did, the Site would flood in the area south of Grevatt's Lane West. The flood level would be 3.72 mAOD and in order to prevent the Site from flooding in this unlikely scenario, ground levels will be raised so they are set above this level. Finished floor levels will also be raised to reduce the potential for flooding to a minimum.

- According to the EA's Risk of Flooding from Rivers and Sea (RoFRS) map, which considers the type, condition and crest height of flood defences, the Site has a Negligible risk of flooding from Rivers and the Sea, with an area of low risk adjacent to the south eastern boundary. Present and future risks are very low including mitigation.
- According to the EA's Risk of Flooding from Surface Water (pluvial) flood mapping, the Site has a very low risk of pluvial flooding.
- Groundwater Flood Risk screening data indicates a Low to Moderate risk of groundwater flooding at the surface in the vicinity of the Site during a 1 in 100 year event. Ground level raising in the south of the Site is likely to reduce the risk of groundwater emergence at the ground surface.
- The risk of flooding from artificial (man-made) sources such as reservoirs, sewers and canals has been assessed:
 - The EA's Risk of Flooding from Reservoir map confirms the Site is not at risk of reservoir flooding.
 - Ordnance Survey (OS) data confirms there are no canals near to the Site.

- A sewer flooding history search was undertaken using the Strategic Flood Risk Assessment (JBA Consulting, 2016). This confirms no recorded incidences of sewer flooding at or within the vicinity of the Site.

The risk of flooding from artificial sources is considered to be negligible.

- The risk to the development has been assessed over its expected 100 year lifetime, including appropriate allowances for the impacts of climate change. More extreme weather events could increase the risk to the site from sea level rise. Site specific assessment indicates risk to the site will not increase significantly and appropriate mitigation measures are proposed.

In accordance with paragraphs 157, 164 and footnote 51 of the NPPF (2019), as the development proposals are comprised of additional buildings within present day Flood Zone 1, the Sequential Test is not required.

It should also be noted that the ground levels will be raised in the which means the Site would not be affected by future scenario (2115) Flood Zone 3a either. In consideration of the deliverability of the Site within the HELAA (2019) and the Sites location in present day and future Flood Zone 1, this would negate the requirement for the Sequential Test.

Proposed mitigation

Ground level raising will be undertaken in the southern area of the Site, south of Grevatt's Lane West, to a minimum level of 3.72 mAOD to reduce the risks of tidal and groundwater flooding to a minimum.

Finished floor levels will be raised by 0.3 m above the existing and proposed ground levels with the consideration of additional measures including:

- Passive flood door systems;
- Temporary flood barriers;
- Air brick covers (manual or automatic closing);
- Non-return flap valves on sewer outfalls.
- Interceptor drains (where applicable).
- Landscaping to divert water away from property;
- Flood resilient materials and designs:
 - Use of low permeability building materials up to 0.3 m such as engineering bricks (Classes A and B) or facing bricks;
 - Hard flooring and flood resilient metal staircases;
 - The use of internal lime plaster/render or where plasterboards are used these should be fitted horizontally instead of vertically and/or using moisture resistant plasterboard at lower levels;
 - Water, electricity and gas meters and electrical sockets should be located above the predicted flood level;

- Communications wiring: wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage.

Additional Measures

The park area in the south of the Site will be water compatible and floodable structures.

A surface water drainage strategy report has been prepared separately (ref: 73345.02R1) to ensure surface water can be managed effectively through the use of SuDS features, over the lifetime of the proposed development, including sufficient allowances for climate change.

2. Introduction

Background and purpose

A site-specific flood risk assessment has been undertaken, to assess the flood risk to and from the development site. This assessment has been undertaken by firstly compiling information concerning the Site and the surrounding area. The information gathered was then used to construct a 'conceptual site model', including an understanding of the appropriateness of the development as defined in the NPPF (2019) and the source(s) of any flood risk present. Finally, a preliminary assessment of the steps that can be taken to manage any flood risk to the development was undertaken.

This report has been prepared with reference to the NPPF (2019) and NPPG (2014).

"The National Planning Policy Framework set out the Government's planning policies for England and how these are expected to be applied" (NPPF, 2019).

The NPPF (2019) and NPPG (2014) promote a sequential, risk based approach to the location of development. This also applies to locating a development within a Site which has a variable risk of flooding.

"This general approach is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. The aim should be to keep development out of medium and high risk flood areas (Flood Zones 2 and 3) and other areas affected by other sources of flooding where possible" (NPPG, 2014).

The purpose of this report is to provide clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at the Site.

Report scope

In accordance with the requirements set out within NPPG 2014 (Paragraph: 030 Reference ID: 7-030-20140306), a thorough review of a commercially available flood risk report and EA supplied data indicating potential sources of flood risk to the Site from rivers and coastal sources, surface run-off (pluvial), groundwater and reservoirs, including historical flood information and modelled flood extent. Appropriate measures are recommended to manage and mitigate the flood risk to the property.

Information obtained from the EA and a review of the Arun District Council Strategic Flood Risk Assessment (SFRA) (JBA Consulting, 2016) and the Local Flood Risk Management Strategy (LFRMS) (West Sussex County Council, 2014) are used to ascertain local flooding issues and, where appropriate, identify information to support a Sequential and/or Exception test required as part of the NPPF (2019).

The existing and future flood risks to and from the Site from all flood sources is assessed in line with current best practice using the best available data. The risk to the development has been assessed over its expected lifetime, including appropriate allowances for the impacts of climate change. Residual risks that remain after the flood risk management and mitigation measures are implemented, are considered with an explanation of how these risks can be managed to keep the users of the development safe over its lifetime.

An indication of whether the site will potentially increase flood risk elsewhere is provided, including where the proposed development increases the building footprint at the Site. A drainage strategy to control runoff has been completed separately.

Report limitations

It is noted that the findings presented in this report are based on a desk study of information supplied by third parties. Whilst we assume that all information is representative of past and present conditions, we can offer no guarantee as to its validity and a proportionate programme of site investigations would be required to fully verify these findings.

The basemap used is the OS Street View 1:10,000 scale, however the Site boundary has been drawn using BlueSky aerial imagery to ensure the correct extent and proportion of the Site is analysed.

This report excludes consideration of potential hazards arising from any activities at the Site other than normal use and occupancy for the intended land uses. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities.

Datasets

The following table shows the sources of information that have been consulted as part of this report:

Table 1: Datasets consulted to obtain confirmation of sources of flooding and risk

Source of flooding	Datasets consulted			
	Commercial Flood Maps (Appendix B)	SFRA	Environment Agency (Appendix C)	OS Data
Historical	X	X	X	
Fluvial/tidal	X	X	X	
Surface water (pluvial)	X	X	X	
Groundwater	X	X		
Sewer		X		
Culvert/bridges		X		X
Reservoir		X	X	

*The SFRA and local guidance has been used to inform this report as referenced in Section 6.

3. Site analysis



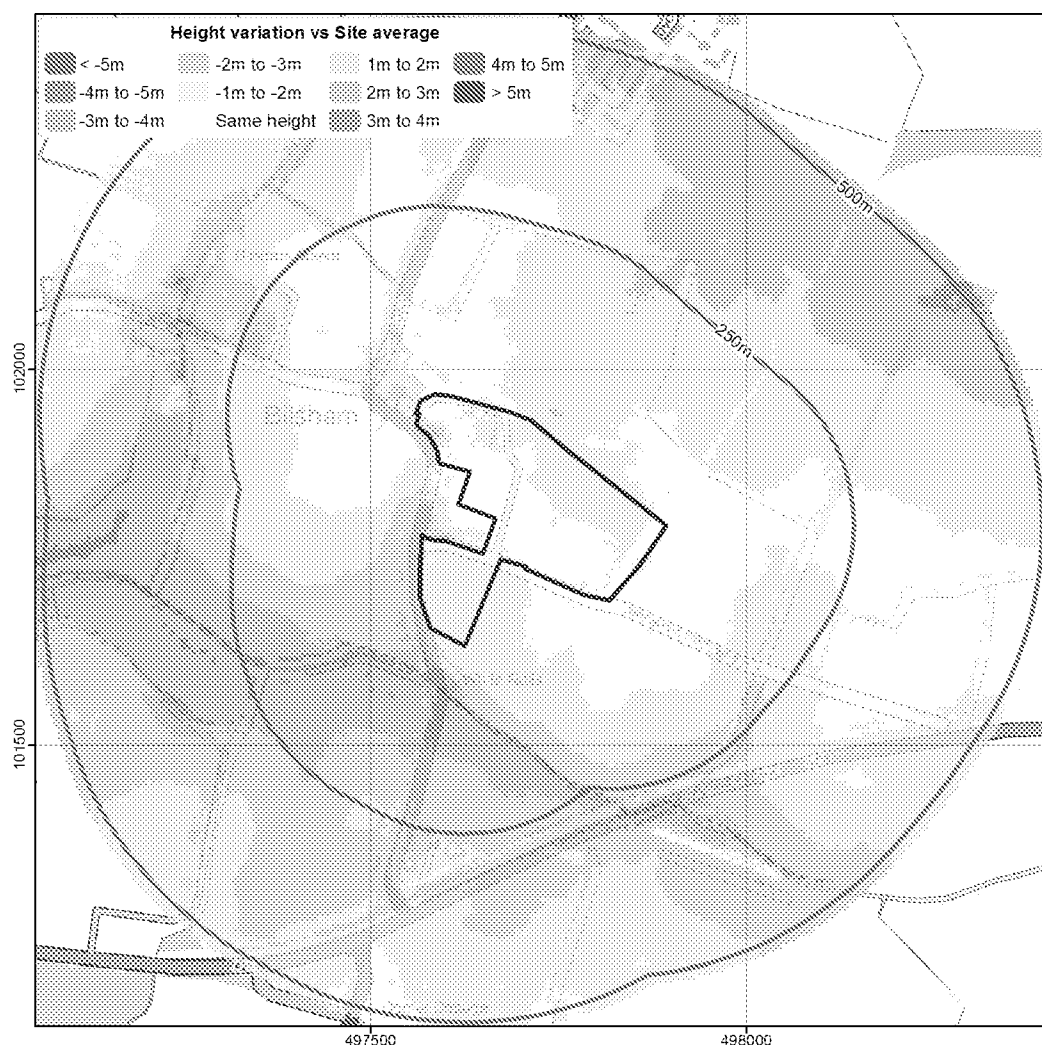
Site information

The Site is located in Yapton in a setting of greenfield, commercial and residential land use at National Grid Reference SU 97649 101823. Site plans and drawings are provided in Appendix A.

According to OS data, using a 500 m buffer around the Site, the area is on a gentle slope (Figure 1). It is noted that to the north land rises to c. 5.84 m above Ordnance Datum (AOD). To the west land falls to 1.23 m AOD, to the east land rises to c. 5.37 m AOD and to the south falls to 3.98 m AOD.

The topographic data confirms the Site is generally flat with a slight fall in a westerly direction from 5.6 m AOD along the western boundary to 2.5 m AOD along the eastern boundary. This is based on EA elevation data obtained for the Site to a 1 m resolution with a vertical accuracy of ± 150 mm (Appendix D).

Figure 1 Site Location and Relative Elevations



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Development

The majority of the Site is currently greenfield however there is an area of commercial development located in the north of the Site. Development proposals comprise the construction of 81 dwellings as well as an enlarged employment area and open park space. An area of park space is proposed in the southern most section of the Site which is adjacent to Flood Zone 2 along the southwest boundary of the Site. Site plans are included within Appendix A.

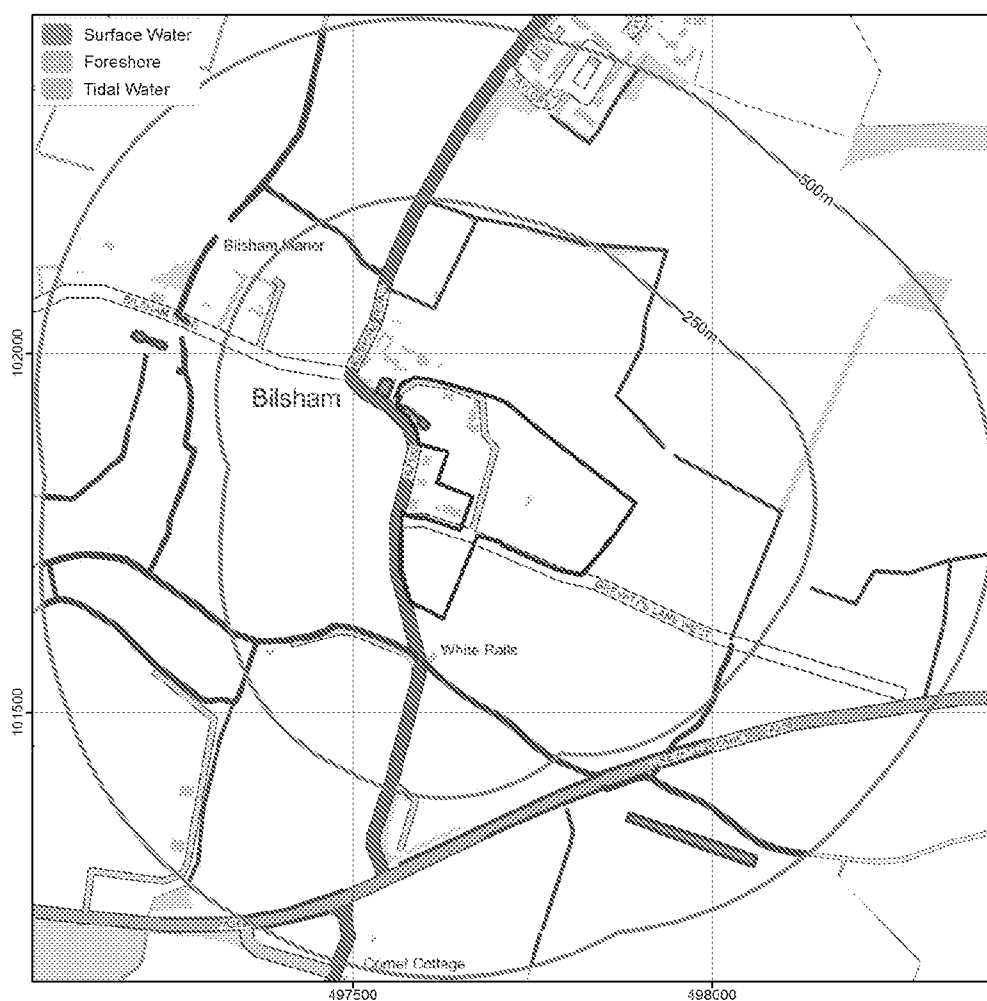
The effect of the overall development will result in an increase in number of occupants and/or users of the Site and will result in the change of use, nature or times of occupation. According to Table 2 of the NPPG (2014), the vulnerability classification of the existing development is Less Vulnerable and proposed development is More Vulnerable. The estimated lifespan of the development is 100 years.



Hydrological features

There are numerous surface water drainage ditches within 500 m of the Site (Figure 2), these are included in the mapping below:

Figure 2 Surface water features



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There is a surface water body located on Site in the northwest corner.

There is a surface water body located adjacent to the northwest corner of the Site.

