

AMBIENTAL

ENVIRONMENTAL ASSESSMENT

Flood Risk Assessment 6299

Seafever,
188 Elmer Road,
Bognor Regis,
West Sussex
PO22 6JA

Ambiental Environmental Assessment
Sussex Innovation Centre,
Science Park Square,
Brighton, BN1 9SB

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Prepared for: Clive Caplin

Reference: 6299

Site Location: Seafever, 188 Elmer Road, Bognor Regis, West Sussex, PO22 6JA

Proposed Development: It is understood that the development is for the demolition of the existing residential dwelling on site, followed by the construction of a replacement dwelling.

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1. Summary

- 1.1 Ambiental Environmental Assessment has been appointed by Clive Caplin to undertake a National Planning Policy Framework (NPPF) compliant Flood Risk Assessment (FRA) for the proposed development at Seafever, 188 Elmer Road, Bognor Regis, West Sussex, PO22 6JA.
- 1.2 The site currently comprises an existing residential dwelling. It is understood that the development is for the demolition of the existing dwelling, followed by the construction of a replacement dwelling. Plans of the development provided by the client demonstrate that the built footprint of the replacement dwelling will be the same as that of the existing house. Sleeping accommodation will be provided at the first and second floor levels of the proposed house. Plans of the proposed development are in Appendix 1.
- 1.3 With reference to the Environment Agency (EA) Flood Map for Planning, the proposed development site is located within Flood Zones 1, 2 and 3 (low, medium, and high risk of flooding from fluvial and tidal sources). The English Channel is approximately 55m south of the site (based on the Mean High-Tide Water Level) and Elmer Rife, an EA Main River, is approximately 540m east of the site.
- 1.4 The existing residential dwelling is considered “More Vulnerable” under Table 2 of the Flood Risk and Coastal Change Planning Practice Guidance and the principles of the National Planning Policy Framework (NPPF). There will be no change in flood risk vulnerability of the site post-development.
- 1.5 A summary of the main findings within this report are as follows:
 - The EA provided site-specific modelled flood information for both undefended and defended scenarios. The model used was the River Arun to East Head Coastal Modelling, completed in 2016 by JBA Consulting.
 - The EA does not hold records of previous flooding events affecting the site.
 - If there were no existing flood defences in place, the rear of the site would be affected by flooding in the 1:200-year tidal flood event; and the site would be wholly affected by flooding in the 1:1,000-year tidal flood event.
 - Information provided by the Environment Agency shows that there is an existing tidal wall (Asset ID: 127642) which benefits the site and is maintained by the Environment Agency. The current standard of protection is 100 years from 2006, and its effective crest level is 5.5m. The site also likely benefits from the breakwaters and sand and shingle beach, south-east of the site.
 - Due to these flood defences, the site is shown to remain unaffected by flooding in the modelled defended flood scenarios, during the 1:200-year and 1:1,000-year tidal flood events. The site is, however, shown to be affected by flooding in the 1 in 200-year (2115 epoch) flood event, according to the 2016 data. This does not take account of the EA’s latest climate change allowances.
 - To account for this, Ambiental have used the 1:200-year flood level (undefended) at the site and the December 2019 updated climate change allowances for sea level rise to calculate the flood levels and depths on site. The calculations, ignoring the presence of flood defences, have demonstrated the following:

- A flood level of 5.03mAOD in the 1:200-year +CC (Higher Central) undefended event, resulting in maximum flood depths of 1.23m on site.
- During the 1:200-year +CC (Upper End) undefended scenario, the site could be affected by a flood level of 5.41mAOD, resulting in maximum flood depths of 1.60m on site.
- These climate change flood levels represent a worst-case scenario, if no flood defences were benefitting the site.
- The Beachy Head to Selsey Bill Shoreline Management Plan (2006) demonstrates that the Policy Unit 4d21, in which the site is located, should continue to be managed and maintained through holding the line, up until the year 2105. Thus, the site should continue to benefit from coastal flood defences up to 2105.
- From a review of the plans, it is not known whether the built footprint on site will increase as a result of the development. The site is in a coastal floodplain, therefore flood compensatory storage is not required.
- The site is positively drained as existing. Given that the proposal is for the replacement of the existing dwelling on site, it is recommended that the surface runoff is discharged via the existing drainage infrastructure. Any additional surface water runoff generated as a result of the development should be attenuated by temporarily storing in a rainwater harvesting system, such as water butts or rain planters. Water butts can provide non-potable water uses on site and rain planters can provide additional ecological benefits to the site.

1.6 The following mitigation measures are recommended for the proposed replacement dwelling:

- Plans of the proposed dwelling show that the proposed Finished Floor Level of the ground floor will be set to 4.11mAOD. The proposed plans do not indicate a floor level for the first and second floors. Floor to ceiling heights are typically 2.4m, so it is expected that the first-floor level would be at 6.5mAOD.
- Habitable rooms should be provided at the ground floor level (kitchen, dining room, studio, utility room, study and snug), with sleeping accommodation at the first and second floor levels.
- Sleeping accommodation should be raised a minimum of 600mm above the 1:200-year +CC flood level, using the worst-case Upper End scenario, which would result in a floor level of 6.01mAOD.
- Emergency safe refuge could be sought at the first and second floor levels, if required. Furthermore, given the nature of tidal flooding, it is likely that sufficient early warning would be provided before flood waters reach the site.
- Residents should sign up to the EA Flood Warning service. In the event of an EA Flood Warning, the site shall be evacuated for the duration of the warning.
- The proposed replacement dwelling should incorporate flood resilience measures in line with current best practice for construction within an area at risk of flooding in line with CLG 2007 'Improving the Flood Performance of New Buildings. These are outlined in Section 7 of the report.
- Additional SuDS devices could be implemented to provide some additional betterment.

Following the guidelines contained within the NPPF, the proposed development is considered to be suitable assuming appropriate mitigation (including adequate warning procedures) can be maintained for the lifetime of the development.

Development Description	Existing	Proposed
Development Type:	Existing two-storey residential dwelling	Demolition of existing dwelling and construction of a replacement three-storey dwelling.
Number of Bedrooms:	N/A	3no. bedrooms
EA Vulnerability Classification:	More vulnerable	More vulnerable
Ground Floor Level:	Existing ground levels are circa 3.8mAOD to 4.8mAOD, according to the EA's 2m DTM LiDAR dataset. The topographic survey supports this. Finished Floor Level of existing house is 4.40mAOD, according to plans.	Finished Floor Level of proposed new dwelling are 4.11mAOD, according to plans.
Level of Sleeping Accommodation:	N/A	First and second floor
Impermeable Surface Area:	Existing built footprint is approx. 132m ²	Proposed built footprint is the same as existing.
Surface Water Drainage:	Existing building is positively drained	Recommended that the proposed replacement dwelling is drained via the existing drainage infrastructure. Additional SuDS devices could be implemented to provide additional betterment.
Site Size:	331m ²	Same as existing
Risk to Development	Summary	Comment
EA Flood Zone:	Flood Zone 3	The Environment Agency has provided modelled flood information for the site. The existing flood defences near the site have a design standard of protection of up to the 1 in 100-year event, according to information provided by the EA. The modelled flood outputs for the defended scenarios demonstrate that the site would not be affected by flooding in the 1:200-year and 1:1000-year tidal events; the site could, however, be affected by flooding in the 1:200-year event (2115 epoch), based on old climate change allowances.
Flood Source:	Tidal	
1:200 Year Flood Level	Site is defended	
1:200 Year Flood Level & Climate Change	Site is defended	
1:1000 Year Flood Level	Site is defended	
Recorded Flood Events in Area:	No	EA have stated they hold no records of flooding in this area.
Recorded Flood Events at Site:	No	
SFRA Available:	Yes	Arun District Council SFRA (2016)
Management Measures	Summary	Comment
Ground floor level above extreme flood levels:	Yes	Modelled outputs for the defended event show the site would not be affected by flooding up to the 1:1000-year event. Therefore, floors will be above extreme flood levels.
Safe Access/Egress Route:	Yes	See Section 7
Flood Resilient Design:	Yes	See Section 7
Site Drainage Plan:	Yes	Recommended that the proposed replacement dwelling is drained via the existing drainage infrastructure. Additional SuDS devices could be implemented to provide additional betterment.
Flood Warning & Evacuation Plan:	Yes	EA Flood Alert/Warning Service Area
Offsite Impacts	Summary	Comment
Displacement of floodwater:	No	Site is in a tidally dominated floodplain, so flood compensation storage is not required.
Increase in surface run-off generation:	No	The development will result in an increase in built footprint, however any increase in surface water run-off will be discharged via the existing drainage infrastructure for the site or via small-scale SuDS devices.
Impact on hydraulic performance of channels:	None	Development should not affect any watercourses.

Table 1 Summary of flood risks, impacts and proposed flood mitigation measures.

N/A¹ not required for this assessment; N/A² data not available.

2. Development Description and Site Area

Proposed Development and Location

- 2.1 The proposed development is located at Seafever, 188 Elmer Road, Bognor Regis, West Sussex, PO22 6JA (Figures 1 and 2).
- 2.2 The site currently comprises an existing two-storey residential dwelling. It is understood that the development is for the demolition of the existing dwelling, followed by the construction of a replacement three-storey dwelling. From reviewing the proposed plans of the development, which are included in Appendix 1, it is understood that the built footprint of the replacement dwelling will be the same as that of the existing house.
- 2.3 The Environment Agency's 2m remotely sensed DTM LiDAR dataset provides a representation of terrain, with features such as buildings and vegetation removed. Ambiental have reviewed this dataset and found that the existing ground levels at the site are between approximately 3.80mAOD and 4.80mAOD. A topographic survey of the site has been provided by the client (see Appendix 1) and the ground levels shown at the site agree with those from the EA's LiDAR data. The lowest topographic level (3.80mAOD) is at the front of the site, closest to Elmer Road, whilst the highest topographic level (4.80mAOD) is at the rear of the site.
- 2.4 A cross-section of the site topographic is shown in Figure 3, using the EA's 2m LiDAR dataset. Contour lines have been shown at 0.2m intervals.

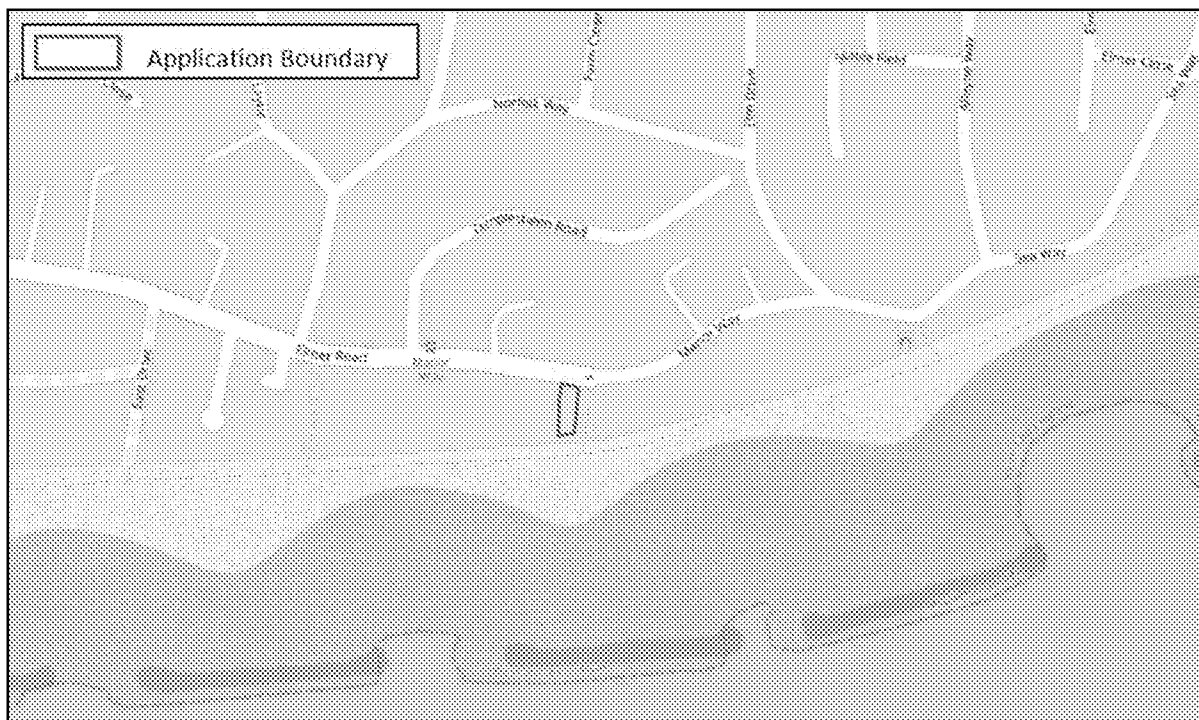


Figure 1 Location Map, identifying the location of the proposed development (Source: OS)



Figure 2: Aerial imagery, showing location of site (Source: Google Satellite)

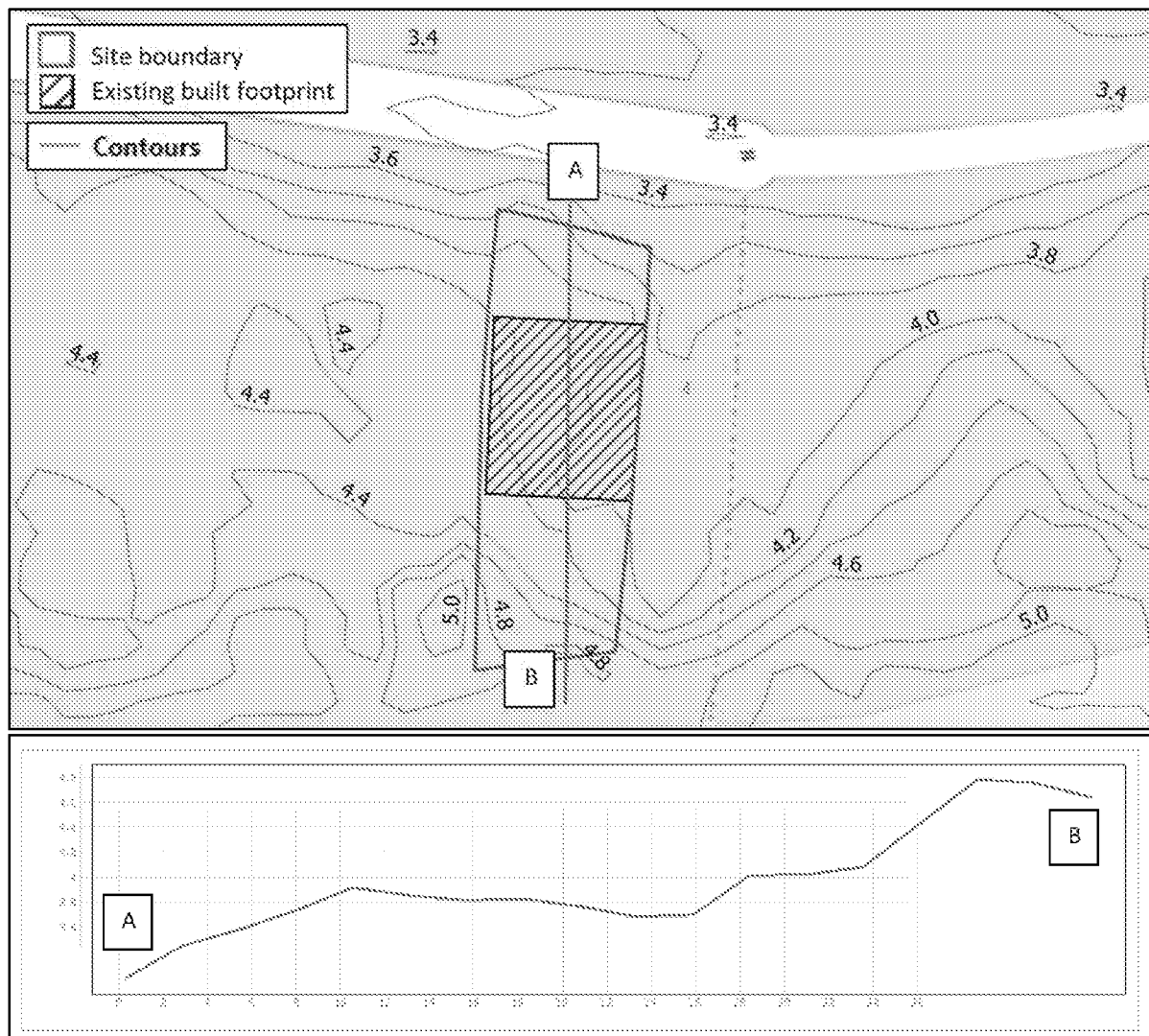


Figure 3: Cross section of site topography and contour lines at 0.2m intervals, using EA's 2m DTM LIDAR

Vulnerability Classification

2.5 The EA Flood Map for Planning (Figure 4) demonstrates that the proposed development site lies within Tidal Flood Zones 1, 2 and 3. The EA Flood Zones are defined as follows:

- Flood Zone 1: areas have a low probability of less than 1 in 1,000 (<0.1%) of flooding from seas or tidal estuaries in any year;
- Flood Zone 2: areas have a medium probability of between 1 in 200 and 1 in 1,000 (0.1% to 0.5%) of flooding from seas or tidal estuaries in any year;
- Flood Zone 3: areas have a high probability of greater than 1 in 200 (0.5%) of flooding from seas or tidal estuaries in any year.

2.6 Under Table 2 of the Flood Risk and Coastal Change Planning Practice Guidance and the principles of the National Planning Policy Framework (NPPF), the existing site is classified as 'More Vulnerable', due to its residential usage. The proposal is for the demolition of the existing dwelling and construction of a replacement dwelling. As such, post-development, the NPPF flood risk vulnerability will be unchanged compared to the existing situation.

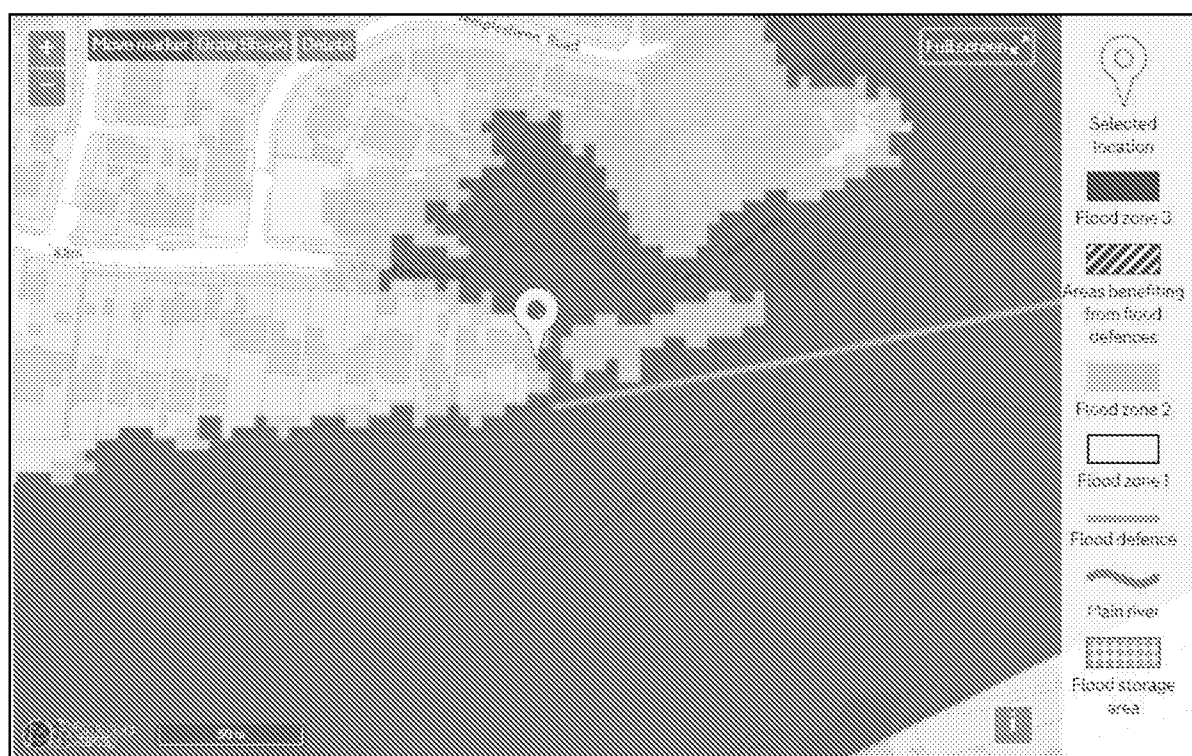


Figure 4: EA Flood Map for Planning (Source: EA)

Geology

- 2.7 The British Geological Survey (BGS) Geology of Britain Viewer indicates that the bedrock underlying the site is Newhaven Chalk Formation, which comprises of chalk. (Source: BGS). This formation is considered to be a Principal aquifer (Source: EA; Magic Map online resource. See Figure 5). A Principal aquifer is highly permeable, supporting water supply and/or river base flow on a strategic scale.
- 2.8 The superficial deposits underlying the site are Raised Beach Deposits, 1, comprising of sand and gravel (Source: BGS). This formation is a Secondary 'A' aquifer and Secondary (undifferentiated) aquifer (Source: EA; Magic Map online resource. See Figure 6). A Secondary 'A' aquifer is permeable, supporting water supplies at a local scale and may contribute to base flow of rivers. A Secondary (undifferentiated) aquifer is permeable, supporting water supplies at a local scale and may contribute to base flow of rivers and/or low permeability but with limited groundwater available in fissures or thin geological horizons.
- 2.9 The site is not within an area identified as an EA groundwater Source Protection Zone, according to the online Magic Maps. This is shown in Figure 7.

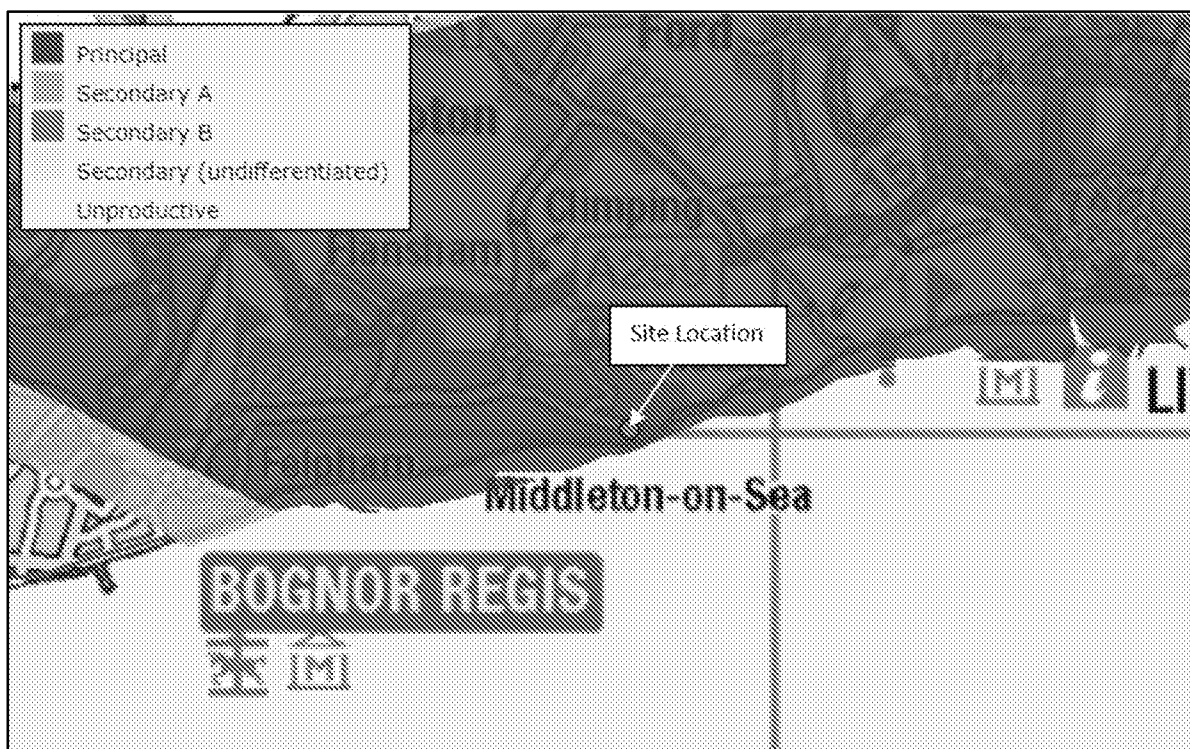


Figure 3: Aquifer Designation of Bedrock Geology, indicating location of site (Source: MagicMap online)

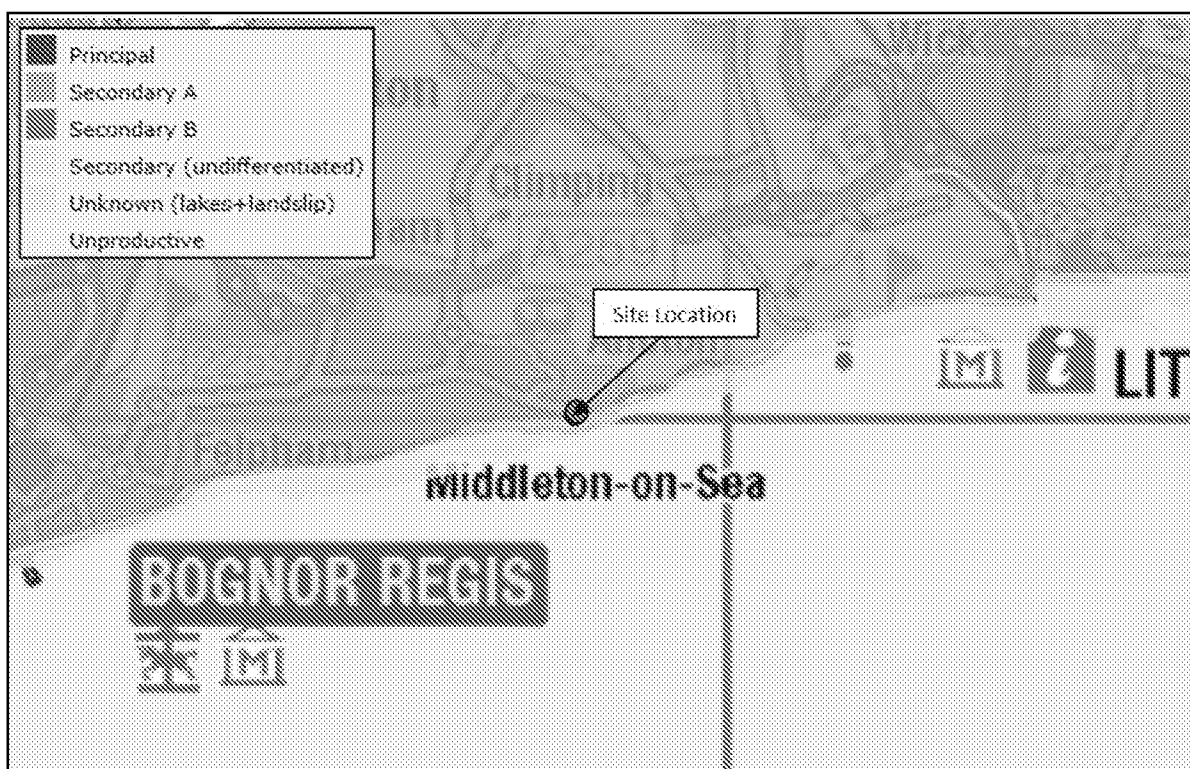


Figure 6: Aquifer Designation of Superficial Deposits, indicating location of site (Source: MagicMap online)