The Ryebank Rife is located 60 m to the South of the Site and also flows 315 m west of the Site. The surface water course to 215 m east of the Site is a tributary to the Ryebank Rife.

A drainage ditch is shown to be located on the eastern site boundary on OS mapping.

The English Channel is located 2 km south of the Site.

The Product 4 data shows a surface water course, drainage ditch on the eastern boundary of the Site (Appendix C).



Proximity to relevant infrastructure:

The nearest flood defences are located 65 m south of the Site and 370 m west of the Site on the surface water course and comprises of a fluvial high ground flood defence designed to protect up to a 1 in 5 year event.

There is a small bridge over the Ryebank Rife located 60 m south of the Site.



Hydrogeological features

British Geological Survey (BGS) mapping indicates the underlying superficial geology consists of River Terrace Deposits (undifferentiated) - Sand, Silt And Clay. (BGS, 2020) and is classified as a Secondary (A) Aquifer (EA, 2020).

BGS mapping indicates the underlying bedrock geology consists of the Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation And Portsdown Chalk Formation (undifferentiated) (BGS, 2020) and is classified as a Principal Aquifer (EA, 2020).

The Site does not lie within a groundwater Source Protection Zone (SPZ) (EA, 2020).

A review of the BGS borehole database (BGS, 2020) indicates there are no relevant/relevant boreholes within the vicinity of the site.

The hydrogeological characteristics suggest there is potential for a shallow groundwater table beneath the site.

Groundwater levels may rise in the bedrock and superficial aquifer in response to high river events subject to hydraulic continuity between the driving water level, the groundwater system and the site.

Groundwater levels may rise in the bedrock and superficial aquifer in response to prolonged rainfall recharge which may cause an unusually high peak in groundwater levels during some years, subject to hydraulic continuity between the groundwater system and the site.

4. Flood risk to the development

Historical flood events

According to the EA's historical flood map, no historical flood events have been recorded at the Site (EA, 2020). The purpose of historical flood data is to provide information on where and why flooding may have occurred in the past. The absence of any recorded events does not mean flooding has never occurred on Site or that flooding will never occur at the Site.

Rivers (fluvial) / Sea (coastal/tidal) flooding

The Site is located in a coastal location and the predominant risk at the Site is from flooding from the sea, termed as coastal and/or tidal processes.

Coastal flooding is caused by extreme tidal conditions that occur because of three main mechanisms, either individually or in combination. These are:

High tide levels – variations in tidal levels due to gravitational effects of the sun and moon can result in higher sea levels – there is an approximate twice daily variation between high and low tide, onto which is superimposed a spring-neap tide cycle when extra high and low tides occur.

Surge – an increase in sea level above tidal level caused by low atmospheric pressure which may be exacerbated by the wind acting on the sea.

Wave action – dependent on wind speed and direction, local topography and exposure.

Flood Zones

According to the EA's Flood Map for Planning Purposes (Figure 3), the Site is located in present day Flood Zone 1 (low probability). The southwestern corner of the Site is located adjacent present day Flood Zone 2 along the boundary.

According to the climate change mapping tiles (ref: ADC_13) of the 2016 SFRA (Appendix E) and modelled flooding data obtained from the EA (Appendix C), the southwest area of the Site (to the south of Grevatt's Lane West) is located within an undefended Tidal Flood Zone 3a. However, ground level raising is proposed in this area which means the Site would not be affected in this event.

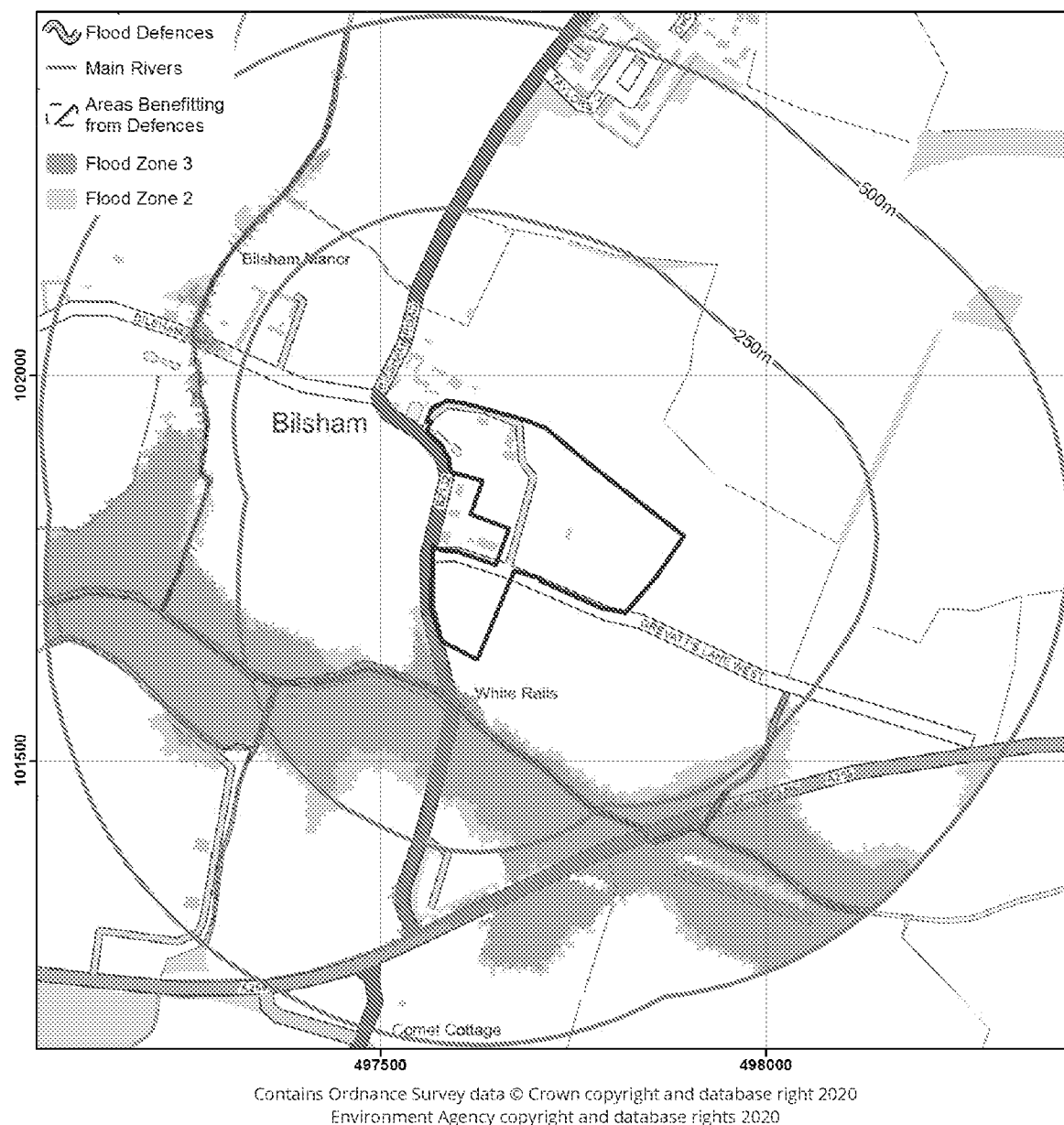
As defined in the NPPF (2019):

Guidance

Ignoring the presence of any defences, land located in a Flood Zone 1 is considered to have a Low probability of flooding, with less than a 1 in 1000 annual probability of fluvial or coastal flooding in any one year.

Development of all uses of land is appropriate in this zone (see glossary for terminology).

Figure 3 EA Flood Map for Planning Purposes (EA, 2020)



Flood defences

The nearest flood defences are located 65 m south of the Site and 370 m west of the Site on the surface water course and comprises of a fluvial high ground flood defence designed to protect up to a 1 in 5 year event.

Guidance

Sites that are located close to flood defences are likely to be zones where rapid inundation will occur in the event of the flood defences being overtopped or breached. A Site located close to flood defences (within 250 m) may require a more detailed FRA subject to local topography.

Detailed flood model data

The Environment Agency's detailed flood modelling has been obtained to inform the tidal analysis within this flood risk assessment. The data has been extracted from the River Arun to East Head Coastal Modelling (2D) which was completed by JBA Consulting in 2016.

Modelled flood elevation data was requested from the EA to confirm fluvial flood levels. However, the EA confirm they do not hold any detailed modelling for Ryebank Rife. In the absence of detailed modelling, national generalised JFLOW flood depth maps were obtained from the data.gov portal and climate change mapping obtained from the Arun District Council website to assess flood risk.

Fluvial Flood Risk

Analysis of the JFLOW data illustrated the Site remained flood-free in each scenario. Map C2-F - Climate Change Fluvial Flood Zones of the 2008 SFRA also confirms the Site would remain flood free in all modelled climate change scenarios, where all fluvial flows would remain in the Ryebank Rife.

Tidal Flood Risk

The EA's tidal flood data is provided for the 'defended' (including formal tidal flood defences) and 'undefended' (without the presence of formal tidal flood defences) scenarios. This data is illustrated in Table 2 (defended) and 3 (undefended) scenarios below for the node point locations outlined in Figure 4. This is also included within Appendix C.

Figure 4 Node point locations on the Site

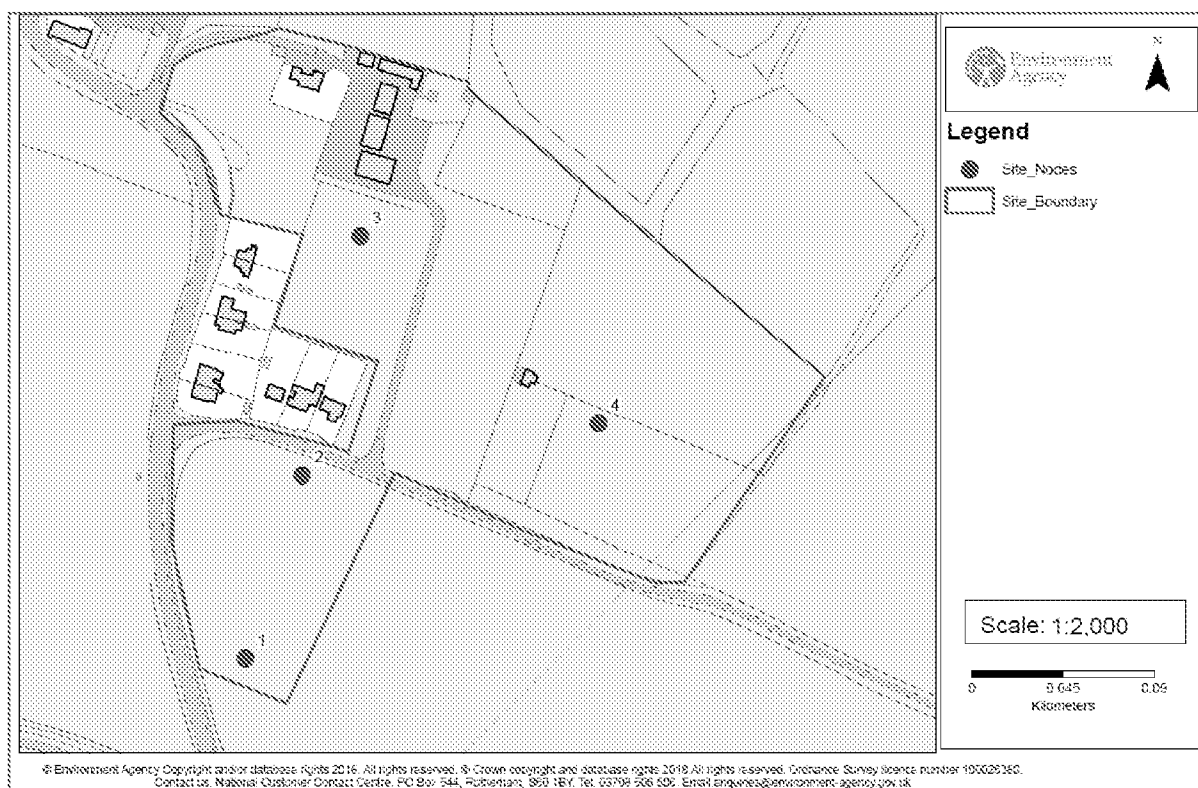


Table 2: EA modelled flood level data (Tidal Defended Scenario)

Node Point	Modelled Flood Levels (mAOD)			
	1 in 200 year (0.5%)	1 in 200 year (2070) 0.5%	1 in 200 year (2115) 0.5%	1 in 1000 year (0.1%)
1	No flooding	No flooding	No flooding	No flooding
2	No flooding	No flooding	No flooding	No flooding
3	No flooding	No flooding	No flooding	No flooding
4	No flooding	No flooding	No flooding	No flooding

Table 3: EA modelled flood level data (Tidal Un defended Scenario)

Node Point	Modelled Flood Levels (mAOD)			
	1 in 200 year (0.5%)	1 in 200 year (2070) 0.5%	1 in 200 year (2115) 0.5%	1 in 1000 year (0.1%)
1	No flooding	No flooding	3.72	No flooding
2	No flooding	No flooding	3.72	No flooding
3	No flooding	No flooding	No flooding	No flooding
4	No flooding	No flooding	No flooding	No flooding

Node points 1 and 2 lie within the southern half of the Site, south of Grevatt's Lane West as shown in Figure 4. The area associated with node point 1 is proposed for a park area ('water compatible') and node point 2 is proposed for residential houses ('more vulnerable').

Ground level raising is proposed to ensure flooding would not occur in the area of node point 1 and 2 during the 1 in 200 year (2115) scenario.