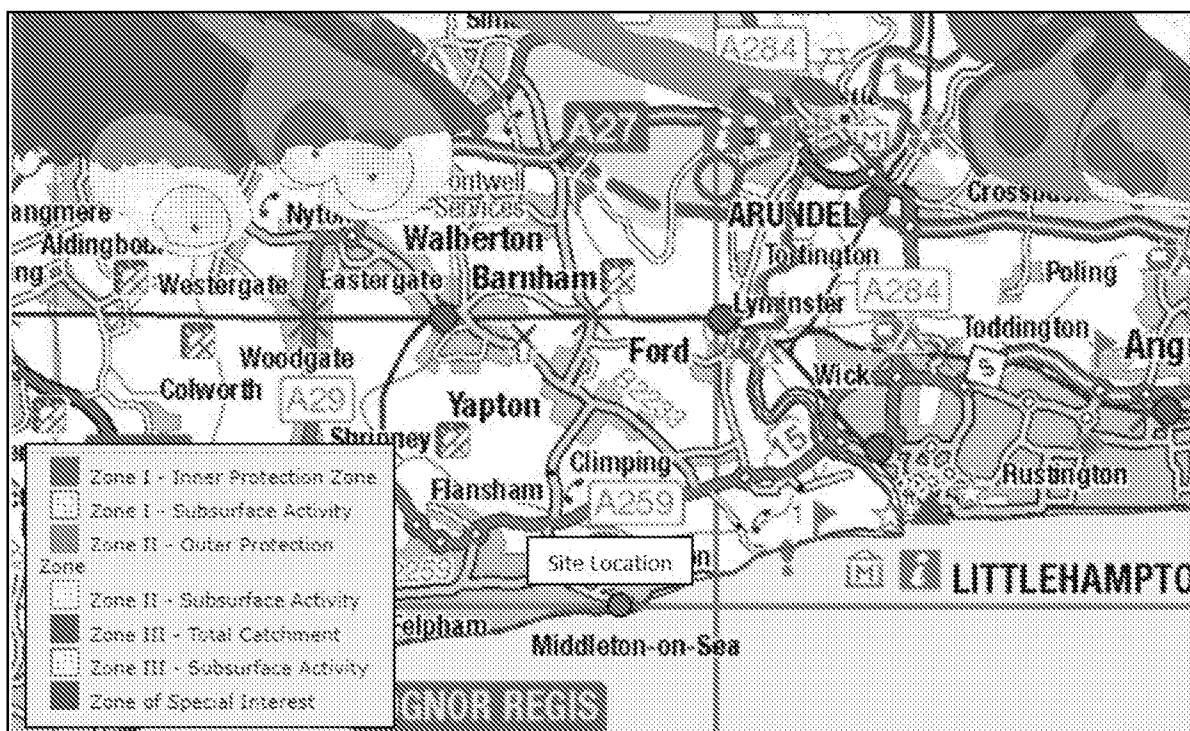


Figure 7: EA Groundwater Source Protection Zones, indicating location of site (Source: Magic Map online)

3. Sequential Test/Exception Test

- 3.1 Under the NPPF, all new planning applications should undergo a *Sequential Test*. This test should be implemented by local planning authorities with a view to locating particularly vulnerable new developments (e.g. residential, hospitals, mobile homes etc.) outside of the floodplain.
- 3.2 The Flood Risk and Coastal Change Planning Practice Guidance (PPG) *Sequential Test: Flood Risk Vulnerability and Flood Zone 'Compatibility' Table* is reproduced below;

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test Required	✓	✓
	Zone 3a	Exception Test Required	✓	✗	Exception Test Required	✓
	Zone 3b <i>Functional Floodplain</i>	Exception Test Required	✓	✗	✗	✗

Table 2 The Sequential Test: Flood Risk Vulnerability and Flood Zone 'Compatibility' Table as specified by NPPF
 Please note: ✓ means development is appropriate; ✗ means the development should not be permitted.

- 3.3 The proposal is considered as a 'More Vulnerable' development, under the NPPF guidance. The site is located in Flood Zone 1, 2 and 3. As indicated in Table 2 above, 'More Vulnerable' developments located in Flood Zones 1 and 2 do not require an Exception Test; however, 'More Vulnerable' developments in Flood Zone 3 are required to be submitted alongside an Exception Test. In accordance with this, the proposed development is required to have an Exception Test.
- 3.4 Paragraph 160 of the Flood Risk and Coastal Change Planning Practice Guidance states, for the Exception Test to be passed, it should be demonstrated that:
- The development would provide wider sustainability benefits to the community that outweigh the flood risk; and
 - The development would be safe for its lifetime without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.
- 3.5 As the site is partially in Flood Zone 3 and the development is 'More Vulnerable', a Sequential Test would normally be required. The proposed development is for the replacement of the existing dwelling on site. Thus, it could be argued that the proposal is for the replacement of the existing lawful use and should not require a Sequential Test.
- 3.6 All developments in Flood Zones 2 and 3 require a site-specific flood risk assessment to be submitted alongside the planning application.
- 3.7 Therefore, the proposed development is required to have a flood risk assessment, which demonstrates that the development will be safe for its lifetime without increasing flood risk elsewhere.

4. Site Flood Hazards

Sources of Flooding

- 4.1 The proposed development is located within Flood Zones 1, 2 and 3 (low, medium and high risk of flooding) and is considered to be 'More Vulnerable' according to the Flood Risk and Coastal Change Planning Practice Guidance (PPG). Table 3 summarises the potential sources of flooding to the site:

Source	Description
Tidal	Flood Zones 1, 2 and 3
Fluvial	Elmer Rife
Surface	Very Low risk at site; High risk on Elm Drive
Groundwater	<i>'Potential for groundwater flooding to occur at surface'</i>
Sewer	Local area has been affected by sewer flooding in the past

Table 3 Summary of flood sources.

Tidal

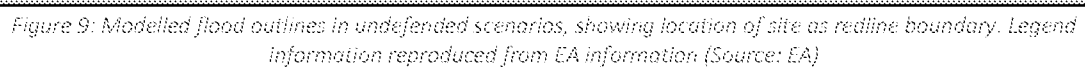
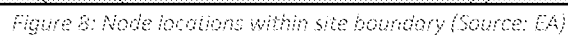
- 4.2 With reference to the EA Flood Map for Planning (Figure 4), the site is shown to be located within Flood Zone 1, 2 and 3 (low, medium and high risk of flooding).
- 4.3 The Mean High-Tide Water Level for the English Channel is approximately 55m south of the site.
- 4.4 Existing ground levels of the site are between approximately 3.80mAOD and 4.80mAOD according to the Environment Agency's 2m remotely sensed DTM LiDAR dataset.
- 4.5 Ambiental have received modelled flood information from the Environment Agency for the site.
- 4.6 Information provided by the Environment Agency shows that there is an existing tidal wall (Asset ID: 127642) which benefits the site and is maintained by the Environment Agency. The current standard of protection is 100 years from 2006, and its effective crest level is 5.5m. This indicates that the existing sea wall should provide protection to the site in the 1 in 100-year flood event. The site also benefits from offshore breakwaters on Elmer Beach, south of the site.
- 4.7 The Beachy Head to Selsey Bill Shoreline Management Plan (completed in 2006) indicates that the long-term plan for Elmer (Breakwaters) (Policy Unit reference of 4d21) is that existing defences will continue to be protected and maintained, through holding the line, thus defending and maintaining the current defended position of Elmer. The SMP further states that the long-term policy for this area of continuing to defend the frontage *'would likely be provided through maintaining the detached breakwaters and terminal groyne and increasing the volume of beach renourishment when required'*. The plans for this area seek to manage Elmer (Breakwaters) through holding the line up until the year 2105. Given that the site lies within this area, the site should continue to be defended up to 2105.
- 4.8 The Elmer Coastal Defence Scheme was completed in 2020 and comprised of improvements to the existing rock revetments and recharging the beach with additional shingle. This scheme was carried out on behalf of the Environment Agency, Arun District Council and Elmer Sands Limited and should provide better

protection to properties in Elmer. Given the proximity of the site to the beach, it is considered that this scheme should provide additional protection to the proposed site.

- 4.9 The EA provided site-specific modelled flood information for both undefended and defended scenarios. The model used was the River Arun to East Head Coastal Modelling, completed in 2016 by JBA Consulting.
- 4.10 The EA have also confirmed that they do not hold any records of previous flood events affecting the site.

Undefended

- 4.11 The undefended scenario represents the potential flooding which could occur if there were no flood defences benefitting the site. Thus, this represents a worst-case scenario.
- 4.12 The Environment Agency have provided flood levels extracted from within the site boundary, from 3 different locations (see Figure 8). These are as follows:
- Node 1: Front of site
 - Node 2: Middle of site
 - Node 3: Rear of site
- 4.13 During the 1 in 200-year tidal flood event (undefended), the rear of the site, represented by Node 3, could be affected by a flood level of 3.92mAOD. The rest of the site is shown to be unaffected by flood levels in this event. The highest existing ground levels at the rear of the site are 4.8mAOD, according to the EA's LiDAR dataset, so are topographically higher than the modelled flood level.
- 4.14 During the 1 in 1,000-year tidal flood event (undefended), the site could be affected by a flood level of 4.11mAOD. Existing topographic levels within the site boundary are between 3.80mAOD and 4.80mAOD. As such, maximum flood depths of 0.31m could be experienced at the topographically lowest areas on site, which are in front of the existing building.
- 4.15 Figure 9 shows the modelled flood outlines provided by the EA for the following return periods, in the undefended tidal scenarios (See Appendix 2 for EA data):
- 0.5% AEP (1 in 200-year);
 - 0.5% AEP (1 in 200-year) in 2070 epoch;
 - 0.5% AEP (1 in 200-year) in 2115 epoch;
 - 0.1% AEP (1 in 1,000-year).



Defended

- 4.16 Flood defences south of the site provide a standard of protection of up to the 1 in 100-year event. Modelled flood outputs provided by the EA demonstrate that the site would remain unaffected by flooding in the modelled 1 in 200-year and 1 in 1,000-year flood events, in the present-day defended scenario.
- 4.17 Figure 10 shows the modelled flood outlines provided by the EA for the following return periods, in the defended tidal scenarios (See Appendix 2 for EA data):
- 0.5% AEP (1 in 200-year);
 - 0.5% AEP (1 in 200-year) in 2070 epoch;
 - 0.5% AEP (1 in 200-year) in 2115 epoch;
 - 0.1% AEP (1 in 1,000-year).
- 4.18 As indicated in the Beachy Head to Selsey Bill Shoreline Management Plan (2006), the policy area in which the site is located should continue to be managed through holding the line, up until the year 2105. The Elmer Coastal Defence Scheme completed in 2020, which involved improvements and maintenance works to the existing rock revetments and the addition of shingle to Elmer beach, should provide better protection to the proposed site.

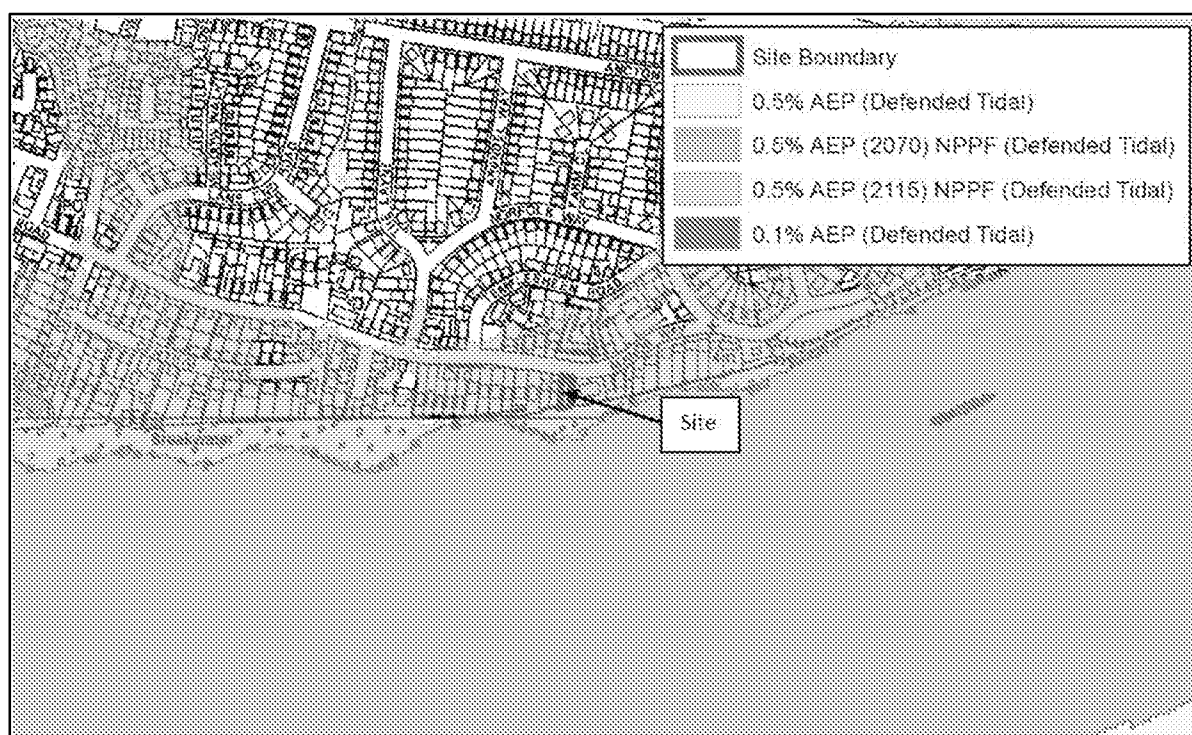


Figure 10: Modelled flood outlines in defended scenarios, showing location of site as redline boundary. Legend information reproduced from EA information (Source: EA)

Fluvial

- 4.19 Elmer Rifer, an EA Main River, is located approximately 540m east of the site. This is a tributary of Ryebank Rife, which is further north of the site.
- 4.20 The Environment Agency have not provided fluvial flood data for this site; however, they have provided tidal flood data. Therefore, Ambiental have viewed that the dominant source of flood risk to the site is tidal.