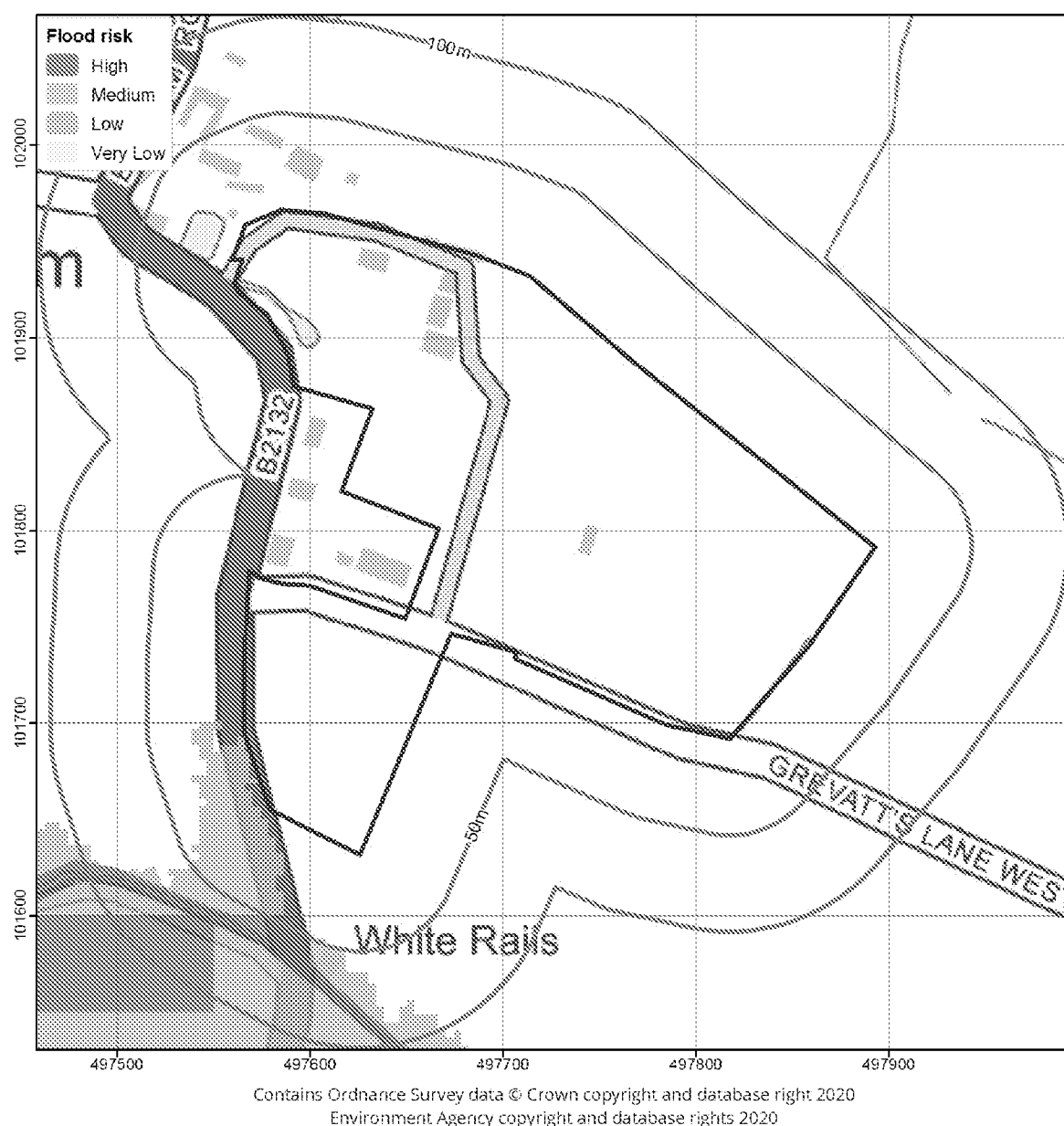
Flood risk including the benefit of defences

The type and condition of existing flood defences influence the 'actual' risk of fluvial flooding to the Site, albeit the long-term residual risk of flooding (ignoring the defences) should be considered when proposing new development.

According to the EA's Risk of Flooding from Rivers and the Sea (RoFRS) mapping (Figure 5), which considers the crest height, standard of protection and condition of defences, the flood risk from Rivers and the Sea is Negligible apart. There is an area adjacent to the southwestern boundary where the flood risk is mapped as being Low.

As ground level raising is proposed, which would protect the Site from flooding over its lifetime, the risks would remain as negligible over the lifespan of the development.

Figure 5 Risk of Flooding from Rivers and Sea map (EA, 2020)



Surface water (pluvial) flooding

Surface water flooding occurs when intense rainfall exceeds the infiltration capacity of the ground and overwhelms the drainage systems. It can occur in most locations even at higher elevations and at significant distances from river and coastal floodplains.

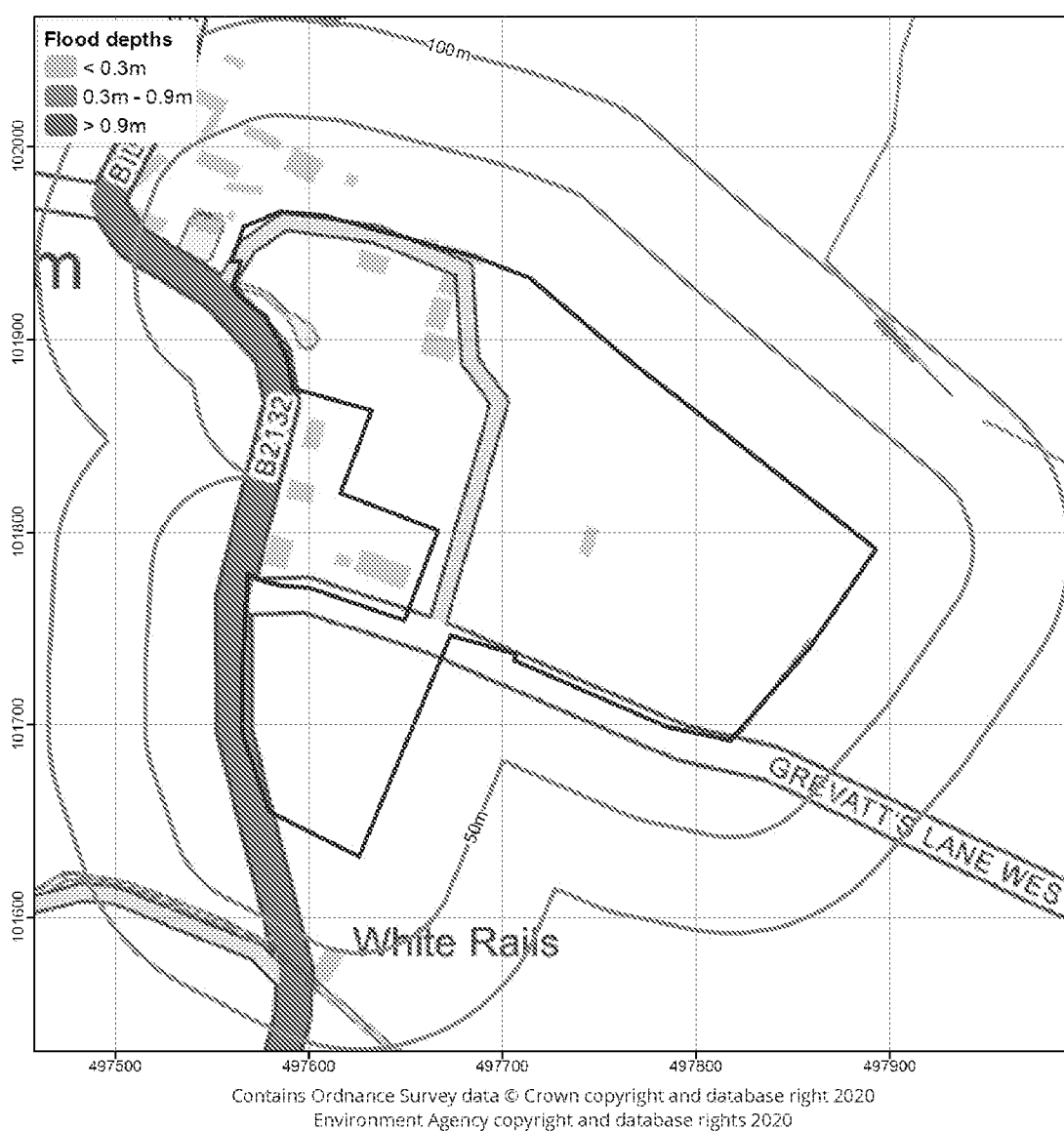
According to the EA's Risk of Flooding from Surface Water (pluvial) mapping, there is a Very Low risk of pluvial flooding at the Site.

Guidance

According to EA's surface water flood risk map the site is at:

- Very Low risk - chance of flooding of less than 1 in 1000 (0.1%).

Figure 6 EA Medium (100 year) surface water flood risk map (EA, 2020)



During a 1 in 1000 year event, the Site remains flood free, apart from on areas associated with the on-Site surface water features. Flood depths up to 0.9 m are possible along the eastern boundary, but may not affect the Site.

Analysis of OS mapping, ground elevation data and the EA's pluvial flow route mapping in the 1 in 1000 year event confirms the Site is not located on a potential overland flow route during a low risk scenario.

Appendix H of the SFRA does not indicate reported incidents of historical surface water flooding within 100 m of the Site (JBA Consulting, 2016). The SFRA confirms the Site is not located within a Critical Drainage Area (CDA)¹ (JBA Consulting, 2016).

Climate change may lead to an increase in rainfall intensity which affects river levels, land and urban drainage systems. Rainfall intensity for small and urban catchments may increase from 5 to 20% (central estimate) or 10% to 40% (Upper estimate) over the period to 2115 (EA, 2020). The increase in surface water flood risk is best represented by the 1 in 1000 year pluvial flood extent but according to the mapping this is unlikely to impact the Site.

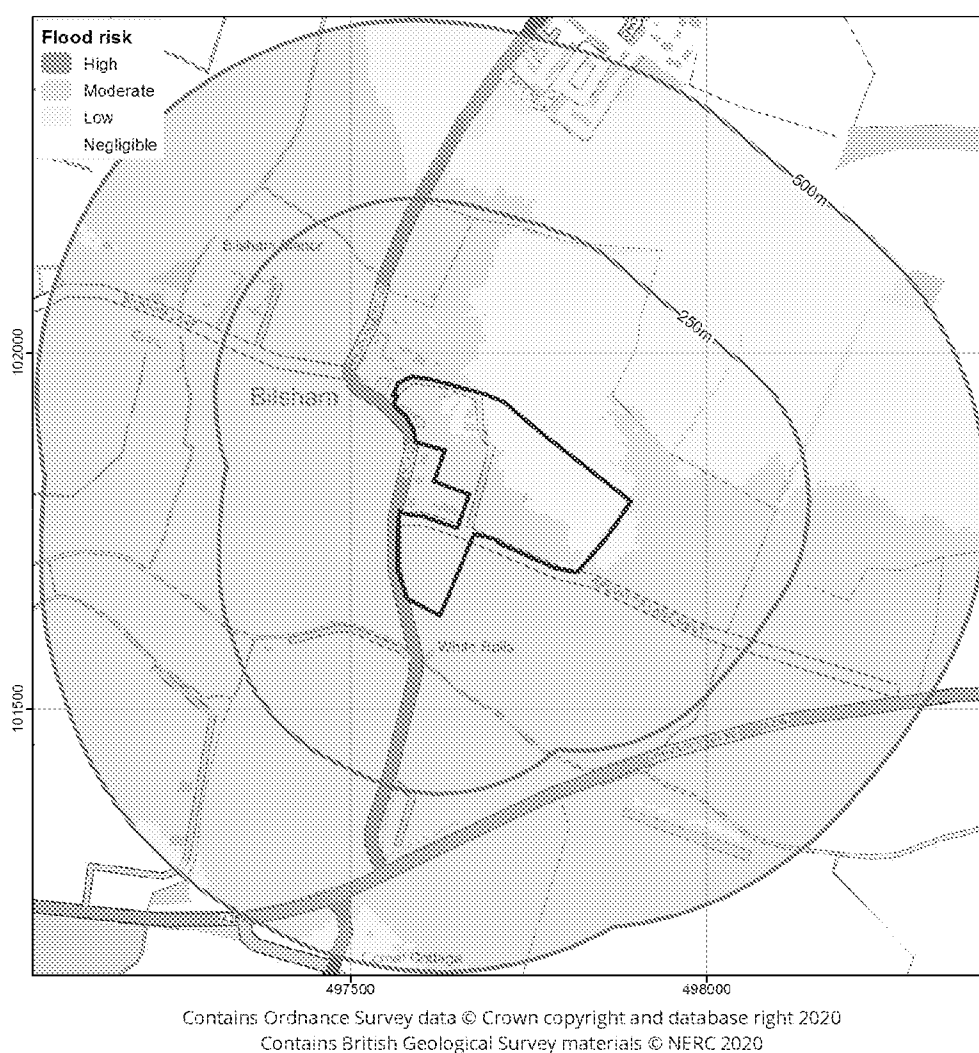
¹ A Critical Drainage Area (CDA) is an area that has critical drainage problems and which has been notified to the local planning authority as such by the Environment Agency in line with the National Planning Policy Framework (NPPF, 2019). CDA's are specific to Flood Zone 1, defined as areas where runoff can and may have historically contributed to flooding downstream, although they are not necessarily areas where flooding problems may occur. Where a Site is located in Flood Zone 1 and within a CDA, a Flood Risk Assessment (FRA) is required and the Council may also request Sustainable Drainage Scheme (SuDS) features to be included within the proposed development.

Groundwater flooding

Groundwater flooding occurs when sub-surface water emerges from the ground at the surface or into Made Ground and structures. This may be as a result of persistent rainfall that recharges aquifers until they are full; or may be as a result of high river levels, or tides, driving water through near-surface deposits. Flooding may last a long time compared to surface water flooding, from weeks to months. Hence the amount of damage that is caused to property may be substantially higher.

Groundwater Flood Risk screening data (Figure 7) indicates there is a Low to Moderate risk of groundwater flooding at surface in the vicinity from permeable bedrock and superficial during a 1 in 100 year event. Mapped classes combine likelihood, possible severity and the uncertainty associated with predicting the subsurface system. The map is a national scale screening tool to prompt site-specific assessment where the impact of groundwater flooding would have significant adverse consequences. Mapping limitations and a number of local factors may reduce groundwater flood risk to land and property even where it lies within mapped groundwater flood risk zones, which do not mean that groundwater floods will occur across the whole of the risk area.

Figure 7 GeoSmart GW5 Groundwater Flood Risk Map (GeoSmart, 2020)



The SFRA does not indicate reported incidents of historical ground water flooding within 20 m of the Site (JBA Consulting, 2016).

Based on a review of (limited) site specific data groundwater levels may rise in the bedrock and superficial aquifer in response to high river events.

It is noted that groundwater flooding may occur in response to prolonged high river levels even if overtopping of flood defences does not occur.

Topographic low points have been identified on-Site where groundwater discharge may accumulate.

Site specific assessment suggests that groundwater levels could reach the surface and appropriate mitigation is required.

On the basis of the site-specific assessment the groundwater flood risk is considered to be low to moderate.

The risks are higher for basements, buried infrastructure and soak-away systems which may be affected by high groundwater levels. This has been considered separately within the surface water (SuDS) strategy.

Guidance

Low Risk - There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location.

Moderate Risk - There will be a significant possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location.

Climate change predictions suggest an increase in the frequency and intensity of extremes in groundwater levels. Rainfall recharge patterns will vary regionally resulting in changes to average groundwater levels. A rise in peak river levels will lead to a response of increased groundwater levels in adjacent aquifers subject to the predicted climate change increases in peak river level for the local catchment. Sea level rises of between 0.4m and 1m are predicted by 2100, leading to a rise in average groundwater levels in the adjacent coastal aquifer systems, and potential increases in water levels in the associated drainage systems. The 'backing up' of groundwater levels from both coast and tidal estuary locations may extend a significant distance inland and affect infrastructure previously constructed above average groundwater levels.

The impact of climate change on groundwater levels beneath the Site is linked to the predicted risk in both peak river levels and sea levels and also the variation in rainfall recharge which is uncertain.

Ground level raising is proposed in the southwest of the Site to ensure the Site would remain flood free in all modelled tidal events for the lifetime of the development, this would also reduce the risks of groundwater emergence in these areas. Based on the available evidence the resulting increase to groundwater flood risk will be mitigated by the proposed measures.

Flooding from Artificial Sources

Artificial sources of flood risk include waterbodies or watercourses that have been amended by means of human intervention rather than natural processes. Examples include reservoirs (and associated water supply infrastructure), docks, sewers and canals. The flooding mechanism associated with flood risk from artificial sources is primarily related to breach or failure of structures (reservoir, lake, sewer, canal, flood storage areas, etc.)

Sewer flooding

Table 5.2 of the SFRA has identified 20 incidences of flooding as a result of surcharging sewers within the BN18 0 postcode. However, it is recognised that this five digit postcode covers a large area and instances of flooding are not specific to the Site (JBA Consulting, 2016).

Guidance

Properties classified as “at risk” are those that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system either once or twice in the ten year reference period. Records held by the sewage utility company provide information relating to reported incidents, the absence of any records does not mean that the Site is not at risk of flooding.

Canal Failure

According to Ordnance Survey (OS) mapping, there are no canals within 500 m of the Site.

Water supply infrastructure

Water supply infrastructure is comprised of a piped network to distribute water to private houses or industrial, commercial or institution establishments and other usage points. In urban areas, this represents a particular risk of flooding due to the large amount of water supply infrastructure, its condition and the density of buildings. The risks of flooding to properties from burst water mains cannot be readily assessed.

If more information regarding the condition and history of the water supply infrastructure within the vicinity of the Site is required, then it is advisable to contact the local water supplier (Southern Water).

Culverts and bridges

A bridge has been identified within 500 m of the Site. However, this structure is a significant distance from the Site and is unlikely to represent a flood risk to the Site in the event of a blockage. The SFRA has not identified any historic drainage issues within the Site area (JBA Consulting, 2016).

Reservoir flooding

According to the EA’s Risk of Flooding from Reservoir mapping, the Site is not considered to be at risk of flooding from a breach in any nearby reservoirs.

Guidance

The risk of reservoir flooding is related to the failure of a large reservoir (holding over 25,000 m³ of water) and is based on the worst-case scenario. Reservoir flooding is extremely unlikely to occur (EA, 2020).

5. Flood risk from the development

Floodplain storage

The Site is located within present day Flood Zone 1. The Site would remain unaffected in both the present day and future flooding scenarios, where defences have been accounted for in the modelling.

According to mapping included in the 2016 SFRA (Appendix E) and obtained from the EA (Appendix C), the south western area of the Site (south of Grevatt's Lane West) is affected by the modelled undefended, 1 in 200 year (future 2115) scenario event (Future Flood Zone 3a).

However, ground level raising is proposed in the south western area of the Site to raise ground levels above the maximum future flood level of 3.72 mAOD. This means the Site would remain within Flood Zone 1 in both the present day and future flooding scenarios.

In undefended tidal areas, raising ground levels is unlikely to impact on maximum tidal levels so the provision of compensatory storage is not considered to be necessary (CIRIA C624 (2004)).

It is however, considered to be best practice to provide an overall improvement in flood risk, so compensatory flood storage and / or Sustainable Drainage (SuDS) features will be provided wherever this is possible.

Drainage and run-off

A surface water drainage strategy report has been prepared separately (ref: 73345.02R1) to ensure surface water can be managed effectively through the use of SuDS features, over the lifetime of the proposed development, including sufficient allowances for climate change.

6. Suitability of the proposed development

The information below outlines the suitability of proposed development in relation to national and local planning policy.

National policy and guidance

The aims of the national planning policies are achieved through application of the Sequential Test and in some cases the Exception Test.

Guidance
Sequential test: The aim of this test is to steer new development towards areas with the lowest risk of flooding (NPPF, 2019). Reasonably available sites located in Flood Zone 1 should be considered before those in Flood Zone 2 and only when there are no reasonably available sites in Flood Zones 1 and 2 should development in Flood Zone 3 be considered. Exception test: In some cases, this may need to be applied once the Sequential Test has been considered. For the exception test to be passed it must be demonstrated that the development would provide wider sustainability benefits to the community that outweigh flood risk and a site-specific FRA must demonstrate that 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.

Suitability of the proposed development, and whether the Sequential and Exception Tests are required, is based on the Flood Zone the Site is located within and the flood risk vulnerability classification of the existing and proposed development. Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.

This report has been produced to assess all development types, prior to any development. The vulnerability classification and Flood Zones are compared within Table 6 overleaf (Table 3 of the NPPG (2014)).

The Site is identified within Appendix 1.1 of Arun District Council's HELAA (2019) as a 'Deliverable Site' under reference HELAA 46 (Land East of Bilsham Road, Adjacent to Little Meadow, Yapton), which has a potential yield for 99 residential houses.

The proposed development will comprise of a mix of vulnerabilities, as follows:

- Commercial area in the northeast of the Site (Less Vulnerable);
- Residential areas in east and southwest (More Vulnerable) including 81 dwellings in total;
- Play park area in the southwest (Water Compatible).

According to the flood data provided by the EA, the Site is located within present day Flood Zone 1. As the Site is located within Flood Zone 1, all types of development listed within the Table overleaf are acceptable according to National Policy.

According to climate change mapping contained within the 2016 SFRA, the south western area of the Site could be located within a tidal Flood Zone 3a in the future. However, ground level raising is proposed in the southwest, which will raise the Site above this level. As such, the Site and access routes to and from the Site are currently in Flood Zone 1 and will be for the lifespan of the proposed development.

The Sequential Test is therefore not considered to be required in this instance, the ground level raising proposed would also ensure the Site is located within Flood Zone 1 over the lifetime of the proposed development.

Table 6: Flood risk vulnerability and flood zone 'compatibility' (taken from NPPG, 2014)

Flood risk vulnerability classification		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable ¹	Less vulnerable
Flood Zone	Zone 1 – low probability	✓	✓	✓	✓	✓
	Zone 2 – medium probability	✓	✓	Exception test required	✓	✓
	Zone 3a – high probability	Exception test required	✓	X	Exception test required	✓
	Zone 3b – functional flood plain	Exception test required	✓	X	X	X

¹The Site will be located in Flood Zone 1 in the present day and future flooding scenarios.

EA Flood Risk Standing Advice for vulnerable developments located in or within the vicinity of Flood Zones 2 or 3

For all relevant vulnerable developments (i.e. more vulnerable, less vulnerable and water compatible), advice on the points should be followed:

- Surface water management;
- Access and evacuation; and
- Floor levels.

Surface water management

Plans for the management of surface water need to meet the requirements set out in either the local authority's:

- Surface water management plan where available; OR
- Strategic flood risk assessment.

They also need to meet the requirements of the approved building regulations Part H: drainage and water disposal. Read section H3 rainwater drainage.

Planning permission is required to use a material that can't absorb water (e.g. impermeable concrete) in a front garden larger than 5 square metres.

Access and evacuation

Details of emergency escape plans should be provided for any parts of a building that are below the estimated flood level:

Plans should show:

- Single storey buildings or ground floors that don't have access to higher floors can access a space above the estimated flood level, e.g. higher ground nearby;
- Basement rooms have clear internal access to an upper level, e.g. a staircase;
- Occupants can leave the building if there's a flood and there's enough time for them to leave after flood warnings.

Floor levels

The following should be provided:

- Average ground level of the building; and
- Finished floor level of the lowest habitable room in the building.

Ground floor levels should be a minimum of whichever is higher of:

- 300 millimetres (mm) above the general ground level of the site; OR
- At least 600 mm above the estimated river or sea flood level².

If you cannot raise floor levels above the estimated flood level, you need to consider extra flood resistance and resilience measures.

² This is 600 mm above the 1 in 100 year fluvial or 1 in 200 year tidal flood events. The 600 mm is split into a 300 mm freeboard allowance for climate change and 300mm allowance for the inaccuracies in the EA's flood modelling. Where the climate change flood level is known, a 300 mm allowance should be added to the climate change flood level to allow for the inaccuracies in the EA's flood modelling.

Extra flood resistance and resilience measures

Follow the extra flood resistance and resilience requirements for developments in flood risk areas where ground floor levels are lower than the estimated flood level for the site.

Water depth up to 300 mm

The design of the building or development should keep water out as much as possible. You should use materials that have low permeability (materials that water cannot pass through, for example, impermeable concrete).

Water depth from 300 mm to 600 mm

The design of the building or development should keep water out (unless there are structural concerns) by:

- using materials with low permeability to at least 300mm
- using flood resilient materials (for example lime plaster) and design (for example raised electrical sockets)
- making sure there's access to all spaces to enable drying and cleaning

Water depth above 600 mm

The design of the building or development should allow water to pass through the property to avoid structural damage by:

- using materials with low permeability to at least 300 mm
- making it easy for water to drain away after flooding
- making sure there's access to all spaces to enable drying and cleaning

Local policy and guidance

For this report, several documents have been consulted for local policy and guidance and relevant information is outlined below:

Arun District Council Strategic Flood Risk Assessment (JBA Consulting, 2016):

- *The Arun District is bounded by the English Channel. As such the coastline is at risk of tidal flooding. In addition, the lower River Arun has also been classified as a tidal river and water levels in the lower reaches are affected by tide levels.*
- *Significant groundwater flooding has been observed across Sussex in 1993/94, 2000/01 and 2002/03. The areas subjected to this flooding were mainly the upper reaches of Chalk catchments, in areas of localised low topography, and in areas of drift cover absence.*
- *Significant events of groundwater flooding reported in West Sussex, 44 are reported to have occurred in:*
 - 1974
 - Winter 1993–1994
 - Winter 2000–2001
 - Winter 2002–2003
 - 2012 – Westergate/Barnham area
 - 2013/14 – Westergate/Barnham area
 - 2014 – Northfields Lane/Nyton Road/Level Mere Lane, Aldingbourne

It was observed that the extensive groundwater flooding of winter 2000 / 2001 followed a period of exceptionally high rainfall, but the direct source was not identified and therefore it may be that flooding was caused by a burst underground pipe rather than flooding from hard rock aquifers or superficial deposits.

Guidance

Strategic Flood Risk Assessments are carried out by local authorities, in consultation with the Environment Agency, to assess the flood risk to the area from all sources both now and in the future due to climate change. They are used to inform planning decisions to ensure inappropriate development is avoided (NPPF, 2019).

Environment Agency pre-application response:

The EA (2020) was contacted as part of this FloodSmart report in order to obtain site-specific feedback on the proposed development. However, a response was not received within the timeframe of this report.

7. Resilience and mitigation

Based on the flood risk identified at the Site, the national and local policies and guidance and proposed development, the mitigation measures outlined within this section of the report are likely to help protect the development from flooding.

Sea (coastal/tidal) flood mitigation measures

The Site is located within an area which is potentially affected by flooding from the sea in future (undefended) scenarios, the following table confirms the flood depths associated with the area proposed for development.

Table 7: Flood levels compared to ground levels in the area proposed for development

Node Point	Modelled Flood Depths (mAOD)			
	1 in 200 year (0.5%)	1 in 200 year (2070) 0.5%	1 in 200 year (2115) 0.5%	1 in 1000 year (0.1%)
1	No flooding	No flooding	0.39	No flooding
2	No flooding	No flooding	0.12	No flooding
3	No flooding	No flooding	No flooding	No flooding
4	No flooding	No flooding	No flooding	No flooding

The EA's data confirms the Site would remain flood free in all modelled 'defended' scenarios.

The EA's mapping confirms the Site is located within present day Flood Zone 1, but mapping included within the Council's 2016 SFRA illustrates the Site is located within an undefended tidal Flood Zone 3a location. The undefended tidal data provided by the EA confirms flood depths up to 0.39 m affect the south western area of the Site, where a park is proposed and flood depths up to 0.12 m affect the area proposed for residential development south of Grevatt's Lane West.

In this instance, ground level raising is proposed to ensure the Site would remain flood free in the future flood scenarios, to ensure the development is safe for its lifetime. This would also negate the requirement for the Sequential and Exceptions Tests.

It is also recommended the finished floor levels of the proposed residential dwellings are raised by 0.3 m above ground levels.

The area proposed for the park development will include water compatible structures which are also floodable.

Additional Mitigation

Where it is not possible to raise the minimum finished floor levels to the recommended elevation, it may be appropriate to adopt a water exclusion strategy for flood depths up to

0.3 m in line with the EA's Standing Advice. A water exclusion strategy, using avoidance and resistance measures, is appropriate where floods are expected to last for short durations. Potential water exclusion strategies include:

- Passive flood door systems;
- Temporary flood barriers;
- Air brick covers (manual or automatic closing);
- Non-return flap valves on sewer outfalls.
- Landscaping to divert water away from the property;

Avoidance and resistance measures are unlikely to completely prevent floodwater entering a property, particular during longer duration flood events. Therefore, it is recommended that the following flood resilience measures are also considered.

- Flood resilient materials and designs:
 - Use of low permeability building materials up to 0.3 m such as engineering bricks (Classes A and B) or facing bricks;
 - Hard flooring and flood resilient metal staircases;
 - The use of internal lime plaster/render or where plasterboards are used these should be fitted horizontally instead of vertically and/or using moisture resistant plasterboard at lower levels;
 - Water, electricity and gas meters and electrical sockets should be located above the predicted flood level;
 - Communications wiring: wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage.

Rivers (fluvial) flood mitigation measures

According to analysis of JFLOW data and the Councils SFRA (2016) mapping, the Site is not identified as being at risk of flooding from fluvial sources, therefore, mitigation measures are not required.

Surface water (pluvial) flood mitigation measures

A surface water drainage strategy report has been prepared separately (ref: 73345.02R1) to ensure surface water can be managed effectively through the use of SuDS features, over the lifetime of the proposed development, including sufficient allowances for climate change.

Groundwater flood mitigation measures

The Site is at risk from groundwater flooding therefore it is recommended to raise the finished floor levels of residential dwellings by 0.3 m above the existing ground levels with the consideration of additional specific groundwater measures including:

- Waterproof tanking of the ground floor;
- Interceptor drains;
- Automatic sump and pump to extract flood water; and

- Non-return flap valves on the proposed foul and surface water sewer lines.

If these mitigation measures are implemented this would reduce the flood risk to the development from Moderate to Low. In addition, the ground level raising proposed as part of the development would reduce the risks of groundwater emergence further.

Reservoir flood mitigation measures

The Site is not a risk of flooding from reservoirs; therefore, mitigation measures are not required.

Other flood risk mitigation measures

As the Site is not identified as at risk from other sources, mitigation measures are not required.

Emergency evacuation - safe access / egress and safe refuge

Emergency evacuation to land outside of the floodplain should be provided if feasible. Where this is not possible, 'more vulnerable' developments and, where possible, development in general, should have internal stair access to an area of safe refuge within the building to a level higher than the maximum likely water level. An area of safe refuge should be sufficient in size for all potential users and be reasonably accessible to the emergency services.

Emergency evacuation from the development and the Site should only be undertaken in strict accordance with any evacuation plans produced for the Site, with an understanding of the flood risks at the Site including available mitigation, the vulnerability of occupants and preferred evacuation routes.

Flood Warnings

The EA operates a flood warning service in all areas at risk of flooding; this is available on their website: <https://www.gov.uk/check-flood-risk>. The Site is not located within an EA Flood Alerts/Warning coverage area so is unable to receive alerts and/or warnings (Figure 8).

The EA aims to issue Flood Warnings 2 hours in advance of a flood event. Flood Warnings can provide adequate time to enable protection of property and evacuation from a Site, reducing risk to life and property.

Emergency Evacuation

Where possible, a safe access and egress route with a 'very low' hazard rating from areas within the floodplain to an area wholly outside the 1 in 100 year flood event including an allowance for climate change should be demonstrated.