Surface Water (Pluvial)

- 4.21 The Environment Agency Flood Risk from Surface Water map (Figure 11) shows the site to be within an area of 'Very Low' risk of flooding from surface water. The road to the north of the site, Elmer Road, which provides the main access route, is shown to have areas of 'High' risk of flooding from surface water.
- 4.22 The following definitions of the annual surface water flood risk labels are given by the EA:
- 'High Risk'; >3.3% AEP (more often than 1 in 30);
 - 'Medium Risk'; 3.3% to 1.1% AEP (between 1 in 30 and 1 in 100);
 - 'Low Risk'; 1% to 0.1% AEP (between 1 in 100 and 1 in 1000);
 - 'Very Low Risk'; <0.1% AEP (less often than 1 in 1000).
- 4.23 Ambiental have assessed the Environment Agency's Risk of Flooding from Surface Water (RoFSW) dataset on our internal GIS software. The 1 in 30-year, 1 in 100-year and 1 in 1,000-year flood extents and depths have been reviewed, which are indicative of the 'High', 'Medium' and 'Low' risk extents on the Environment Agency Flood Risk from Surface Water map. Ambiental have used the plans provided by the client to draw the existing and proposed built footprint of the development, and the site boundary.
- 4.24 Following this assessment, it has been confirmed that the site is located wholly outside the modelled flood extents for the 1 in 30-year and 1 in 100-year surface water events, as shown in Figures 12 and 13 respectively.
- 4.25 Elmer Road to the north of the site is shown in Figure 12 to be affected by flood depths of 0.15m to 0.30m in the modelled 1:30-year surface water flood event. It should be noted that Elmer Road heading westwards of the site is unaffected by flood risk in this event.
- 4.26 In the 1:100-year event (see Figure 13), Elmer Road in front of the site is identified as being affected by flood depths of 0.15m to 0.30m and 0.30m and 0.60m.
- 4.27 During the EA modelled 1:1,000-year event, most of the proposed site is unaffected by surface water flooding. The north-eastern corner of the site boundary is affected by depths of up to 0.15m. Elmer Road, directly in front of the site, is shown to be affected by between 0.15m and 0.30m, with flood depths increasing to 0.30m and 0.60m, and between 0.60m and 0.90m in some places.
- 4.28 It should be reiterated that the proposed development site is not affected by flood depths in the EA modelled 1:30-year and 1:100-year surface water flood events and is only partially affected in the 1:1,000-year event. The existing built footprint on site is unaffected by all assess return periods. From reviewing the proposed plans provided by the client, it is considered that the built footprint of the replacement dwelling will be the same as the existing. Therefore, the proposed replacement dwelling is considered to be at very low risk of surface water flooding.
- 4.29 Access and egress routes are discussed in Section 7 of the report.

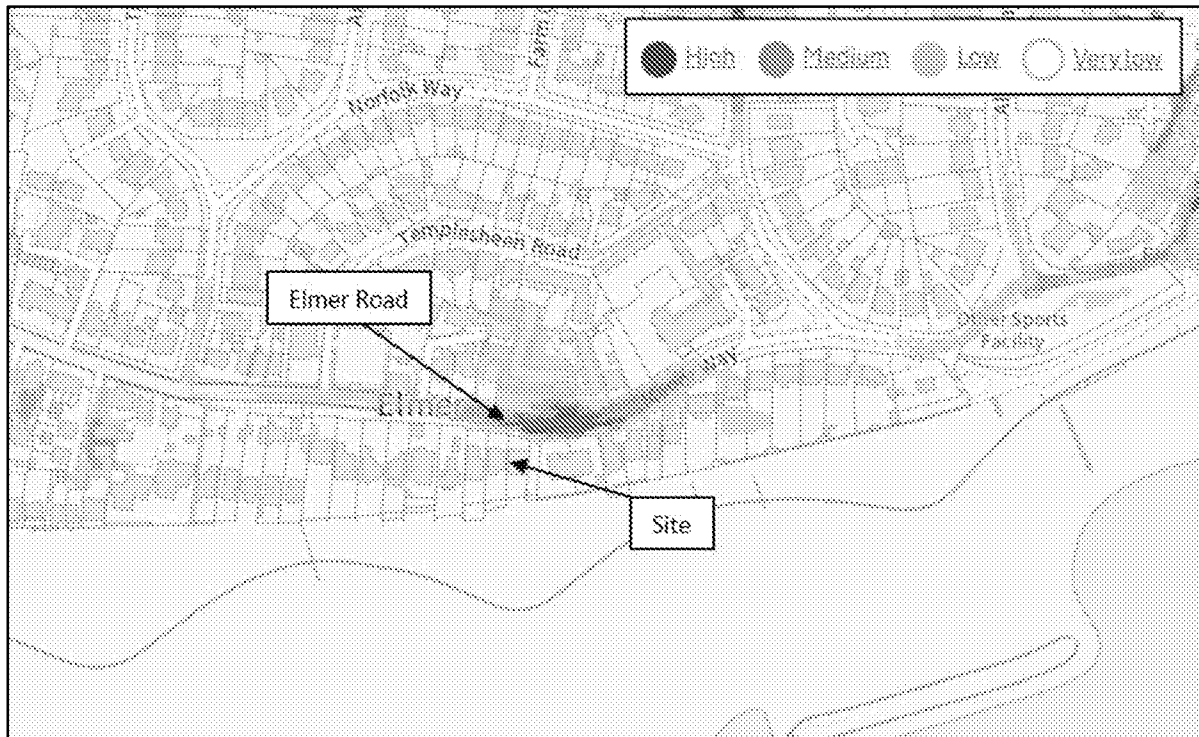


Figure 11: EA Surface Water Flood Risk Map, showing location of site. (Source: EA)

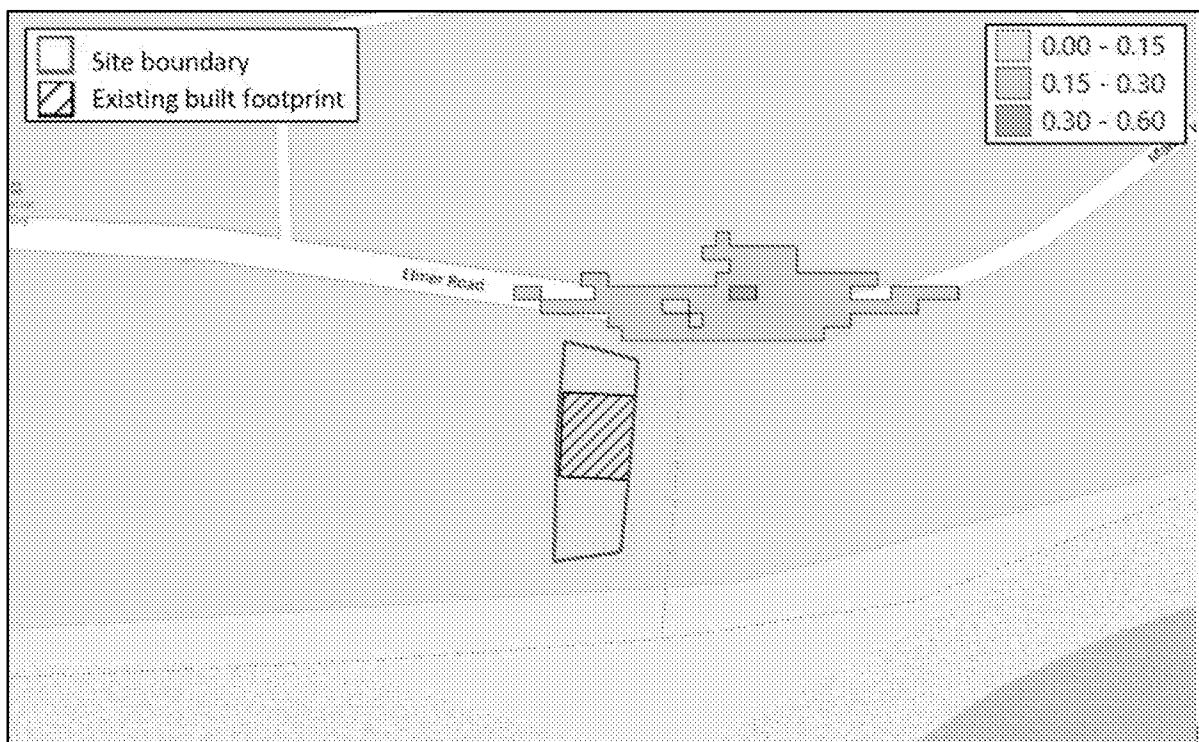


Figure 12: EA RoFSW modelled 1 in 30-year surface water flood depths (Source: EA)

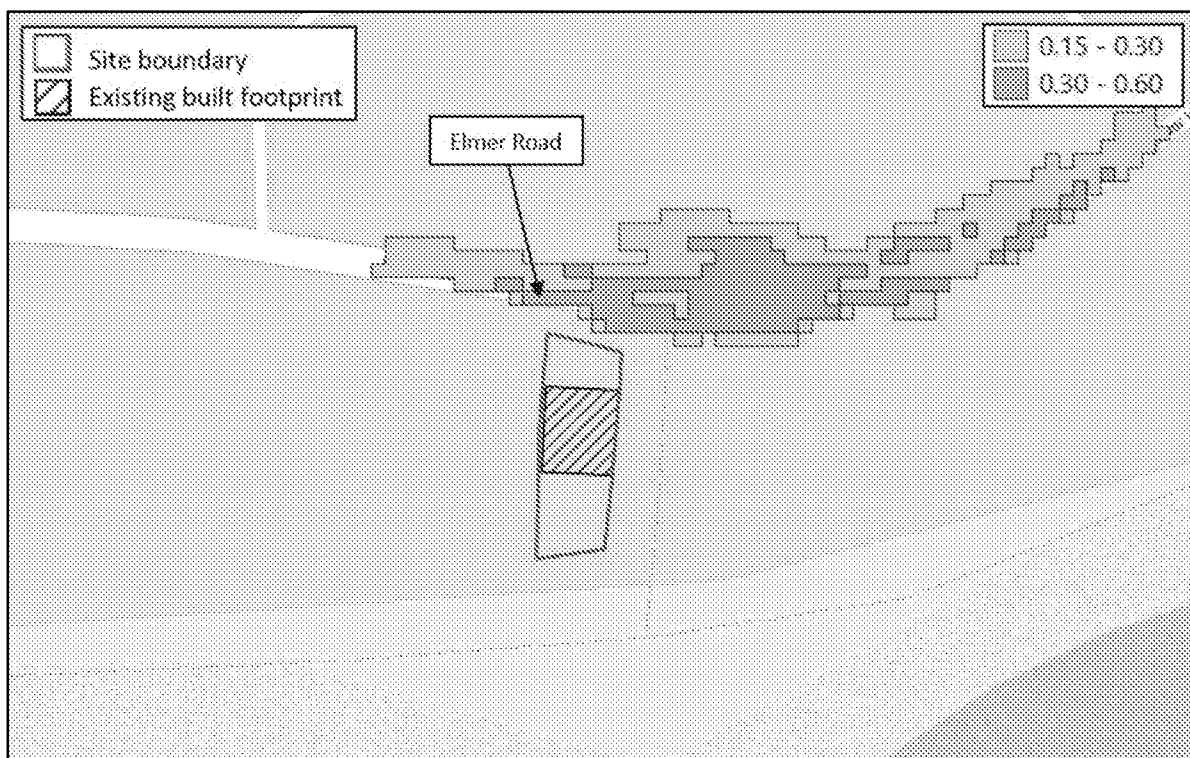


Figure 13: EA RoFSW modelled 1 in 100-year surface water flood depths (Source: EA)



Figure 14: EA RoFSW modelled 1 in 1,000-year surface water flood depths (Source: EA)

Groundwater

4.30 Ambiental have used the British Geological Society's (BGS) Susceptibility to Groundwater Emergence mapping to discern whether there is any potential risk of flooding from groundwater at the proposed site.

- 4.31 As shown in Figure 15, the footprint of the proposed building is shown to be within an area identified as 'Potential for groundwater flooding of property situated below ground level'. This is considered as the medium risk category with regards to groundwater flooding. The site is also located near an area identified as having 'Potential for groundwater flooding to occur at surface', which is the highest category.
- 4.32 As such, mitigation measures have been discussed in Section 7 of the report.