Based on the EA's Flood Zone Map the closest dry evacuation area within Flood Zone 1 is north of Grevatt's Lane West. It is advised that evacuation from the premises would be the preferred option in a flood event if safe to do so. It is recommended that residents prepare to evacuate as soon as an EA Flood Warning is issued in order to completely avoid flood waters.

On-site refuge

Evacuation should be the primary action in preference, however safe refuge could be sought at first floor level in a worst-case scenario as the residential areas of the development are situated on the first and second floor.

Figure 8 EA Flood Warning Coverage for the local area.



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Other relevant information

A Flood Warning and Evacuation Plan (FWEP) is recommended for residents south of Grevatt's Lane West

Registration to the Environment Agency's flood warning scheme can be done by following this link: <https://www.gov.uk/sign-up-for-flood-warnings>.

It is recommended that main communication lines required for contacting the emergency services, electricity sockets/meters, water supply and first aid stations and supplies are not compromised by flood waters. Where possible these should all be raised above the extreme flood level.

8. Conclusions and recommendations

Table 9: Risk ratings following implementation and subsequent maintenance of mitigation measures

Source of Flood Risk	Baseline	After analysis and mitigation
River (fluvial) and Sea (coastal/tidal)	Negligible to Low	Very Low
Surface water (pluvial) flooding	Very Low	Very Low
Groundwater flooding	Low to Moderate	Low
Other flood risk factors present	No	N/A

The present day and future flooding risks have been assessed from all sources, the potential flood risks at the proposed development are all very low to low and the Site is currently in Flood Zone 1 and will be for the lifespan of the development. As such, the Sequential and Exceptions Tests are not considered to be required.

The table below provides a summary of where the responses to key questions are discussed in this report. Providing the recommended mitigation measures are put in place it is likely that flood risk to this Site will be reduced to an acceptable level.

Table 10: Summary of responses to key questions in the report

Key sources of flood risks identified	Groundwater (see Section 4).
Are standard mitigation measures likely to provide protection from flooding to/from the Site?	Yes (see Section 7).
Proposed flood mitigation	
Ground level raising will be undertaken in the southern area of the Site, south of Grevatt's Lane West, to a minimum level of 3.72 mAOD to reduce the risks of tidal and groundwater flooding to a minimum. Finished floor levels will be raised by 0.3 m above the existing and proposed ground levels with the consideration of additional measures including: • Passive flood door systems; • Temporary flood barriers;	

- Air brick covers (manual or automatic closing);
- Non-return flap valves on sewer outfalls.
- Interceptor drains (where applicable).
- Landscaping to divert water away from property;
- Flood resilient materials and designs:
 - Use of low permeability building materials up to 0.3 m such as engineering bricks (Classes A and B) or facing bricks;
 - Hard flooring and flood resilient metal staircases;
 - The use of internal lime plaster/render or where plasterboards are used these should be fitted horizontally instead of vertically and/or using moisture resistant plasterboard at lower levels;
 - Water, electricity and gas meters and electrical sockets should be located above the predicted flood level;
 - Communications wiring: wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage.

Additional Measures

The park area in the south of the Site will be comprised of water compatible and floodable structures.

A surface water drainage strategy report has been prepared separately (ref: 73345.02R1) to ensure surface water can be managed effectively through the use of SuDS features, over the lifetime of the proposed development, including sufficient allowances for climate change.

GeoSmart recommend the mitigation measures discussed within this report are considered as part of the proposed development where possible and evidence of this is provided to the Local Planning Authority as part of the planning application.

9. References and glossary

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Glossary

General terms

BGS	British Geological Survey
EA	Environment Agency
GeoSmart groundwater flood risk model	GeoSmart's national groundwater flood risk model takes advantage of all the available data and provides a preliminary indication of groundwater flood risk on a 50m grid covering England and Wales. The model indicates the risk of the water table coming within 1 m of the ground surface for an indicative 1 in 200 year return period scenario.
Dry-Island	An area considered at low risk of flooding (e.g. In a Flood Zone 1) that is entirely surrounded by areas at higher risk of flooding (e.g. Flood Zone 2 and 3)
Flood resilience	Flood resilience or wet-proofing accepts that water will enter the building, but through careful design will minimise damage and allow the re-occupancy of the building quickly. Mitigation measures that reduce the damage to a property caused by flooding can include water entry strategies, raising electrical sockets off the floor, hard flooring.
Flood resistance	Flood resistance, or dry-proofing, stops water entering a building. Mitigation measures that prevent or reduce the likelihood of water entering a property can include raising flood levels or installation of sandbags.
Flood Zone 1	This zone has less than a 0.1% annual probability of river flooding
Flood Zone 2	This zone has between 0.1 and 1% annual probability of river flooding and between 0.1% and 0.5 % annual probability sea flooding
Flood Zone 3	This zone has more than a 1% annual probability of river flooding and 0.5% annual probability of sea flooding
Functional Flood Plain	An area of land where water has to flow or be stored in times of flood.
Hydrologic model	A computer model that simulates surface run-off or fluvial flow. The typical accuracy of hydrologic models such as this is $\pm 0.25\text{m}$ for estimating flood levels at particular locations.
OS	Ordnance Survey
Residual Flood Risk	The flood risk remaining after taking mitigating actions.
SFRA	Strategic Flood Risk Assessment. This is a brief flood risk assessment provided by the local council
SuDS	A Sustainable drainage system (SuDS) is designed to replicate, as closely as possible, the natural drainage from the Site (before development) to ensure that the flood risk downstream of the Site does not increase as a result of the land being developed. SuDS also significantly improve the quality of water leaving the Site and can also improve the amenity and biodiversity that a site has to offer. There are a range of SuDS options available to provide effective surface water management that intercept and store excess run-off. Sites over 1 Ha will usually require a sustainable drainage assessment if planning permission is required. The current proposal is that from April 2014 for more than a single dwelling the drainage system will require approval from the SuDS Approval Board (SABs).

Aquifer Types

Principal aquifer	These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
Secondary A aquifer	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
Secondary B aquifer	Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.
Secondary undifferentiated	Has been assigned in cases where it has not been possible to attribute either category A or B to a rock type due to the variable characteristics of the rock type.
Unproductive Strata	These are rock layers or drift deposits with low permeability that has negligible significance for water supply or river base flow.

NPPF (2019) terms

Exception test	Applied once the sequential test has been passed. For the exception test to be passed it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk and a site-specific FRA must demonstrate that 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.
Sequential test	Aims to steer new development to areas with the lowest probability of flooding.
Essential infrastructure	Essential infrastructure includes essential transport infrastructure, essential utility infrastructure and wind turbines.
Water compatible	Water compatible land uses include flood control infrastructure, water-based recreation and lifeguard/coastal stations.
Less vulnerable	Less vulnerable land uses include police/ambulance/fire stations which are not required to be operational during flooding and buildings used for shops/financial/professional/other services.
More vulnerable	More vulnerable land uses include hospitals, residential institutions, buildings used for dwelling houses/student halls/drinking establishments/hotels and sites used for holiday or short-let caravans and camping.
Highly vulnerable	Highly vulnerable land uses include police/ambulance/fire stations which are required to be operational during flooding, basement dwellings and caravans/mobile homes/park homes intended for permanent residential use.

Data Sources

Aerial Photography	Contains Ordnance Survey data © Crown copyright and database right 2020 BlueSky copyright and database rights 2020
Flood Risk (Flood Zone/RoFRS/Historic Flooding/Pluvial/Surface Water Features/Reservoir/ Flood Alert & Warning)	Environment Agency copyright and database rights 2020 Ordnance Survey data © Crown copyright and database right 2020
Flood Risk (Groundwater)	GeoSmart, BGS & OS GW5 (v2.3) Map (GeoSmart, 2020) Contains British Geological Survey materials © NERC 2020 Ordnance Survey data © Crown copyright and database right 2020
Location Plan	Contains Ordnance Survey data © Crown copyright and database right 2020
Topographic Data	OS LiDAR/EA Contains Ordnance Survey data © Crown copyright and database right 2020 Environment Agency copyright and database rights 2020

Appendices

Appendix A

Site plans



Location Plan: 1:2500

Land at Little Meadow,
Yapton,
West Sussex,
BN18 0JY

SITE PLAN

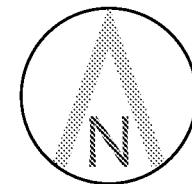
Revisions a) Note/Date/Initial
b)
c)

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Critchley Architecture And Design
Contact: 02392 474 919 | info@caad.online

The Old Brewery, 15E South Street, Havant, PO9 1BU

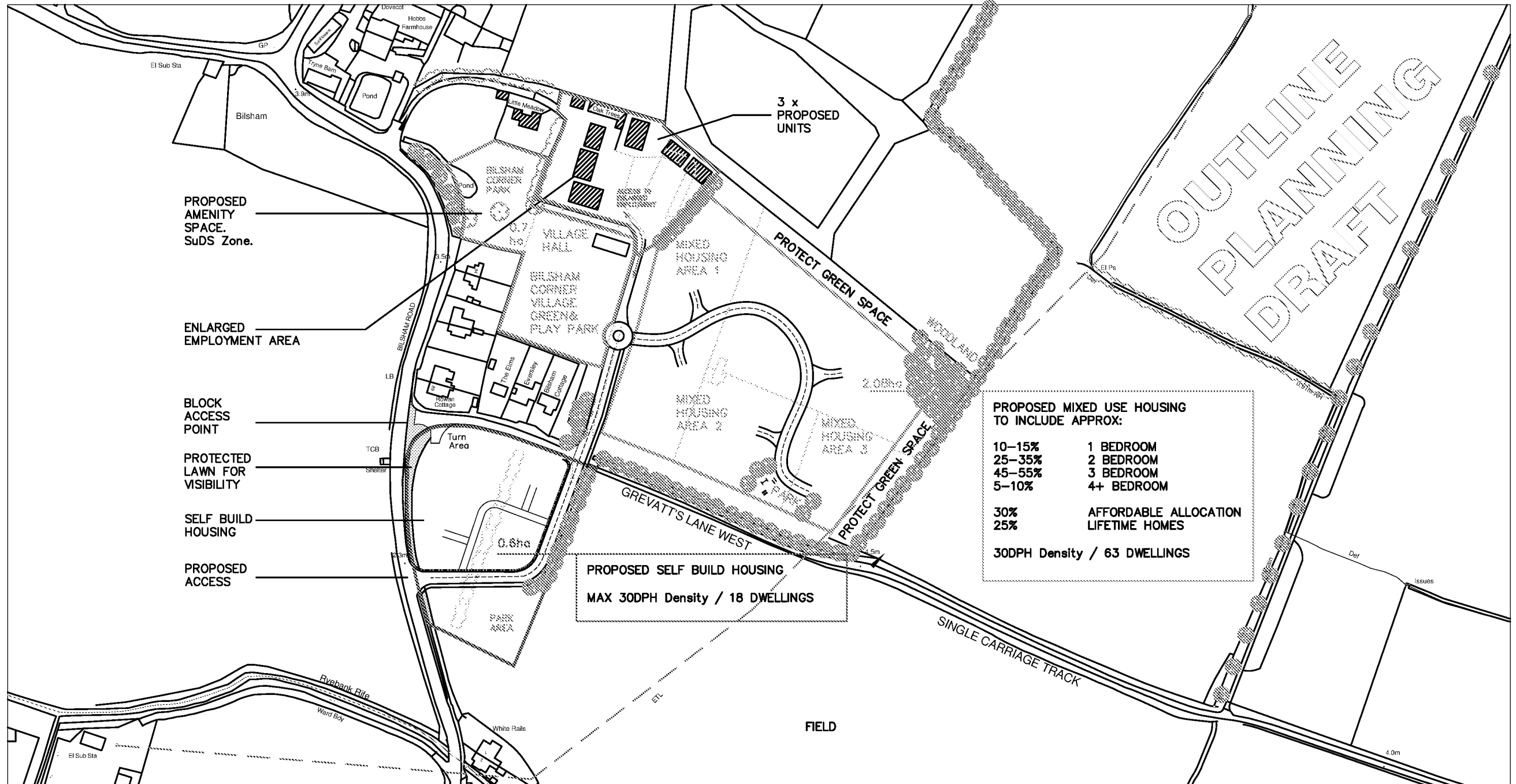


Scale A3 = As Shown
Drawn OS
Date 07/06/18

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0m 10m 20m 30m 40m 50m



Location Plan: 1:2500

Land at Little Meadow,
Yapton,
West Sussex,
BN18 0JY

PROPOSED SITE BOUNDARIES

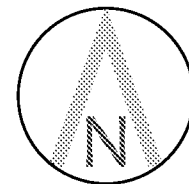
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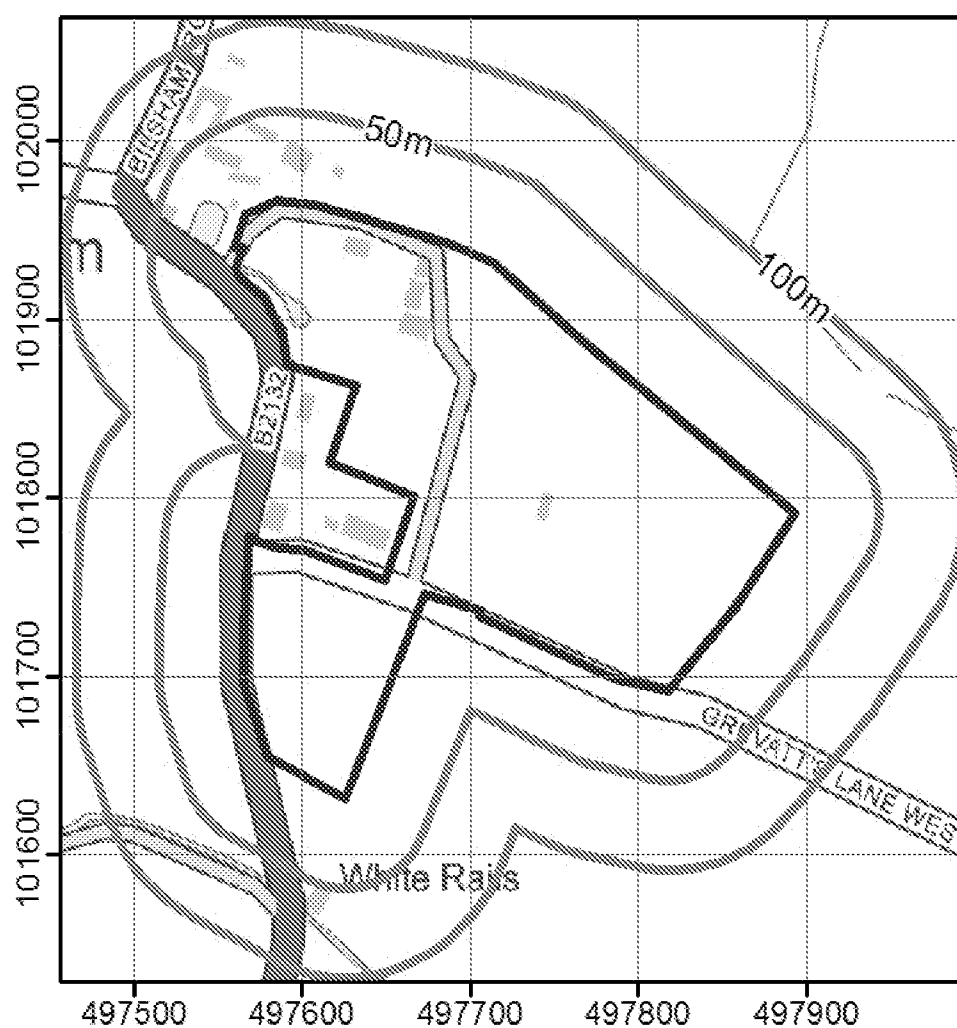
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0m 10m 20m 30m 40m 50m