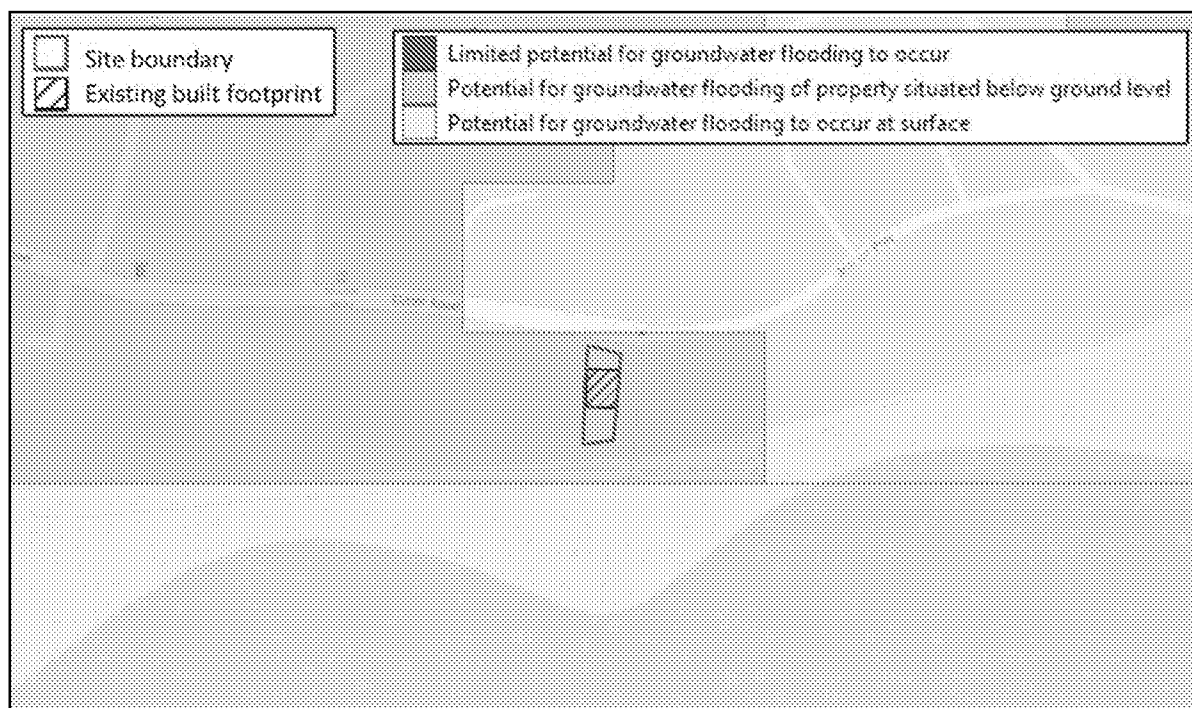


Figure 15: BGS Susceptibility to Groundwater Emergence mapping and location of proposed development

Sewer

- 4.33 Sewer Incident Report Form (SIRF) data was provided by Southern Water and included within the Arun District Council SFRA (2016). This data showed that there has been a total of 315 recorded flood incidents in the district, at the time at which the SFRA was written. There are 27 recorded incidences of sewer flooding within postcode area PO22 6, where the site is located. Due to the nature of this information, it is not known whether the existing property on site has been affected by sewer flooding in the past.
- 4.34 Any new sewer connection created as part of the development proposals should be first agreed with the local sewer provider and fitted with non-return valves to mitigate the risk of sewer flooding.

Surface Water Drainage Strategy

- 4.35 The site currently comprises of an existing residential dwelling. It is understood that the development is for the demolition of the existing dwelling, followed by the construction of a replacement dwelling.
- 4.36 In order to mitigate flood risk posed by the proposed development, adequate control measures are required to be considered. This will ensure that surface water runoff is dealt with at source and the flood risk on/off site is not increased over the lifetime of the development.
- 4.37 The runoff generated will need to be managed in accordance with the National Planning Policy Framework (NPPF 2019) policy which requires the use of Sustainable Drainage Systems (SuDS). The design guidelines for the SuDS should follow the recommendations set out in Local guidance for the South East of England, provided within the 'Water. People. Places. A guide to master planning sustainable drainage into developments' document.

4.38 The management of surface water has been considered in respect to the SuDS hierarchy (Table 4 below) (as detailed in Building Regulations Part H and within the CIRIA 753 'The SUDS Manual', Section 3.2.3):

SuDS Drainage Hierarchy				
			Suitability	Comment
	1.	Infiltration	x	Poor levels of infiltration could be achieved at the site, due to naturally wet soil in this area (according to Soilscales online)
	2.	Discharge to Surface Water	x	There are no open surface water features neighbouring the site, therefore a direct connection cannot be achieved.
	3.	Discharge to Surface Water Sewer, Highway Drain or another Drainage System	✓	The site currently benefits from positive drainage.
	4.	Discharge to Combined Sewer	-	

Table 4: SuDS Hierarchy

4.39 To achieve the reduction in site run off rates, the use of various SuDS has been considered for the development as follows:

Suitability of SuDS Components			
SuDS Component	Description	Constraints and Opportunities	Suitability
Infiltrating SuDS	Infiltration can contribute to reducing runoff rates and volumes while supporting baseflow and groundwater recharge processes. The suitability and infiltration rate depends on the permeability of the surrounding soils.	Site is located over chalk, with superficial deposits comprising of sand and gravel. The soils underlying the site are 'Loamy soils with naturally high groundwater', with naturally wet soil (Source: Soilscales online). As such, poor levels of infiltration could be achieved at this site.	x
Permeable Pavement	Pervious surfaces can be used in combination with aggregate sub-base and/or geocellular/modular storage to attenuate and/or infiltrate runoff from surrounding surfaces and roofs. Liners can be used where ground conditions are not suitable for infiltration.	Permeable paving should be provided within suitable hardstanding areas.	✓
Green / Blue Roofs	Green Roofs provide areas of visual benefit, ecological value, enhanced building performance and the reduction of surface water runoff. They are generally more costly to install and maintain than conventional roofs but can provide many long-term benefits and reduce the on-site storage volumes.	Green/blue roofs may not be suitable for this site, as the proposed replacement dwelling has a pitched roof structure.	x
Rainwater Harvesting	Rainwater Harvesting is the collection of rainwater runoff for use. It can be collected from roofs or other impermeable areas, stored, treated (where required) and then used as a supply of water for domestic, commercial and industrial properties.	This could be a suitable method for this development.	✓
Swales	Swales are designed to convey, treat and attenuate surface water runoff and provide aesthetic and biodiversity benefits. They can replace conventional pipework as a means of conveying runoff,	There is limited space on the proposed site for large SuDS	x

	however space constraints of some sites can make it difficult incorporating them into the design.	devices to be implemented, such as these.	
Rills and Channels	Rills and Channels keep runoff on the surface and convey runoff along the surface to downstream SuDS components. They can be incorporated into the design to provide a visually appealing method of conveyance. They also provide effectiveness in pre-treatment removal of silts.		x
Bioretention Systems	Bioretention systems can reduce runoff rates and volumes and treat pollution using engineer soils and vegetation. They are particularly effective in delivering interception but can also be an attractive landscape feature whilst providing habitat and biodiversity.		x
Retention Ponds and Wetlands	Ponds and Wetlands are features with a permanent pool of water that provide both attenuation and treatment of surface water runoff. They enhance treatment processes and have great amenity and biodiversity benefits. Often a flow control system at the outfall controls the rates of discharge for a range of water levels during storm events.		x
Detention Basins	Detention Basins are landscaped depressions that are usually dry except during and immediately following storm events and can be used as a recreational or other amenity facility. They generally appropriate to manage high volumes of surface water from larger sites such as a neighbourhood.		x
Geocellular Systems	Attenuation storage tanks are used to create a below-ground void space for the temporary storage of surface water before infiltration, controlled release or use. The inherent flexibility in size and shape means they can be tailored to suit the specific characteristics and requirements of any site.	If necessary, these could be provided to complement the other SuDS solutions.	✓
Proprietary Treatment Systems	Proprietary treatment systems are manufactured products that remove specific pollutants from surface water runoff. They are especially useful where site constraints preclude the use of other methods and can be useful in reducing the maintenance requirements of downstream SuDS.	If necessary, these could be provided to complement the other SuDS solutions.	x
Filter Drains and Filter Strips	Filter drains are shallow trenches filled with stone, gravel that create temporary subsurface storage for the attenuation, conveyance and filtration of surface water runoff. Filter strips are uniformly graded and gently sloping strips of grass or dense vegetation, designed to treat runoff from adjacent impermeable areas by promoting sedimentation, filtration and infiltration.	These may be used to provide interception drainage for overland flows from offsite.	x

Table 5 Suitability of SuDS Components

4.40 Ambiental have used the site plans provided by the client to measure the areas of the approximate built footprint of the existing and proposed dwellings, as well as the site boundary. The measurements are as follows:

- The site has an area of approximately 331m².
- The existing residential dwelling has a built footprint of approximately 132m².
- The footprint of the proposed replacement dwelling is the same as the existing dwelling.

4.41 Greenfield runoff rates have been calculated using the HR Wallingford Tool. The calculations are shown in Table 6 below and included in Appendix 3. The site area is associated with a greenfield runoff rate (QBAR) of 0.144 l/s.

4.42 Ambiental have completed initial attenuation storage calculations using the online HR Wallingford Tool. By restricting runoff flow rates to 1 l/s, the calculations demonstrate that the attenuation storage volume

required for managing runoff from the site, taking account of the entire footprint of the proposed replacement dwelling (0.01ha), would be approximately 1m³. The calculations have been included in Appendix 3.

SURFACE WATER DISCHARGE RATES SUMMARY					
	Area (ha)	Discharge Rates (l/s)			
		1 year	2 year/Q _{BAR}	30 year	100 year
Greenfield runoff	1	4.1	4.82	11.1	15.39
Greenfield runoff site	0.03	-	0.144	-	-
Existing dwelling	0.01	-	0.048	-	-
Proposed dwelling	0.01	-	0.048	-	-

Table 6: Surface water discharge rates summary

4.43 The site is positively drained as existing. Given that the proposal is for the replacement of the existing dwelling on site, with no change in built footprint, it is recommended that the surface runoff is discharged via the existing drainage infrastructure. Betterment could be provided by attenuating surface water runoff and temporarily storing water in a rainwater harvesting system, such as water butts or rain planters. Water butts can provide non-potable water uses on site and rain planters can provide additional ecological benefits to the site.

Records of Historical Flooding

4.44 The Arun District Council SFRA (2016) includes mapping of historic flood events. As indicated in Figure 16 below, the site is located in an area which has been affected by surface water flood events. It is not known whether the site has been affected by flooding in the past.

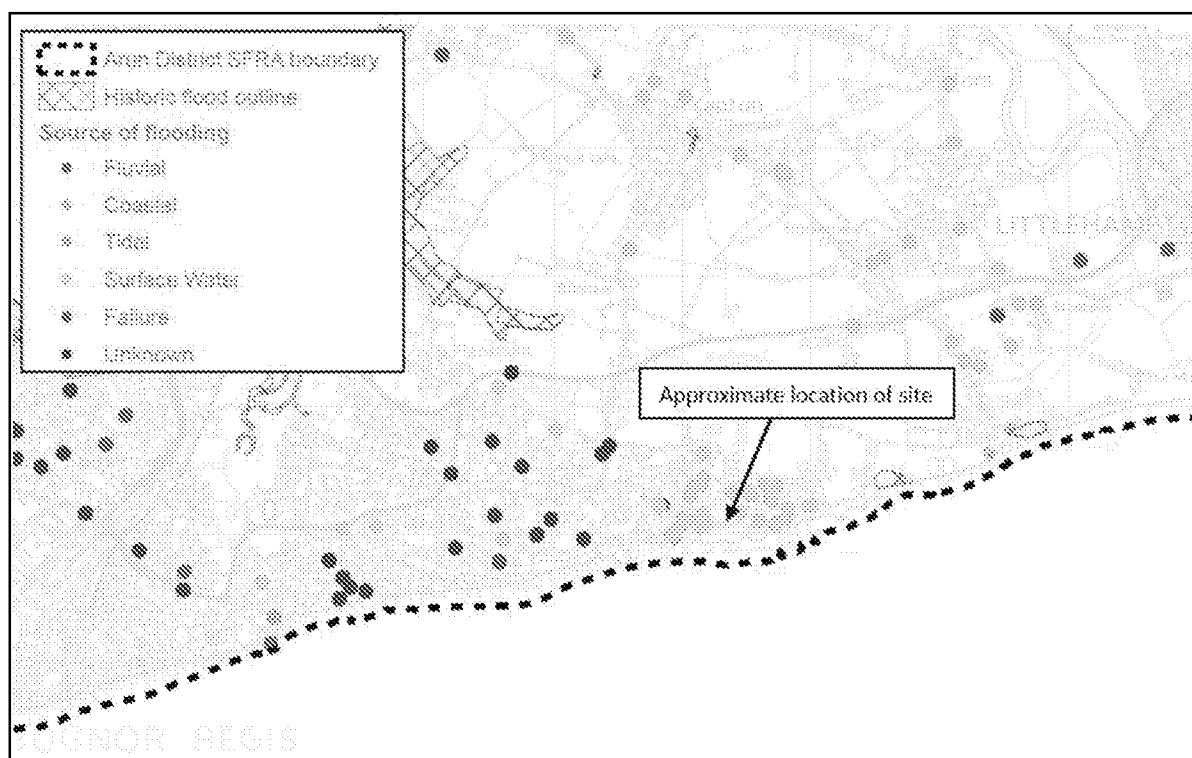


Figure 16: Extract from historic map in Arun DC SFRA (2016), indicating approximate location of site

5. Probability of Flooding

Flood Zones

- 5.1 According to the EA Flood Map for Planning, the site is located within Flood Zones 1, 2 and 3 (low, medium and high risk of flooding).
- 5.2 The EA Flood Map for Planning has been produced in part using a relatively coarse, national scale flood modelling strategy, and in part by detailed modelling. It is important to note that only the potential floodplain is modelled; **the mitigating effects of any flood defences currently in place are not considered.** For reference, the definition of the NPPF flood risk zones is included below (Table 7).