Appendix B

Commercial flood mapping

Site Location Plan (OS, 2020)



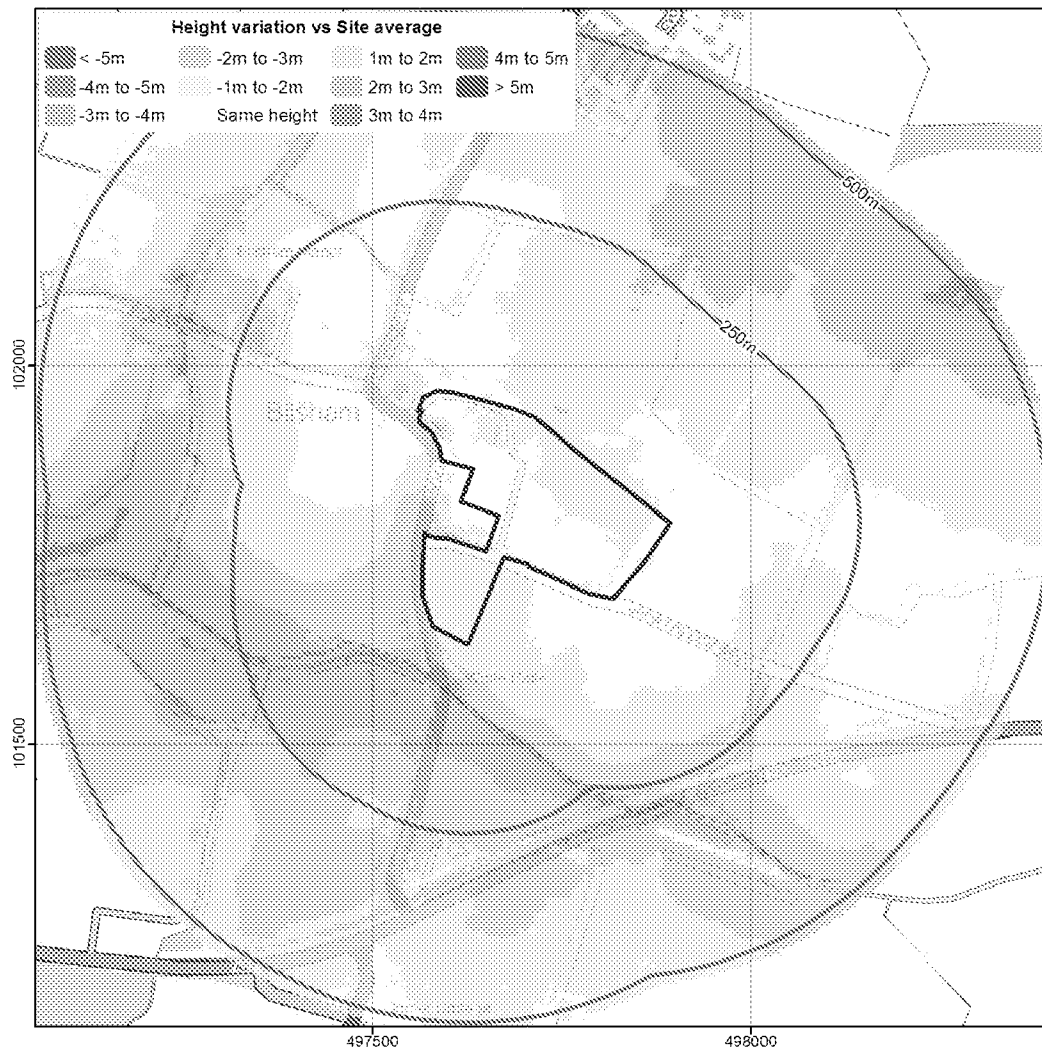
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Aerial Photograph (BlueSky, 2020)



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GeoSmart DTM5 (5m) map (EA, 2020)



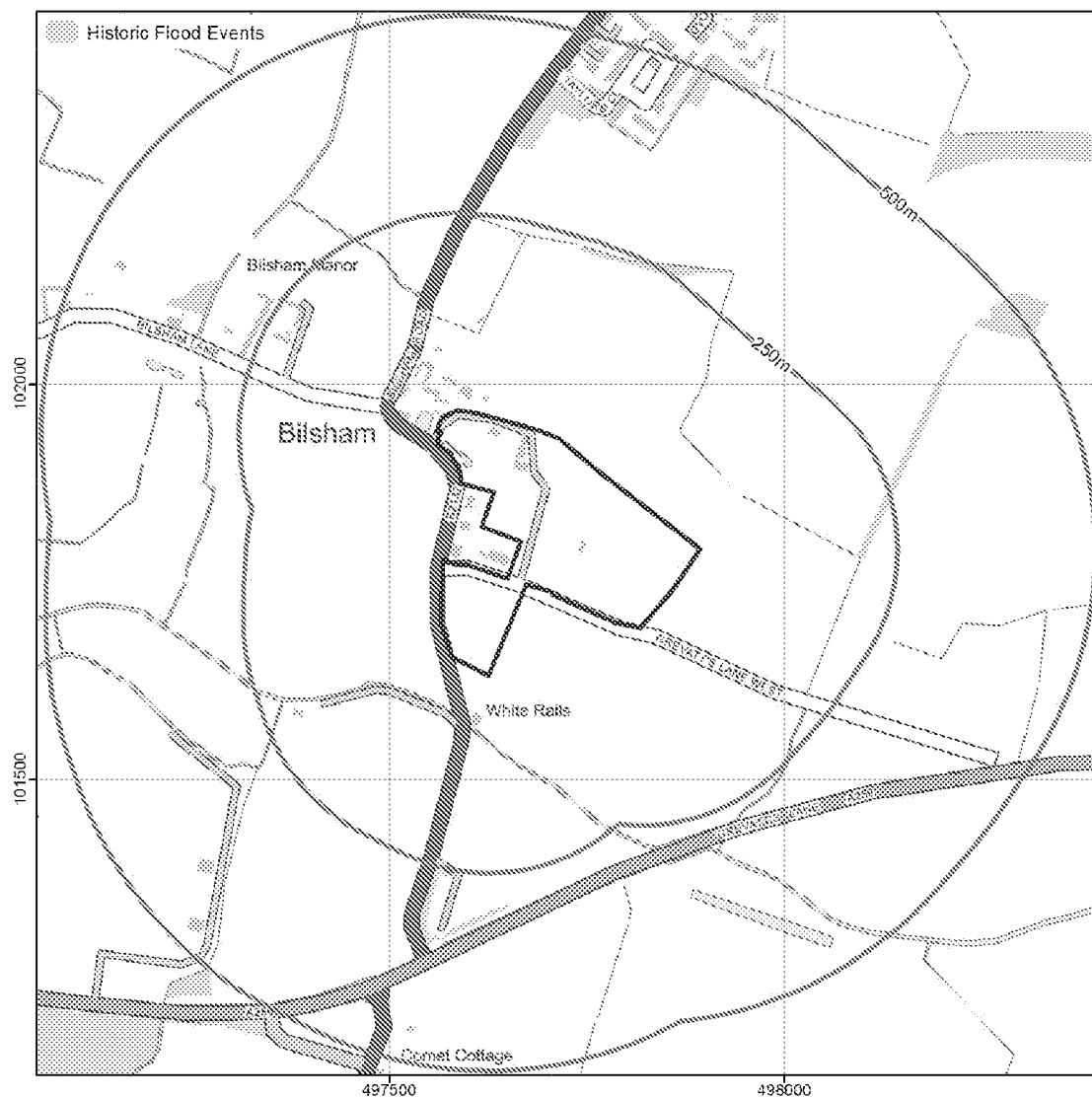
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Ordnance Survey Surface Water Feature Vector Map (OS, 2020)



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Environment Agency Historic Flood Map (EA, 2020)

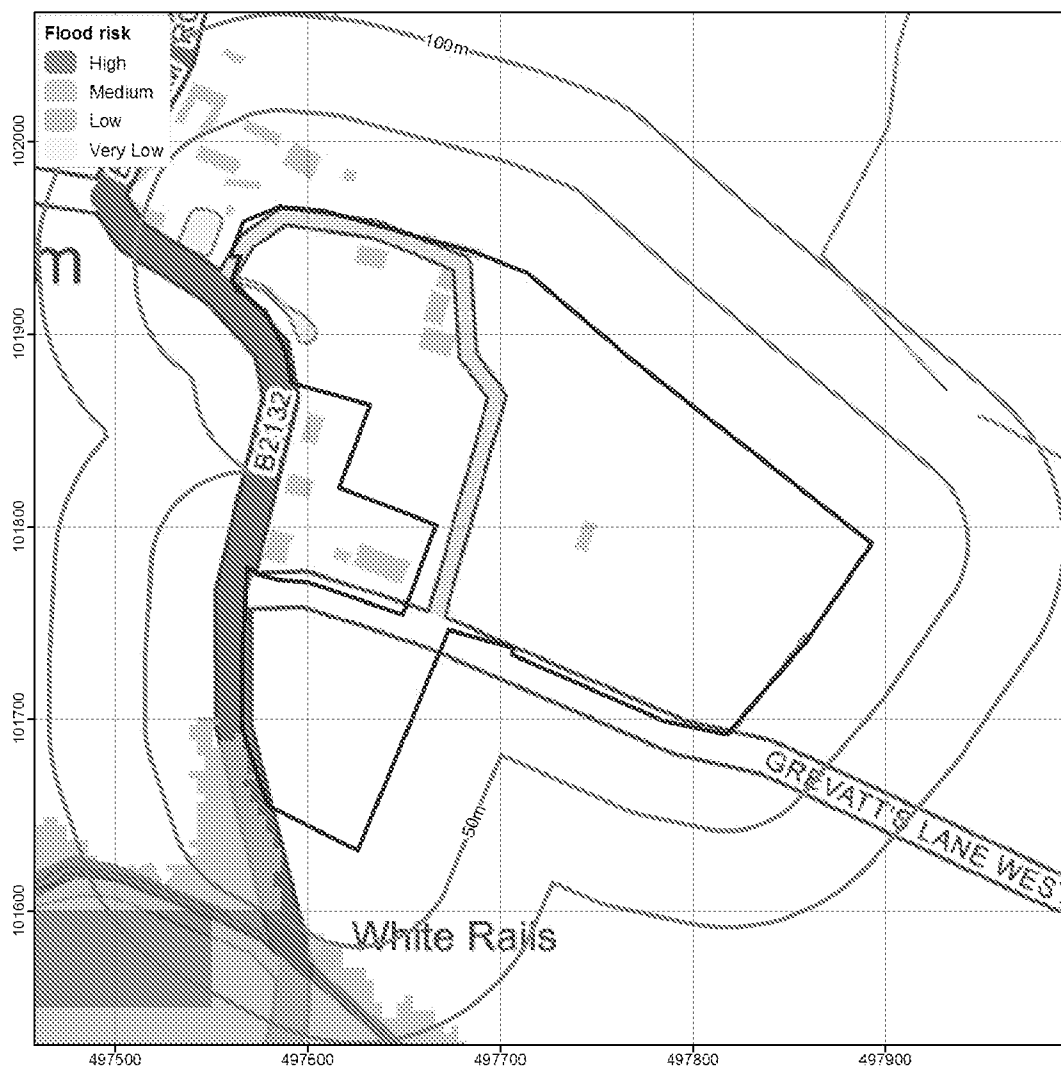


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Environment Agency's Flood Map for Planning Purposes (EA, 2020)

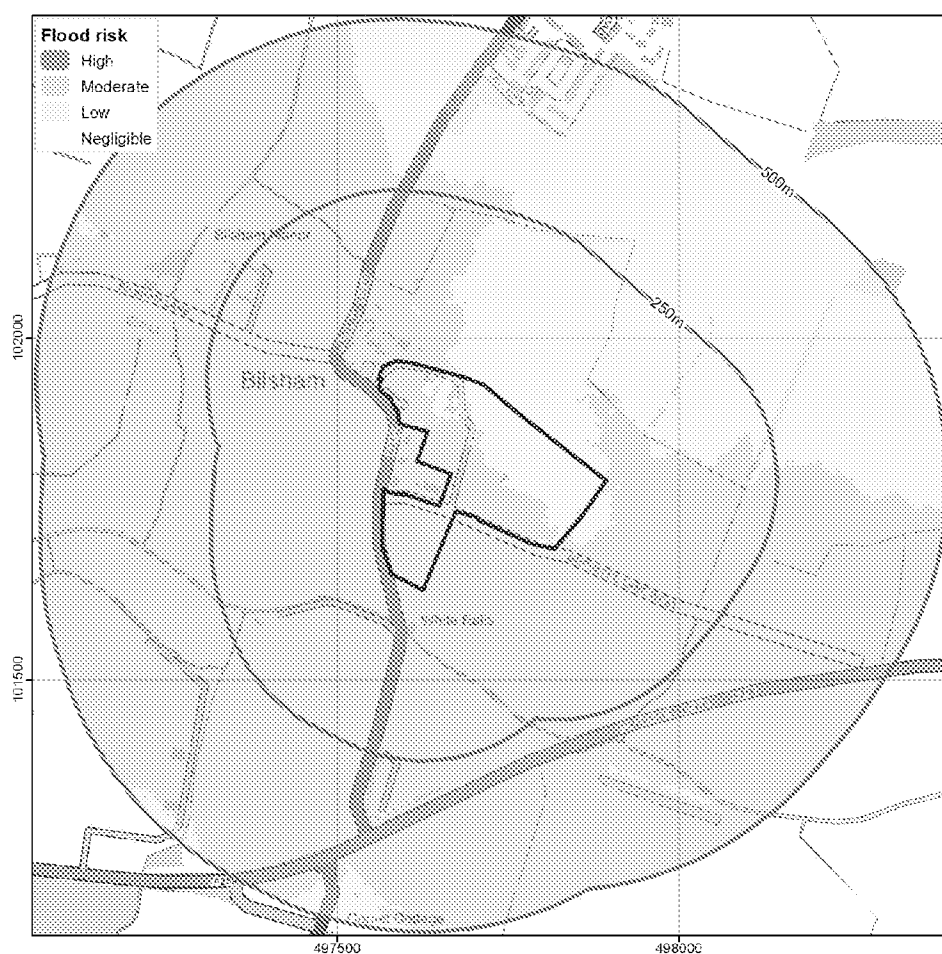


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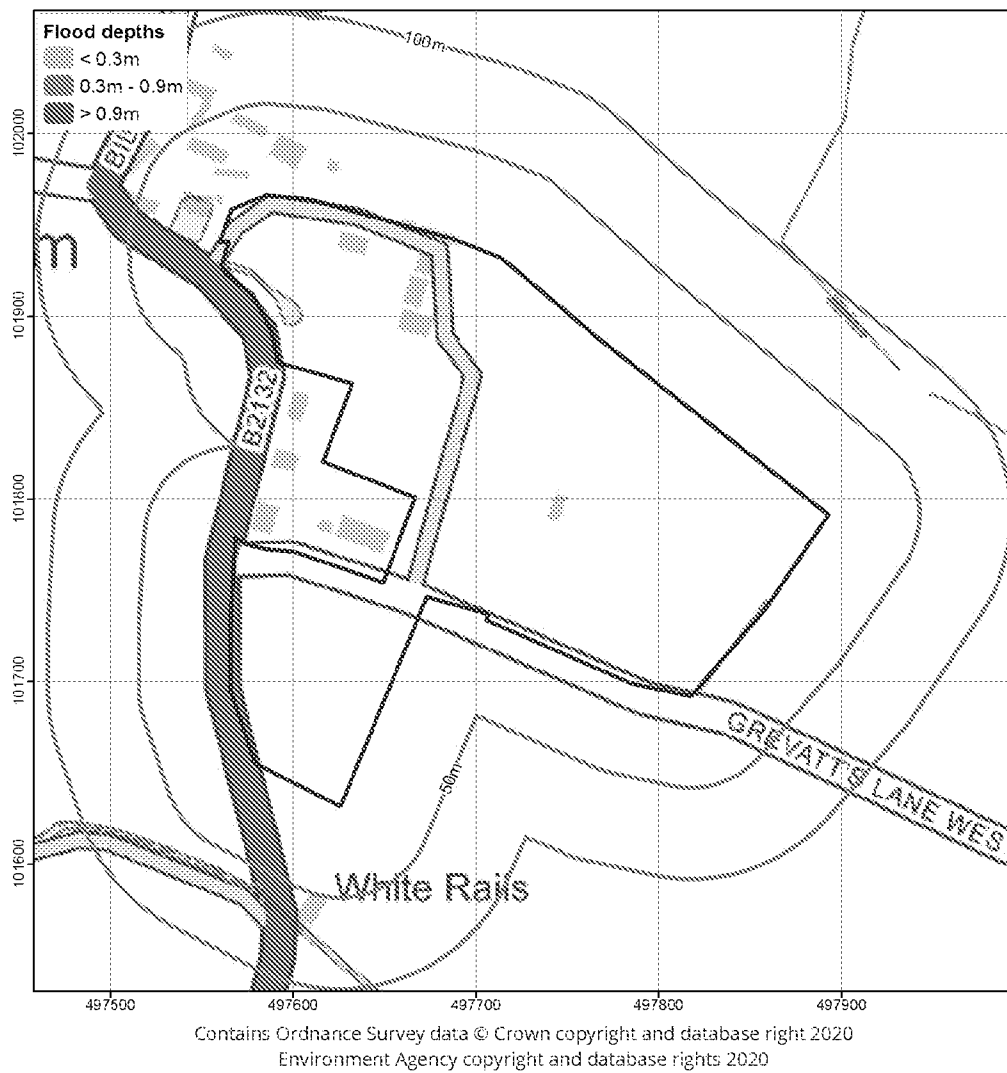
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GeoSmart Groundwater Flood Risk (GW5, v2.3) Map (GeoSmart, 2020)



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EA Risk of Flooding Surface Water (pluvial) Depth map 1 in 100 year (EA, 2020)



Environment Agency Flood Alert and Flood Warning Areas Map (EA, 2020)



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Appendix C

Environment Agency data

Sarah Scully
GeoSmart

Our ref: SSD175714

Date: 02/07/2020

Dear Sarah Scully,

Enquiry Regarding Product 4 for Flood Risk Assessment for Land At Little Meadow, Yapton, West Sussex, BN18 0JY.

Thank you for your enquiry which was received on 19 June 2020.

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

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

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

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

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

Flood Defences

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

Model Information

The model used was the River Arun to East Head Coastal Modelling (2D) which was completed by JBA Consulting in 2016. We do not have any Fluvial modelling covering this site.

Flood History

We hold no record of previous flooding events affecting this site.

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

[FRA advisory text](#)

Name	Product 4
Description	Detailed Flood Risk Assessment Map for Land At Little Meadow, Yapton, West Sussex, BN18 0JY.
Licence	<u>Open Government Licence</u>
Information Warnings	The flood risk data provided is based on existing EA hydraulic models for existing 0.5% annual probability events with an allowance for climate change. Please note the climate change allowances provided are not up to date. These were updated on 17 December 2019. You should refer to ' <u>Flood risk assessments: climate change allowances</u> ' for the most up to date allowances. You will need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.
Information Warning - OS background mapping	<i>The mapping of features provided as a background in this product is © Ordnance Survey. It is provided to give context to this product. The Open Government Licence does not apply to this background mapping. You are granted a non-exclusive, royalty free, revocable licence solely to view the Licensed Data for non-commercial purposes for the period during which the Environment Agency makes it available. You are not permitted to copy, sub-license, distribute, sell or otherwise make available the Licensed Data to third parties in any form. Third party rights to enforce the terms of this licence shall be reserved to OS.</i>
Attribution	Contains Environment Agency information © Environment Agency and/or database rights. Contains Ordnance Survey data © Crown copyright 2020 Ordnance Survey 100024198.

Data Available Online

Many of our flood datasets are available online:

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

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

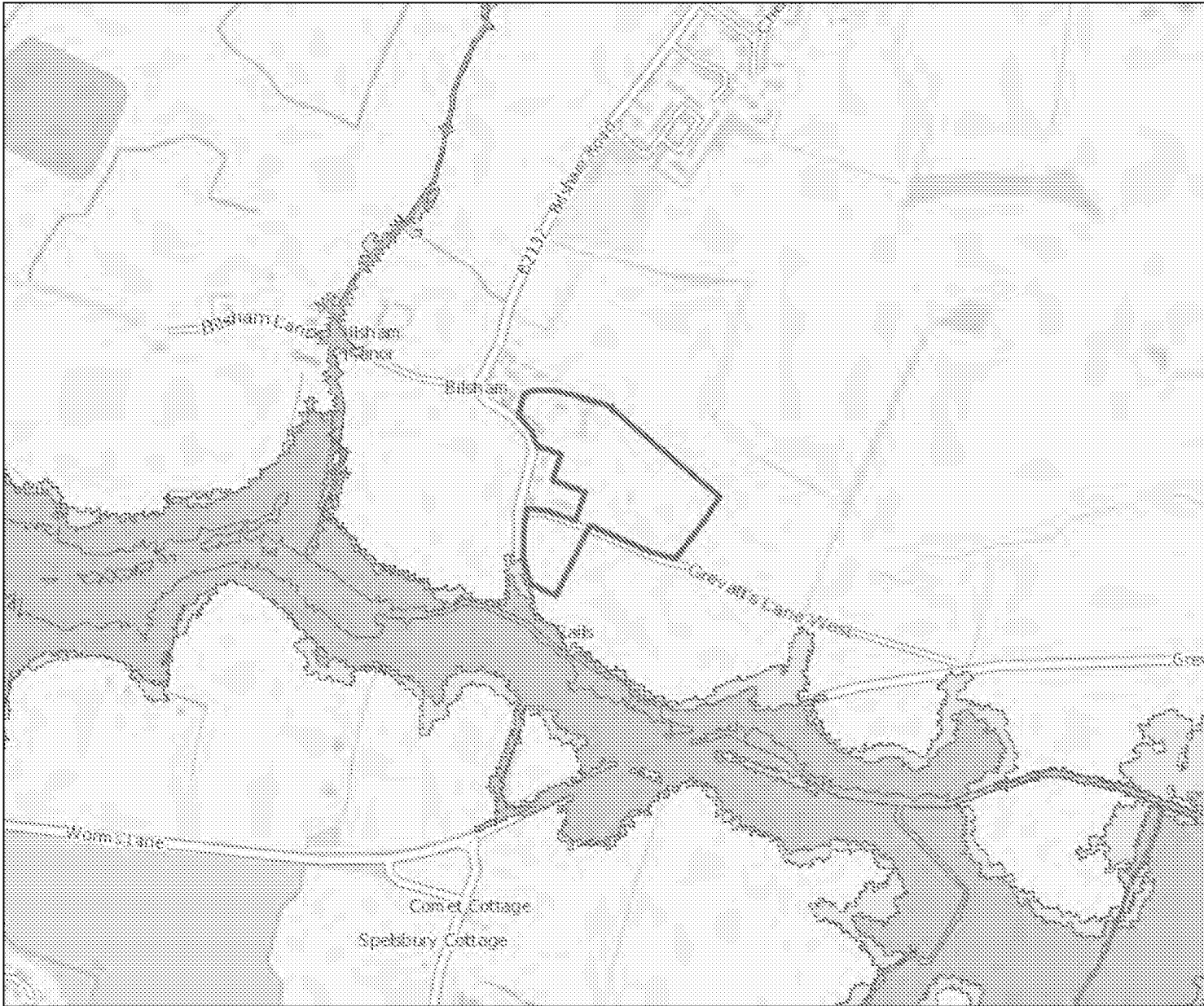
Yours sincerely,

Tom Lamboo

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

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

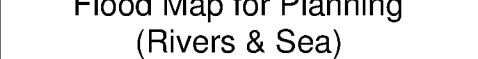
Flood Map for Planning (Rivers and Sea). Centred BN18 0JY. Created 02/07/2020.

 Environment Agency

1: 10,000

0 Metres 250

Flood Map for Planning



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

Flood Zone 3 shows the area that could be

affected by flooding:

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

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

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





Environment
Agency



N

Legend

-  Site_Nodes
-  Site_Boundary

Scale: 1:2,000



00.0450.09

Kilometers

Product 4 Flood Risk Data Requested by: GeoSmart
Site: Land at Little Meadow, Yapton, West Sussex, BN18 0JY

Table 1: Water Levels: Tidal Undefended

Node Ref	NGR		Modelled Flood Levels in Metres AOD			
	Eastings	Northings	Undefended Annual Exceedance Probability			
			0.5%	0.5% (2070)	0.5% (2115)	0.1%
1	497603	101654	-	-	3.72	-
2	497631	101744	-	-	3.72	-
2	497660	101862	-	-	-	-
4	497777	101770	-	-	-	-

Table 2: Water Levels: Tidal Defended

Node Ref	NGR		Modelled Flood Levels in Metres AOD			
	Eastings	Northings	Defended Annual Exceedance Probability			
			0.5%	0.5% (2070)	0.5% (2115)	0.1%
1	497603	101654	-	-	-	-
2	497631	101744	-	-	-	-
3	497660	101862	-	-	-	-
4	497777	101770	-	-	-	-

Table 3: Water Depths: Tidal Undefended

Node Ref	NGR		Modelled Flood Depths in Metres			
	Eastings	Northings	Undefended Annual Exceedance Probability			
			0.5%	0.5% (2070)	0.5% (2115)	0.1%
1	497603	101654	-	-	0.39	-
2	497631	101744	-	-	0.12	-
3	497660	101862	-	-	-	-
4	497777	101770	-	-	-	-

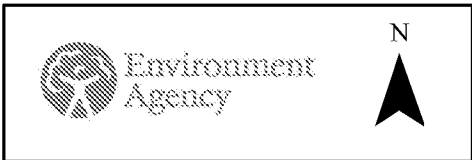
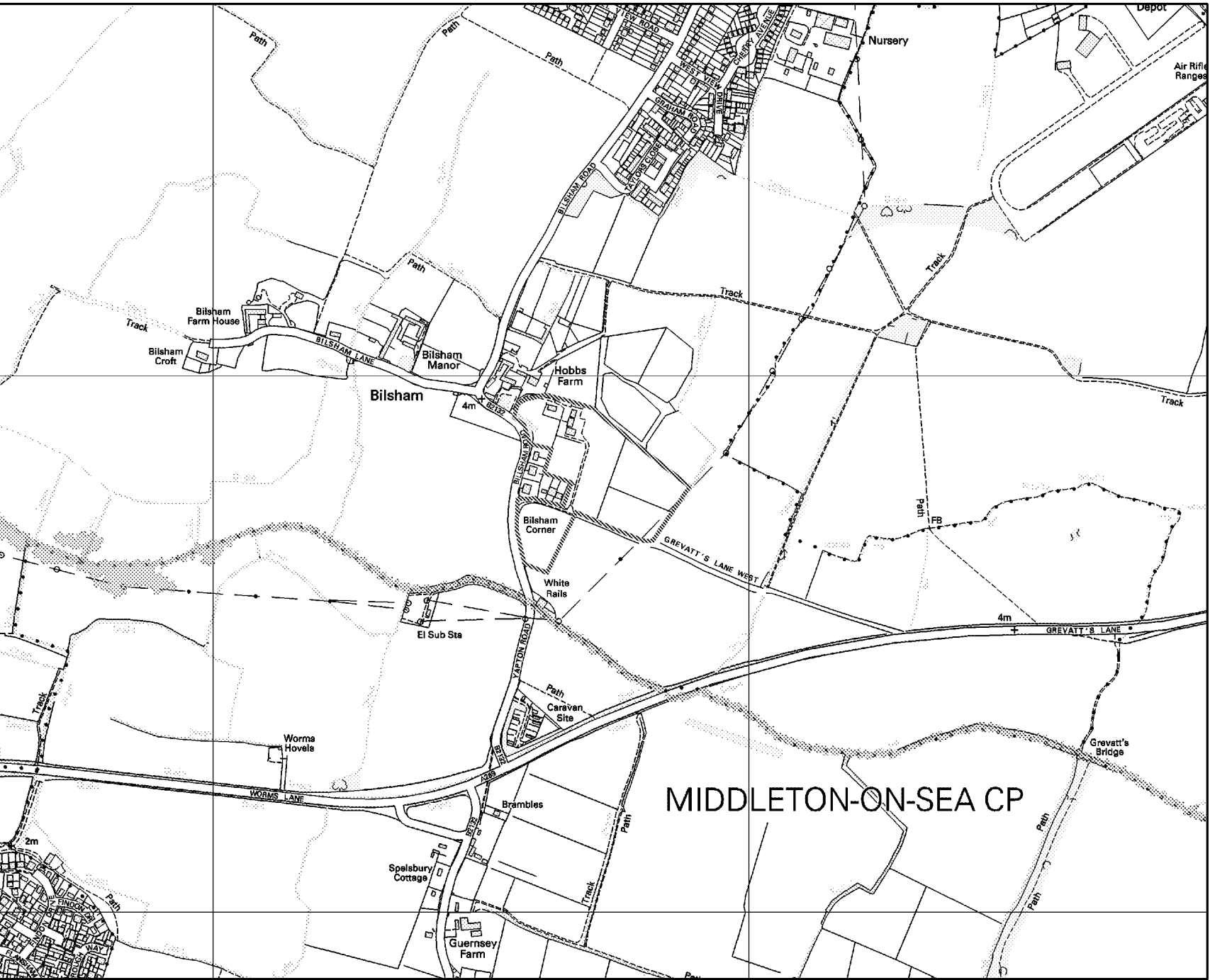
Table 4: Water Depths: Tidal Defended

Node Ref	NGR		Modelled Flood Depths in Metres			
	Eastings	Northings	Defended Annual Exceedance Probability			
			0.5%	0.5% (2070)	0.5% (2115)	0.1%
1	497603	101654	-	-	-	-
2	497631	101744	-	-	-	-
3	497660	101862	-	-	-	-
4	497777	101770	-	-	-	-

All levels taken from: River Arun to East Head Coastal Modelling (2D) (2016)

Produced on: 02/07/2020

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

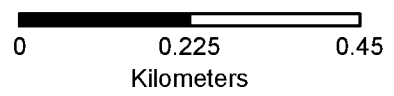


Legend

- Site_Boundary
- 0.5% AEP (Defended Tidal)
- 0.5% AEP (2070) NPPF (Defended Tidal)
- 0.5% AEP (2115) NPPF (Defended Tidal)
- 0.1% AEP (Defended Tidal)

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

Scale: 1:10,000







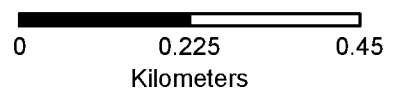
Environment
Agency

N
▲

- Legend**
- Site_Boundary
 - 0.5% AEP (Un defended Tidal)
 - 0.5% AEP (2070) NPPF (Un defended Tidal)
 - 0.5% AEP (2115) NPPF (Un defended Tidal)
 - 0.1% AEP (Un defended Tidal)

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

Scale: 1:10,000



Risk of flooding from Surface Water. Centred BN18 0JY. Created 02/07/2020.