Zone	Description
1	Low Probability. This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
2	Medium Probability. This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.
3a	High Probability. This zone comprises 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.
3b	The Functional Floodplain. This zone comprises land where water has to flow or be stored in times of flood. SFRA's should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the EA, including water conveyance routes).

Table 7 Definition of the NPPF Flood Zones. (Source: EA)

Climate Change on Site

- 5.3 Climate change is likely to increase the flow in rivers, raise sea levels and increase storm intensity. The range of allowances in *Table 8* is based on percentiles. A percentile is a measure used in statistics to describe the proportion of possible scenarios that fall below an allowance level. The 50th percentile is the point at which half of the possible scenarios for peak flows fall below it and half fall above it.
- 5.4 The:
- central allowance is based on the 50th percentile
 - higher central is based on the 70th percentile
 - upper end is based on the 90th percentile
- 5.5 So, if the central allowance is 30%, scientific evidence suggests that it is just as likely that the increase in peak river flow will be more than 30% as less than 30%.
- 5.6 At the higher central allowance, 70% of the possible scenarios fall below this value. So, if the higher allowance is 40%, then current scientific evidence suggests that there is a 70% chance that peak flows will increase by less than this value, but there remains a 30% chance that peak flows will increase by more (Source: EA).

- 5.7 The risk of flooding to the site would, therefore, be expected to increase following the effects of climate change. The likely increases in peak rainfall intensity would also lead to an increased risk of surface water flooding.

Flood Zone	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
1	Central	Central	Central	Central	None
2	Upper End	Higher Central and Upper End	Higher Central and Upper End	Central and Higher Central	Central
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

Table 8: Allowance and Flood Zone Table (Source EA)

- 5.8 The proposed development is 'More Vulnerable' (residential) and is in Flood Zones 1, 2 and 3.
- 5.9 With reference to Table 8, 'More Vulnerable' developments in Flood Zones 2 and 3 should consider the 'Higher Central' and 'Upper End' allowances.
- 5.10 Ambiental have received modelled flood information from the Environment Agency for the site. This includes modelled flood levels in the climate change scenarios, extracted from the River Arun to East Head Coastal Modelling Study, completed in 2016 by JBA Consulting.
- 5.11 The flood data demonstrates that the site should benefit from flood defences in the modelled 1 in 200-year tidal events in both the 2070 and 2115 epochs.
- 5.12 Environment Agency climate change allowances were updated in December 2019 for tidal and coastal flooding. Given that the model used here was completed in 2016, it does not take account of the updated allowances. The EA's latest climate change allowances for tidal and coastal flooding have been applied to the present-day flood level experienced on site in the 1 in 200-year event.
- 5.13 After applying the climate change allowances, which are dependent on the year the model was completed (2016) and the region of the UK (south-east), it has been demonstrated that the cumulative sea-level rise could be approximately 1.11m in the 'Higher Central' scenario and 1.49m in the 'Upper End' scenario.
- 5.14 When this is added to the present-day flood level extracted on site in the 1 in 200-year undefended event (3.92mAOD), the total sea level is calculated to be 5.03mAOD in the 'Higher Central' scenario and 5.41mAOD in the 'Upper End' scenario. This is shown in Table 9 below.
- 5.15 Ambiental have then used the existing ground levels of the site according to the EA's 2m resolution DTM LiDAR dataset to assess the potential flood depths at the site as a result of sea level rise due to climate change. The existing ground levels on site are between 3.80mAOD and 4.80mAOD. During the 'Higher Central' scenario, maximum flood depths of 1.23m could be experienced on site. In the 'Upper End' scenario, the site could be affected by maximum flood depths of 1.60m. It should be noted that the

undefended climate change scenarios represent the flooding which could occur in the future if there were no flood defences benefitting the site.

- 5.16 With reference to the Beachy Head to Selsey Bill Shoreline Management Plan, which was completed in 2006, the site should continue to benefit from coastal flood defences up until the year 2105, due to the long-term plan of continuing to manage and maintain the defended position of Elmer (Breakwaters) through holding the line. Recent improvement and maintenance works were completed on the Elmer beach coastal defences in 2020, which should provide additional protection from tidal flooding at the site.

		Year					
Start Year		2016	2036	2066	2096		
End Year		2035	2065	2095	2125		
Length of time (years)		15	30	30	30		
Sea level rise per year (mm)	Higher Central	5.7	8.7	11.6	13.1		
	Upper End	6.9	11.3	15.8	18.2	Cumulative sea-level rise 2020 to 2125	Total flood level (sum of 1:200-yr flood level on site and cumulative sea-level rise)
	High++	6	12.5	24	33	(metres)	(mAOD)
Cumulative rise (mm)	Higher Central	86	261	348	393	1.11	5.03
	Upper End	104	339	474	546	1.49	5.41
	High++	90	375	720	990	2.20	6.12

Table 9: Cumulative sea-level rise from 2020 to 2125 in South East region and total sea level, based on EA extreme sea level (1 in 200-year)

6. Residual Risks

Identification of Residual Risks

6.1 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.

Defence Breach

6.2 The EA Flood Map for Planning (Figure 4) does not indicate that the site is in an area which benefits from formal flood defences. It is understood that coastal defences have recently been completed south of the site.

6.3 The EA have not provided any defence breach modelling for the site.

Reservoir Failure

6.4 The online EA Risk from Reservoir Flooding Map (Figure 17) demonstrates that the site is outside flood extents in the event of reservoir flooding.



Figure 17: EA Risk from Reservoir Flooding Map, showing location of site (Source: EA)

Drainage Exceedance

- 6.5 In the event of drainage failure/exceedance, overland flows would be dictated by site topography. External levels should be designed to fall away from ground floor thresholds to direct overland flow away from the property and provide some mitigation against drainage exceedance.

7. Flood Risk Management Measures

Flood Risks

- 7.1 The site currently comprises of an existing two-storey residential dwelling. It is understood that the development is for the demolition of the existing dwelling, followed by the construction of a replacement three-storey dwelling. From reviewing the proposed plans of the development, which are included in Appendix 1, it is understood that the built footprint of the replacement dwelling will be the same as that of the existing house.
- 7.2 Ambiental have analysed the modelled flood outputs provided by the Environment Agency for this site. As discussed within this report, the site should remain unaffected by flooding in the modelled 1:200-year and 1:1,000-year defended flood events.
- 7.3 The EA flood data provided was taken from the River Arun to East Head Coastal Modelling, which was completed in 2016. Thus, the flood levels provided for the climate change scenarios (undefended) do not use the latest EA climate change allowances.
- 7.4 To account for this, Ambiental have used the 1:200-year flood level (undefended) at the site and the December 2019 updated climate change allowances for sea level rise to calculate the flood levels and depths on site. The calculations have demonstrated the following:
- A flood level of 5.03mAOD in the 1:200-year +CC (Higher Central) undefended event, resulting in maximum flood depths of 1.23m on site.
 - During the 1:200-year +CC (Upper End) undefended scenario, the site could be affected by a flood level of 5.41mAOD, resulting in maximum flood depths of 1.60m on site.
- 7.5 These climate change flood levels represent a worst-case scenario, which would occur if no flood defences were benefitting the site.
- 7.6 The Beachy Head to Selsey Bill Shoreline Management Plan (2006) indicates that the policy area in which the site is located (Elmer (Breakwaters); Policy Unit 4d21) should continue to be defended from tidal flooding up to the year 2105, due to the long-term plan of holding the line and maintaining and improving defences.

Mitigation Measures

- 7.7 Plans of the proposed dwelling show that the proposed Finished Floor Level of the ground floor will be set to 4.11mAOD. The proposed plans do not indicate a floor level for the first and second floors.
- 7.8 Habitable rooms should be provided at the ground floor level (kitchen, dining room, studio, utility room, study and snug), with sleeping accommodation at the first and second-floor levels.
- 7.9 Sleeping accommodation should be raised a minimum of 600mm above the 1:200-year +CC flood level, using the worst-case Upper End scenario, which would result in a floor level of 6.01mAOD.
- 7.10 Emergency safe refuge could be sought at the first and second-floor levels, if required. Furthermore, given the nature of tidal flooding, it is likely that sufficient early warning would be provided before flood waters reach the site.
- 7.11 The site is in an EA Flood Alert/Warning Service Area, so residents should sign up to this service. In the event of an EA Flood Warning, the site shall be evacuated for the duration of the warning.

7.12 The proposed replacement dwelling should incorporate flood resilience measures in line with current best practice for construction within an area at risk of flooding in line with CLG 2007 'Improving the Flood Performance of New Buildings. These are outlined below.

7.13 The following mitigation measures are recommended for the proposed dwelling:

- First-floor FFLs of residential dwelling should be raised to no lower than 6.01mAOD, which is 600mm above the calculated 1:200 year +CC (Upper End) undefended flood level of 5.41mAOD;
 - Internal access should be maintained from the ground floor to the first and second floor, to allow for emergency safe refuge on site.
- Construction:
 - Sleeping accommodation to be confined to the first and second floor.
 - Flood resilient measures such as airbrick covers to be installed.
 - Ground floor to be of solid construction, with waterproof membrane (where possible).
 - Damp proof membranes should be included within the design of the dwelling, to minimise the passage of water through ground floors. Impermeable polythene membranes should be at least 1200 gauge to minimise ripping. Effective methods of joining membrane sections are overlaps of 300mm, and also taping (mastic tape with an overlap of 50mm minimum). Care should be taken not to stretch the membrane in order to retain a waterproof layer.
 - All floors to be finished with waterproof screed (where possible).
 - Wall cavities to be filled with closed-cell foam throughout.
 - Ground floor internal render to be waterproof.
 - Utilise waterproof seals on the doors/windows of the new building, to minimise flood water ingress during a flood event.
 - External walls to be resistant to flooding up to first floor level.
 - Exterior ventilation outlets, utility points and air bricks to be fitted with removable waterproof covers.
- Electrical connection:
 - Ground floor electrical main ring to be run from first floor level and on separately switched circuit from first floor (where possible).
 - Electrical incomer and meter to be situated at first floor level.
- Gas / water supply:
 - Boilers, control and water storage / immersion to be installed at first floor level (where possible).
 - Gas meter to be installed at first floor level (where possible).
 - All plumbing insulation to be of closed-cell design.

- Drainage:
 - Non-return valves to be fitted to all drain and sewer outlets.
 - Manhole covers to be secured.
 - Anti-syphon fitted to all toilets.
- Interior fittings:
 - Kitchen units to be of solid, water resistant material.
 - Units to be raised on legs above plinth.
 - Use of MDF carpentry (i.e. skirting, architrave, built-in storage) to be avoided at ground floor level.
- Site owners/ staff/ management/residents will be required to sign up to the EA Flood Warning Service.

Flood Warning Service

- 7.14 It is recommended that residents are aware of the EA Flood Information service which identifies whether any flood warnings or alerts have been issued for a specific postcode or place in England or Wales: <https://flood-warning-information.service.gov.uk/>.
- 7.15 During periods of bad weather, site users should monitor local weather reports and sign up for the Met Office UK weather warnings. Warnings can be monitored through an Apple/Android app, Twitter or directly via emails. Further information can be found at <https://www.metoffice.gov.uk/>.
- 7.16 The EA operates a 24-hour telephone service on 0345 988 1188 that provides frequently updated flood warnings and associated floodplain information. Further information can be found on www.environment-agency.gov.uk/floodline. Floodline Warnings Direct is a free service operated by the EA that provides flood warnings direct to occupants by telephone, mobile phone, fax or pager.
- 7.17 The proposed development site is located within an EA Flood Warning Service Area. As such, it is recommended that site users sign up to this service.
- 7.18 Upon receipt of a Flood Warning, site users are advised to evacuate the site to a designated place of safe refuge within Flood Zone 1.
- 7.19 If flood waters along the proposed evacuation route have exceed 25cm, site users are advised, if possible, to seek refuge at the upper floors on site.

What to do if you receive a Flood Alert

- 7.20 A flood alert means you need to prepare, flooding is possible. You should:

- check your flood risk - <https://flood-warning-information.service.gov.uk/long-term-flood-risk>
- sign up for flood warnings - <https://www.gov.uk/sign-up-for-flood-warnings>
- keep up to date with the latest situation - call Floodline on 0345 988 1188 or follow @EnvAgency and #floodaware on Twitter for the latest flood updates



- have a bag ready with vital items like insurance documents and medications in case you need to leave your home
- check you know how to turn off your gas, electricity and water mains supplies
- plan how you'll move family and pets to safety

What to do if you receive a Flood Warning

7.21 A flood warning means you need to act, flooding is expected. You should do all the actions for a flood alert but also:

- move vehicles to higher ground if it's safe to do so
- move family and pets to safety
- move important items upstairs or to a safe place in your property, starting with cherished items and valuables, then furniture and furnishings
- turn off gas, electricity and water supplies if it's safe to do so; never touch an electrical switch if you're standing in water
- if you have property protection products such as flood barriers, or air brick covers, use them now
- keep track of the latest situation - <https://flood-warning-information.service.gov.uk/warnings>



What to do if you receive a Severe Flood Warning

7.22 A severe flood warning means there is danger to life: you must act now:

- call 999 if you're in immediate danger
- follow advice from the emergency services and evacuate if you're told to do so
- make sure you have an emergency kit including a torch, spare batteries, mobile phone and charger, warm clothes, important numbers like your home insurance, water, food, first aid kit and any medicines and baby care items you may need
- alert neighbours and offer help if it's safe to do so
- avoid driving or walking through flood water: just 30cm (1 foot) of fast flowing water could move your car and even shallow moving water can knock you off your feet
- keep your family and pets away from floodwater – it may contain heavy debris, sharp objects, open manhole covers, sewage and chemicals
- wash your hands if you've been in contact with flood water which may contain toxic substances



Flood Evacuation Plan

7.23 The controlling residual flood risk mechanism on site is tidal. Tidal flooding is generally caused by low pressure weather systems creating storm-surges (or storm tides), chiefly via high speed winds. These winds (and to a certain extent, the low pressure) create a 'bulge' of water which, if it coincides with high tide, can generate very high water levels. This mechanism is well understood, so it is very likely that an early warning would be issued before a tidal flood event. Given the nature of the tidal cycle, flood waters on site would likely recede as in-channel water levels fall. It should be noted however that there may not be time to provide a Flood Warning in the event of the sudden and catastrophic failure of flood defences.