1: 10,000

0 Metres 250



Likelihood of flooding from Surface Water

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

Likelihood of flooding from Surface Water

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

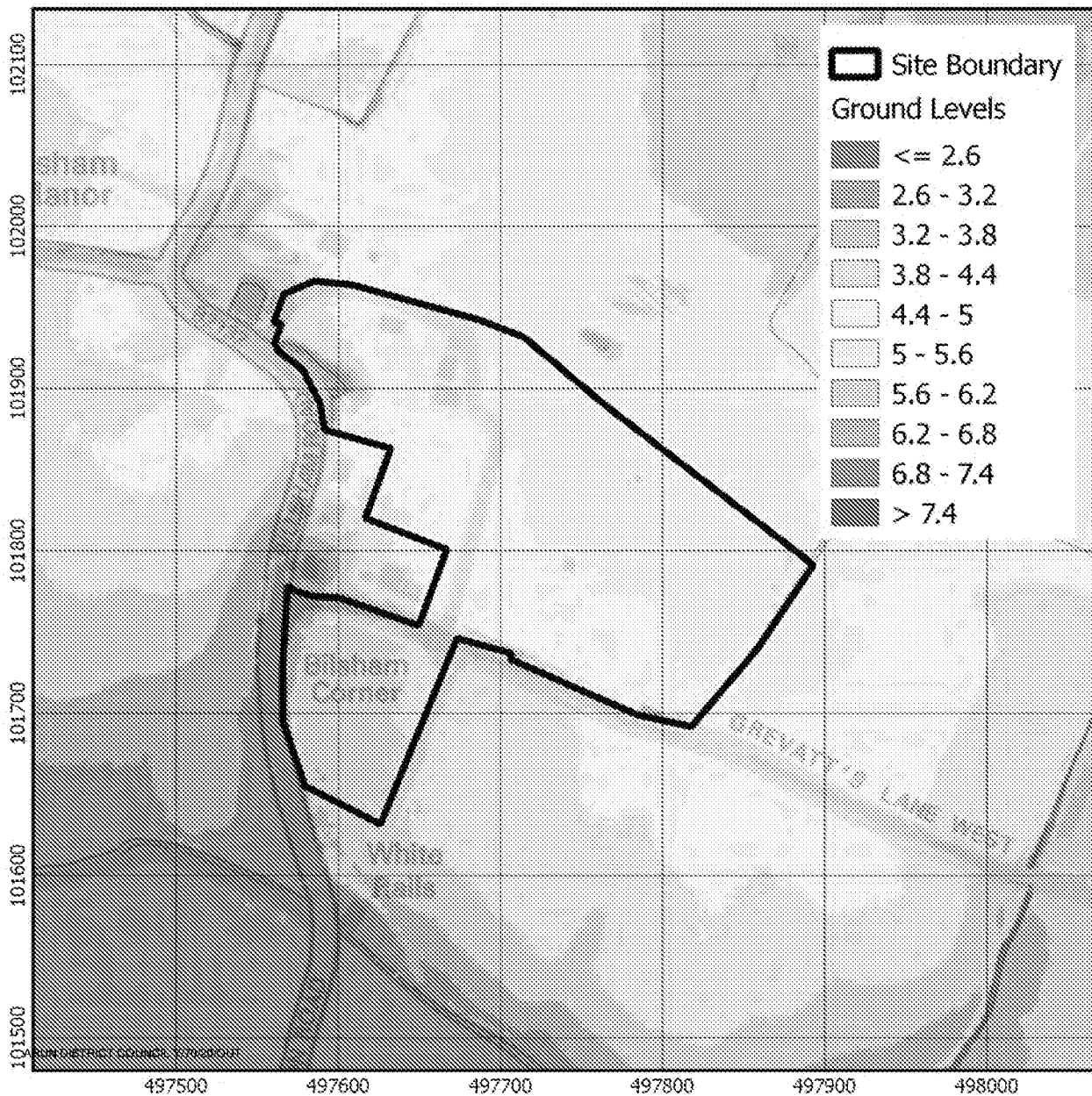
This information is shown on the Risk of Flooding from Surface Water map on GOV.UK.

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Appendix D

Environment Agency LiDAR Ground Elevation Data



Appendix E

2016 SFRA Mapping



Notes

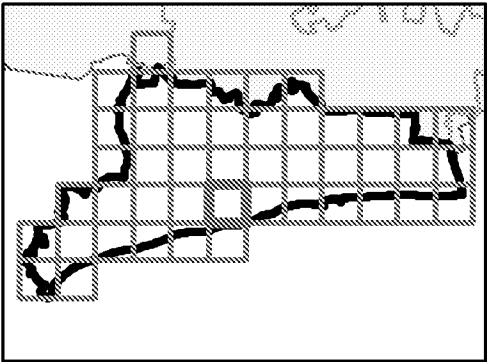
Zone 1: Comprised of land having a less than 1 in 1,000 annual probability of river or sea flooding in any year.

Zone 2: Comprised of land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding or 1 in 200 and 1 in 1,000 annual probability of sea flooding in any year.

Zone 3a: This zone comprises land assessed as having a greater than 1in 100 annual probability of river flooding or a greater than 1 in 200 annual probability of flooding from sea in any year.

Zone 3b: This zone comprises land where water has to flow or be stored in times of flood (the functional floodplain). The SFRA identified this Flood Zone as land which would flood with an annual probability of 1 in 20 years, where detailed modelling exists. In the absence of detailed hydraulic model information, a precautionary approach has been adopted with the assumption that the extent of Flood Zone 3b would be equal to Flood Zone 3a. If development is shown to be in Flood Zone 3a, further work should be undertaken as part of a detailed site specific

Key Plan



Legend

Arun District SFRA boundary

Flood Zone 3b

Flood Zone 3a

Flood Zone 2

REF	Date	Comments
A	June 2010	-
B		
C		

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ARUN DISTRICT COUNCIL

**LEVEL 1 SFRA: APPENDIX C
FLOOD ZONES**

Sheet No: 13 of 48 Index Number: AGC_13

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Notes:

The Arun SFRA is a strategic assessment of flooding. Users of the SFRA should be aware of this when interpreting the information presented. The user is directed to the SFRA reports which outline the uncertainties associated with the studies. Particular attention is drawn to the following:

- Flood extent boundaries are not considered definitive. Land adjacent to these areas may also be at risk.
- Some flooding mechanisms have not been included in the assessment. The 'coastal risk area' is based on advice from LA Engineers and requires further assessment.

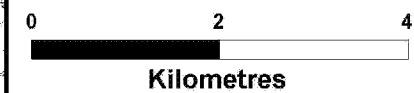
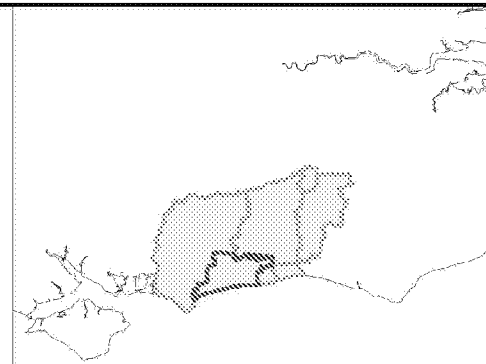
Arun District Council SFRA

Map C2-F - Climate Change Fluvial Flood Zones



CAPITA SYMONDS

-  Arun District Boundary
-  Future Flood Zone 3b (2056)
-  Future Flood Zone 3b (2106)
-  Future Flood Zone 3a (2056)
-  Future Flood Zone 3a (2106)

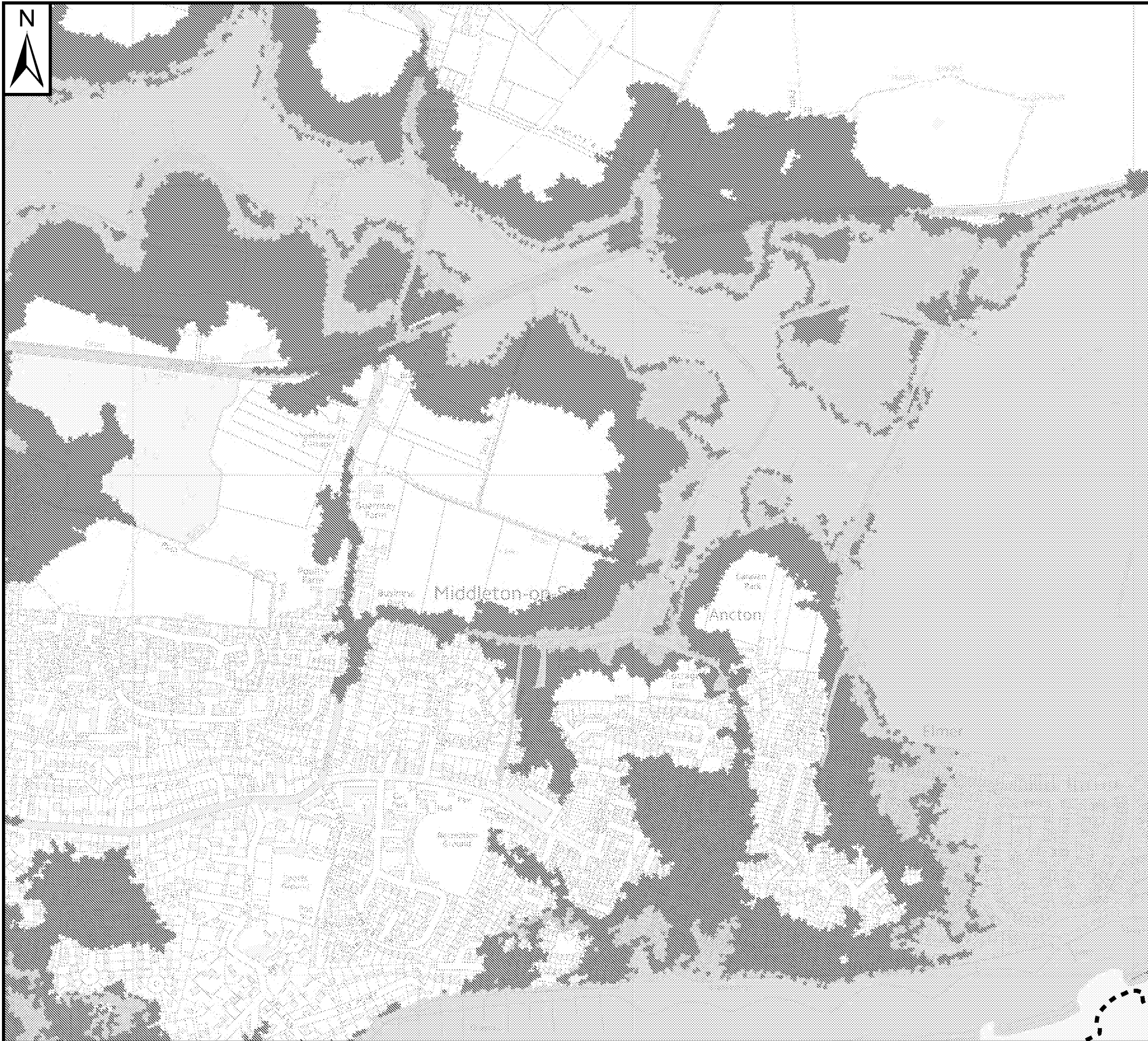


Scale at A3: 1:80,000

Date: 31/01/2008

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Map_C2-F wor



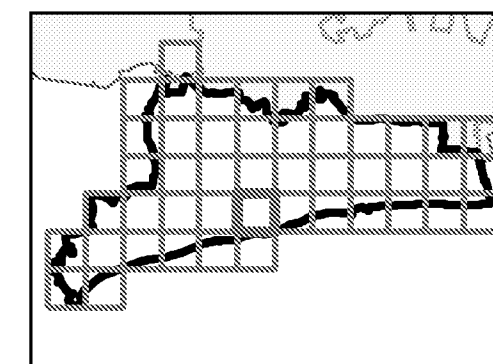
Notes

Hydraulic modelling has been undertaken as part of this SFRA to provide updated climate change flood mapping in the Arun District for Flood Zone 3a. This modelling followed the latest guidance for climate change in FRAs/SFRAs released by the Environment Agency in February 2016 (and updated in April 2016). Climate change for fluvial events has been based on the Higher Central estimates for the years 2031, 2061 and 2111. Present day flood risk information is available for comparison. Arun District is within the South East River Basin District and therefore allowance are:

- 2031 = +15% flows
- 2061 = +30% flows
- 2111 = +45% flows

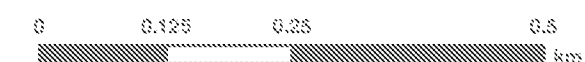
For tidal/coastal models, undefended case still water level and defended case still water level with wave overtopping simulations have been completed to inform future flood risk within the Arun District. Again, climate change allowance predictions are for the years 2031, 2061 and 2111, with present day outputs for comparison.

Key Plan



Legend

- Arun District SFRA boundary
- Present Flood Zone 3a
- Future Flood Zone 3a (2031)
- Future Flood Zone 3a (2111)



REF	Date	Comments
A	August 2016	
B		
C		

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ARUN DISTRICT COUNCIL

LEVEL 1 SFRA: APPENDIX D CLIMATE CHANGE MAPPING

Sheet No: 13 of 46

Index Number: ADC_13

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Tel: 01743 298 100

Email: info@geosmartinfo.co.uk

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The Property Ombudsman scheme

Milford House

43-55 Milford Street

Salisbury

Wiltshire SP1 2BP

Tel: 01722 333306

Fax: 01722 332296

Email: admin@tpos.co.uk

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- Keep you informed by letter, telephone or e-mail, as you prefer, if we need more time.
- Provide a final response, in writing, at the latest within 40 working days of receipt.
- Liaise, at your request, with anyone acting formally on your behalf.

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Alan White

Operations Manager

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Tel: 01743 298 100

alanwhite@geosmartinfo.co.uk

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