- 7.24 As with all Flood Evacuation Plans, in the first instance, all residents and occupants should always defer to, and cooperate with, the direction provided by “Blue Light Responders”. This is especially true in areas which under normal circumstances would be protected by flood defences.
- 7.25 Upon receipt of a Flood Warning, site users are advised to evacuate the site to a designated place of safe refuge.
- 7.26 Based on the EA Flood Zone extents, a recommended evacuation route from the site to a place of safe refuge in Flood Zone 1 has been provided in Figure 18.
- 7.27 Upon receipt of a Flood Warning, residents should leave the site, turn left onto Elmer Road. After approximately 80m, evacuees will be in an area of Flood Zone 1 (low risk). There are bus routes along Elmer Road, which could be used to travel to a place of safe refuge. It is advised that evacuees continue along Elmer Road until they reach either St Nicholas Church.

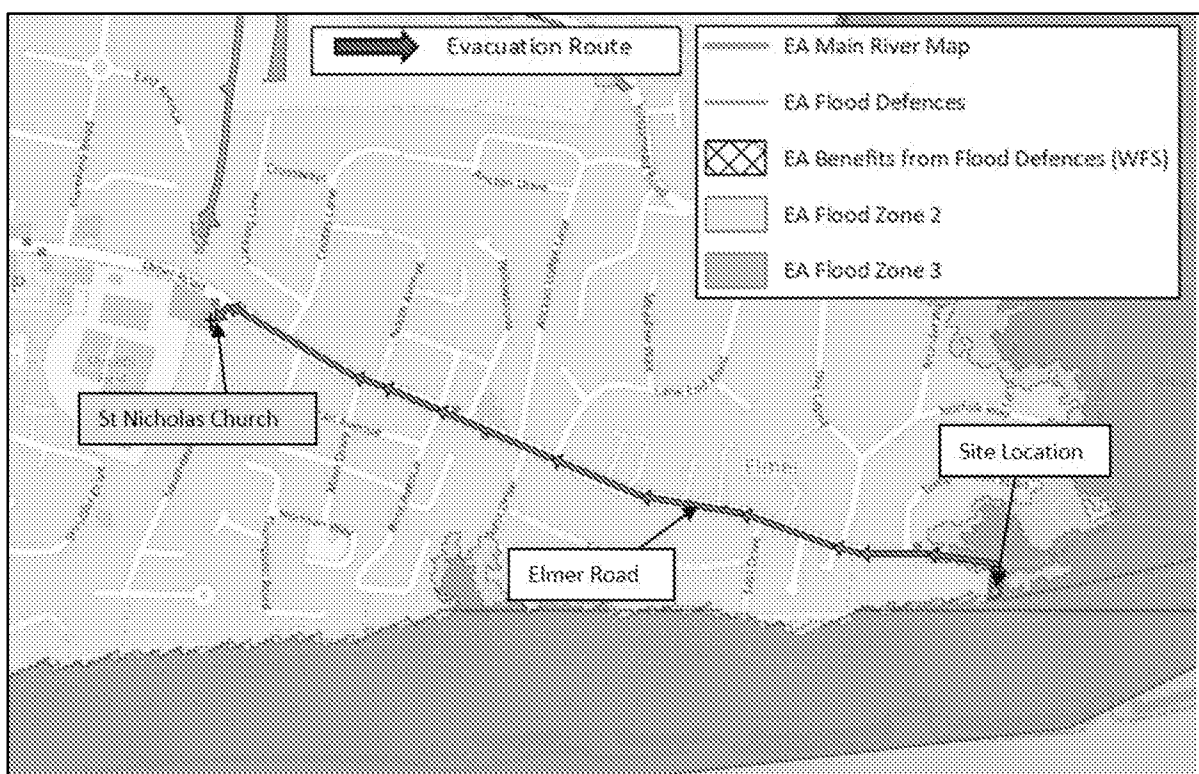


Figure 18: Recommended evacuation route shown as green arrows, from site to safe refuge in Flood Zone 1 (Source: EA)

8. Off Site Impacts

Impact to Flood Risk Elsewhere

- 8.1 The proposed development is for the demolition of the existing dwelling on site, followed by the construction of a replacement building. Given that the site is in an area of Flood Zone 3 which is tidally dominated, it is considered that flood compensatory storage is not required.

Generation of Runoff

- 8.2 The site currently comprises of an existing residential dwelling. It is understood that the development is for the demolition of the existing dwelling, followed by the construction of a replacement dwelling.
- 8.3 In order to mitigate flood risk posed by the proposed development, adequate control measures are required to be considered. This will ensure that surface water runoff is dealt with at source and the flood risk on/off site is not increased over the lifetime of the development.
- 8.4 The site is positively drained as existing. Given that the proposal is for the replacement of the existing dwelling on site, with no change in built footprint, it is recommended that the surface runoff is discharged via the existing drainage infrastructure. Betterment could be provided by attenuating surface water runoff and temporarily storing water in a rainwater harvesting system, such as water butts or rain planters. Water butts can provide non-potable water uses on site and rain planters can provide additional ecological benefits to the site.

9. Conclusion

- 9.1 Ambiental Environmental Assessment has been appointed by Clive Caplin to undertake a National Planning Policy Framework (NPPF) compliant Flood Risk Assessment (FRA) for the proposed development at Seafever, 188 Elmer Road, Bognor Regis, West Sussex, PO22 6JA.
- 9.2 The site currently comprises an existing residential dwelling. It is understood that the development is for the demolition of the existing dwelling, followed by the construction of a replacement dwelling. Plans of the development provided by the client demonstrate that the built footprint of the replacement dwelling will be the same as that of the existing house. Sleeping accommodation will be provided at the first and second floor levels of the proposed house. Plans of the proposed development are in Appendix 1.
- 9.3 With reference to the Environment Agency (EA) Flood Map for Planning, the proposed development site is located within Flood Zones 1, 2 and 3 (low, medium, and high risk of flooding from fluvial and tidal sources). The English Channel is approximately 55m south of the site (based on the Mean High-Tide Water Level) and Elmer Rife, an EA Main River, is approximately 540m east of the site.
- 9.4 The existing residential dwelling is considered “More Vulnerable” under Table 2 of the Flood Risk and Coastal Change Planning Practice Guidance and the principles of the National Planning Policy Framework (NPPF). There will be no change in flood risk vulnerability of the site post-development.
- 9.5 A summary of the main findings within this report are as follows:
- The EA provided site-specific modelled flood information for both undefended and defended scenarios. The model used was the River Arun to East Head Coastal Modelling, completed in 2016 by JBA Consulting.
 - The EA does not hold records of previous flooding events affecting the site.
 - If there were no existing flood defences in place, the rear of the site would be affected by flooding in the 1:200-year tidal flood event; and the site would be wholly affected by flooding in the 1:1,000-year tidal flood event.
 - Information provided by the Environment Agency shows that there is an existing tidal wall (Asset ID: 127642) which benefits the site and is maintained by the Environment Agency. The current standard of protection is 100 years from 2006, and its effective crest level is 5.5m. The site also likely benefits from the breakwaters and sand and shingle beach, south-east of the site.
 - Due to these flood defences, the site is shown to remain unaffected by flooding in the modelled defended flood scenarios, during the 1:200-year and 1:1,000-year tidal flood events. The site is, however, shown to be affected by flooding in the 1 in 200-year (2115 epoch) flood event, according to the 2016 data. This does not take account of the EA’s latest climate change allowances.
 - To account for this, Ambiental have used the 1:200-year flood level (undefended) at the site and the December 2019 updated climate change allowances for sea level rise to calculate the flood levels and depths on site. The calculations, ignoring the presence of flood defences, have demonstrated the following:
 - A flood level of 5.03mAOD in the 1:200-year +CC (Higher Central) undefended event, resulting in maximum flood depths of 1.23m on site.

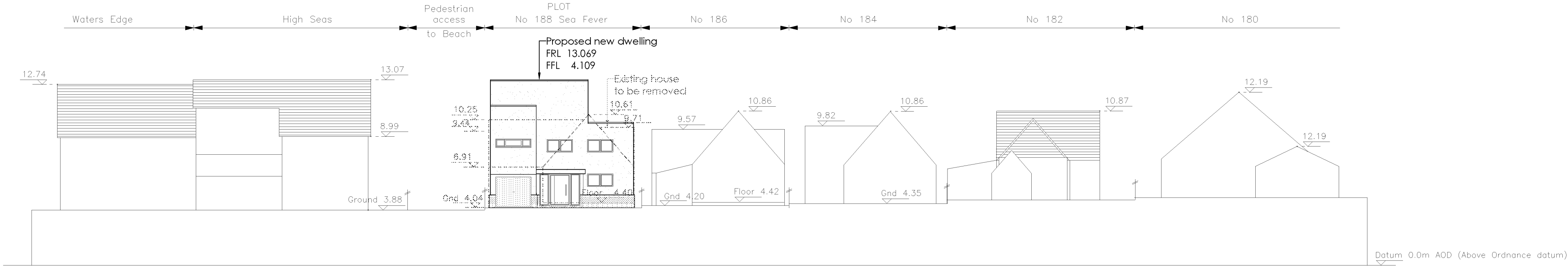
- During the 1:200-year +CC (Upper End) undefended scenario, the site could be affected by a flood level of 5.41mAOD, resulting in maximum flood depths of 1.60m on site.
- These climate change flood levels represent a worst-case scenario, if no flood defences were benefitting the site.
- The Beachy Head to Selsey Bill Shoreline Management Plan (2006) demonstrates that the Policy Unit 4d21, in which the site is located, should continue to be managed and maintained through holding the line, up until the year 2105. Thus, the site should continue to benefit from coastal flood defences up to 2105.
- From a review of the plans, it is not known whether the built footprint on site will increase as a result of the development. The site is in a coastal floodplain, therefore flood compensatory storage is not required.
- The site is positively drained as existing. Given that the proposal is for the replacement of the existing dwelling on site, it is recommended that the surface runoff is discharged via the existing drainage infrastructure. Any additional surface water runoff generated as a result of the development should be attenuated by temporarily storing in a rainwater harvesting system, such as water butts or rain planters. Water butts can provide non-potable water uses on site and rain planters can provide additional ecological benefits to the site.

9.6 The following mitigation measures are recommended for the proposed replacement dwelling:

- Plans of the proposed dwelling show that the proposed Finished Floor Level of the ground floor will be set to 4.11mAOD. The proposed plans do not indicate a floor level for the first and second floors. Floor to ceiling heights are typically 2.4m, so it is expected that the first-floor level would be at 6.5mAOD.
- Habitable rooms should be provided at the ground floor level (kitchen, dining room, studio, utility room, study and snug), with sleeping accommodation at the first and second floor levels.
- Sleeping accommodation should be raised a minimum of 600mm above the 1:200-year +CC flood level, using the worst-case Upper End scenario, which would result in a floor level of 6.01mAOD.
- Emergency safe refuge could be sought at the first and second floor levels, if required. Furthermore, given the nature of tidal flooding, it is likely that sufficient early warning would be provided before flood waters reach the site.
- Residents should sign up to the EA Flood Warning service. In the event of an EA Flood Warning, the site shall be evacuated for the duration of the warning.
- The proposed replacement dwelling should incorporate flood resilience measures in line with current best practice for construction within an area at risk of flooding in line with CLG 2007 'Improving the Flood Performance of New Buildings. These are outlined in Section 7 of the report.
- Additional SuDS devices could be implemented to provide some additional betterment.

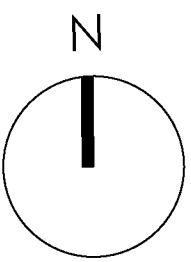
Following the guidelines contained within the NPPF, the proposed development is considered to be suitable assuming appropriate mitigation (including adequate warning procedures) can be maintained for the lifetime of the development.

Appendix I - Site Plans



Proposed Street Scene

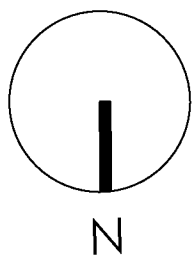
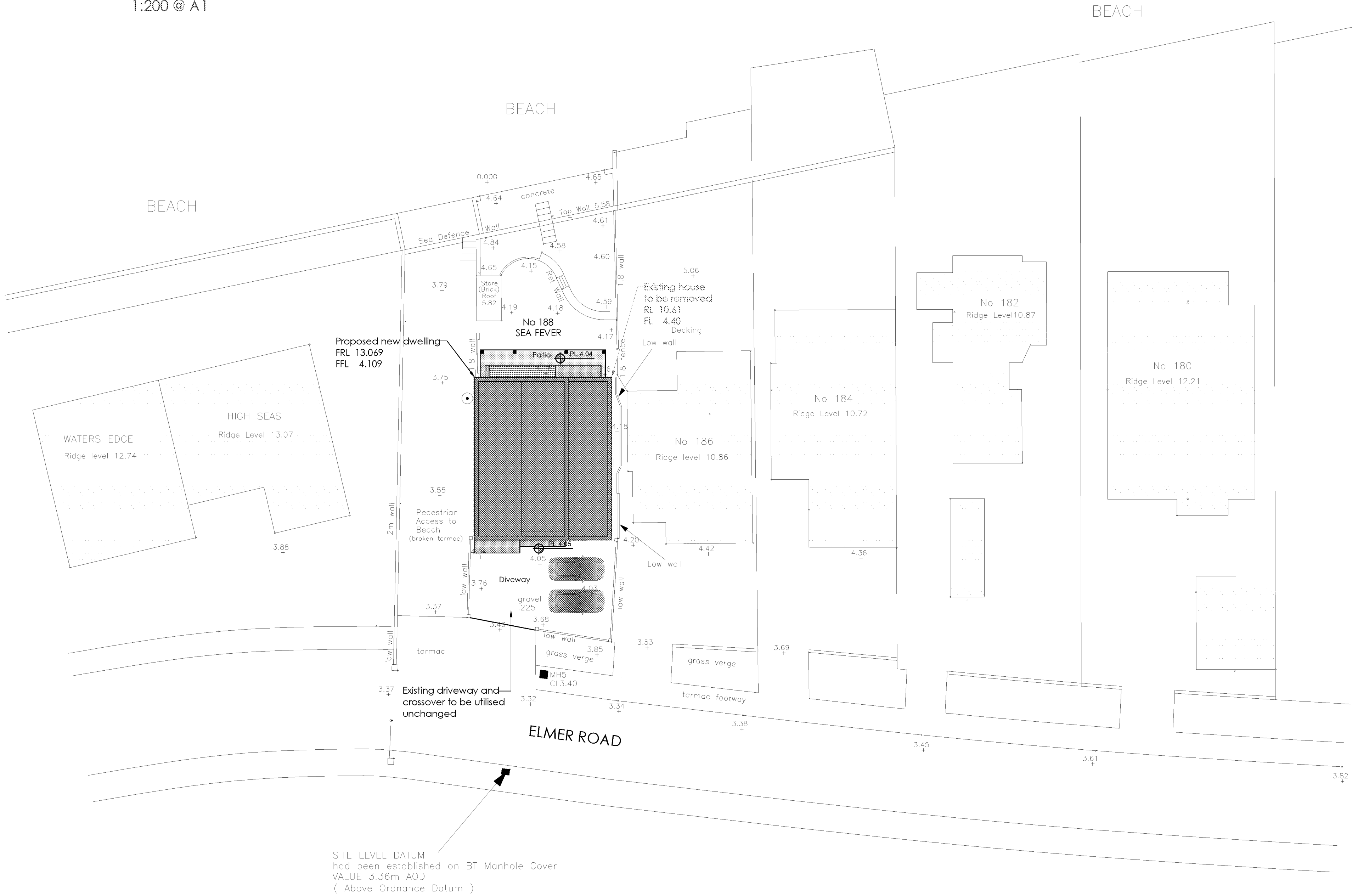
1:200 @ A1



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Location Plan

Area: 331.3m²
1:1250 @ A1



Proposed Block Plan

1:200 @ A1

REV	DATE	BY	REVISION NOTES
1	06/05/21	AS	Suite 2, Clare Hall, St Ives Business Park, Parsons Green, St Ives, Camps, PE27 4WY
COPYRIGHT Tel: 01480 494949 Email: enquiries@planningandarchitecture.co.uk Web: www.planningandarchitecture.co.uk			
PARTNERS in PLANNING and ARCHITECTURE			
PROJECT Proposed new dwelling at Seafever, 188 Elmer Road, Bognor Regis, West Sussex, PO22 6JA			
CLIENT Mr and Mrs Caplin			
DRAWING TITLE Proposed Block Plan and Street Scene			
DRAWN BY AS		SCALE 1:200 @ A1	
DATE 06/05/21		DWG. No. 18-070-101	
		REV. -	



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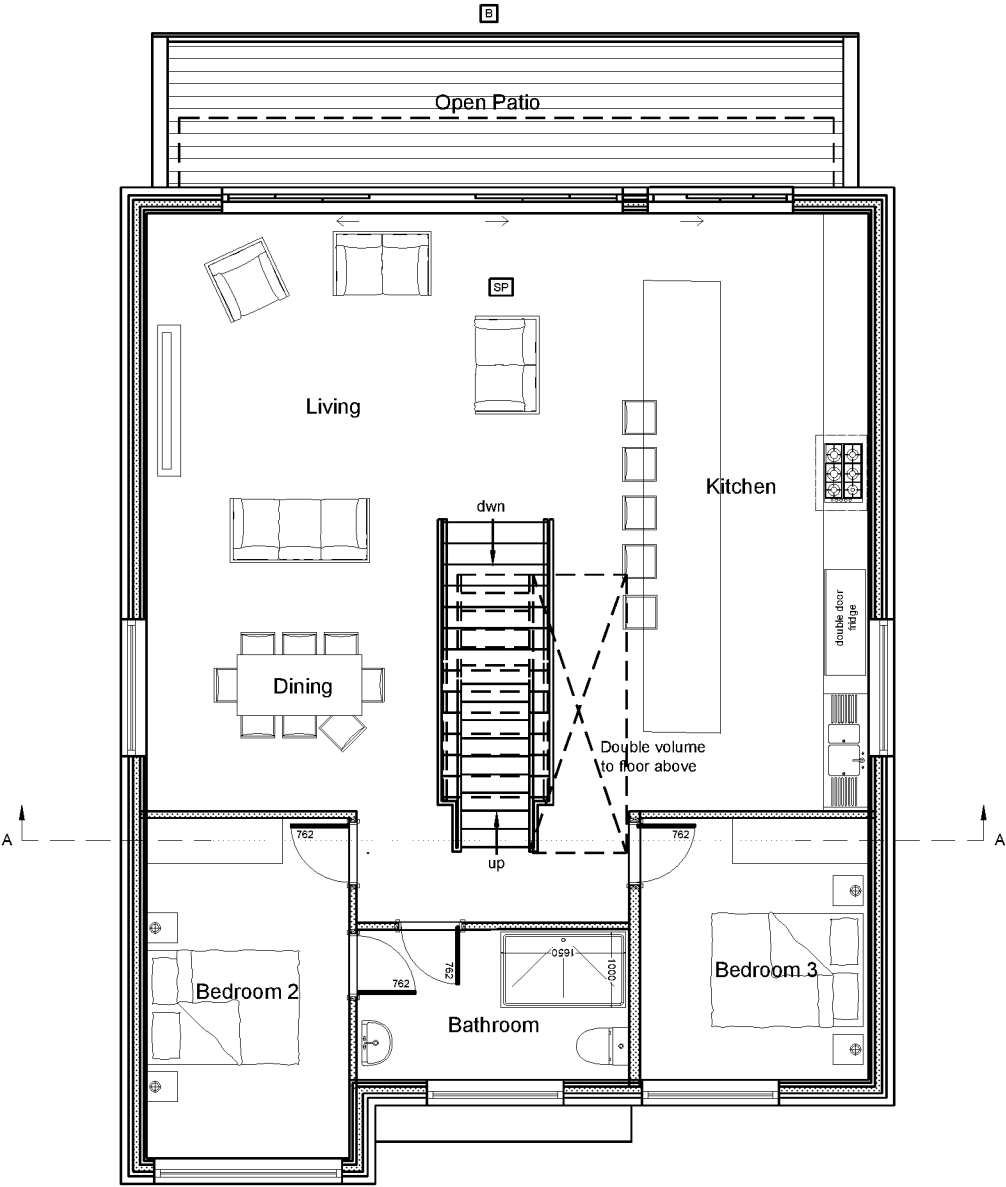


ARUN DISTRICT COUNCIL M/109/21/PL

- SP

Sprinkler system or approved fire suppression system to be provided. (Not by Potton)
- B

Guarding height to balcony to be 1.1m, constructed to prevent 100mm sphere passing through balusters and such that children may not readily climb over (not by Potton).



FIRST FLOOR
FIRST FLOOR INTERNAL AREA: 112.2m²
FIRST FLOOR INTERNAL PERIMETER: 44.1m

F	24/05/21	Amends as per email 17/05/21 & 20/05/21	DS	n/a
E	30/04/21	Amends as per email	ME	n/a
D	17/05/19	Amends to Initial Planning Drawings	DS	n/a
C	20/05/19	Amends to Initial Planning Drawings	DS	n/a
B	07/02/19	Amends to Initial Planning Drawings	DS	-
A	09/08/18	Initial Planning Drawings	DS	-
Rev:	Date:	Description:	Drawn:	Checked:

Client:
Mr & Mrs Caplin

Site Address:
**Seafever, 188 Elmer Road,
Bognor Regis, West Sussex,
PO22 6JA**

Property Type:
Bespoke Dwelling

Drawing Title:
First Floor Plan

Job Number:	Drawing Number:	Revision:
18-070	FF	F

Drawing Scale (UNO):
1:100@A3 0 1 2 3 4 5



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PLANNING

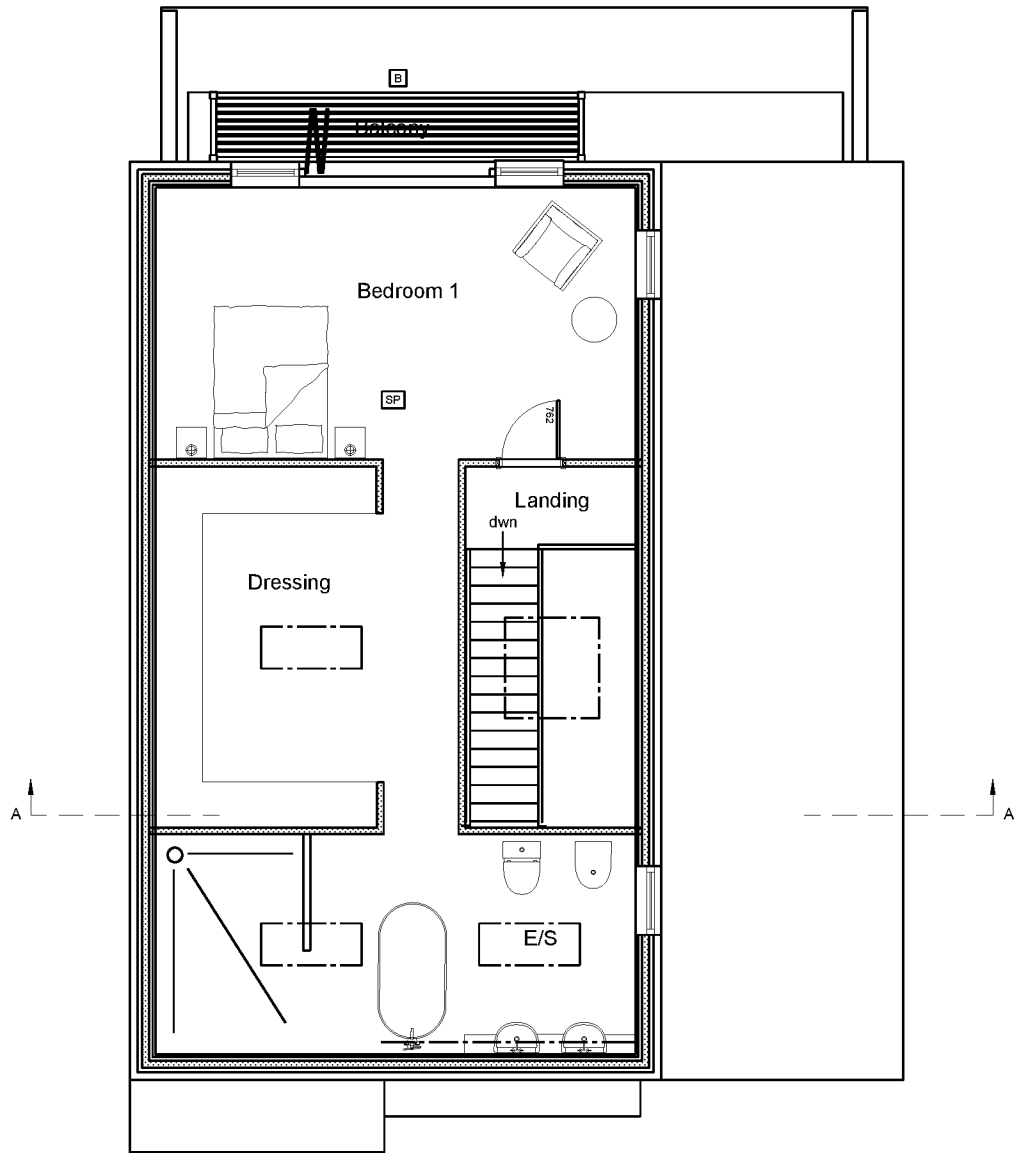
This drawing has been prepared to support the planning application.
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- SF

Sprinkler system or approved fire suppression system to be provided. (Not by Potton)
- E

Guarding height to balcony to be 1.1m, constructed to prevent 100mm sphere passing through balusters and such that children may not readily climb over (not by Potton).
- E

Wet room to be vented by mechanical extract fan ducted to outside air, capable of an extract rate of 6 litres per second with a 15 minute over-run and linked to the light switch.



SECOND FLOOR

SECOND FLOOR INTERNAL AREA: 72.7m²
SECOND FLOOR INTERNAL PERIMETER: 35.7m

PLANNING

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C	20/05/19	Amends to Initial Planning Drawings	DS	n/a
B	07/02/19	Amends to Initial Planning Drawings	DS	-
A	09/08/18	Initial Planning Drawings	DS	-
Rev:	Date:	Description:	Drawn:	Checked:

Client:
Mr & Mrs Caplin

Site Address:
**Seafever, 188 Elmer Road,
Bognor Regis, West Sussex,
PO22 6JA**

Property Type:
Bespoke Dwelling

Drawing Title:
Second Floor Plan

Job Number:
18-070

Drawing Number:
SF

Revision:
F

Drawing Scale (UNO):
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1

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4

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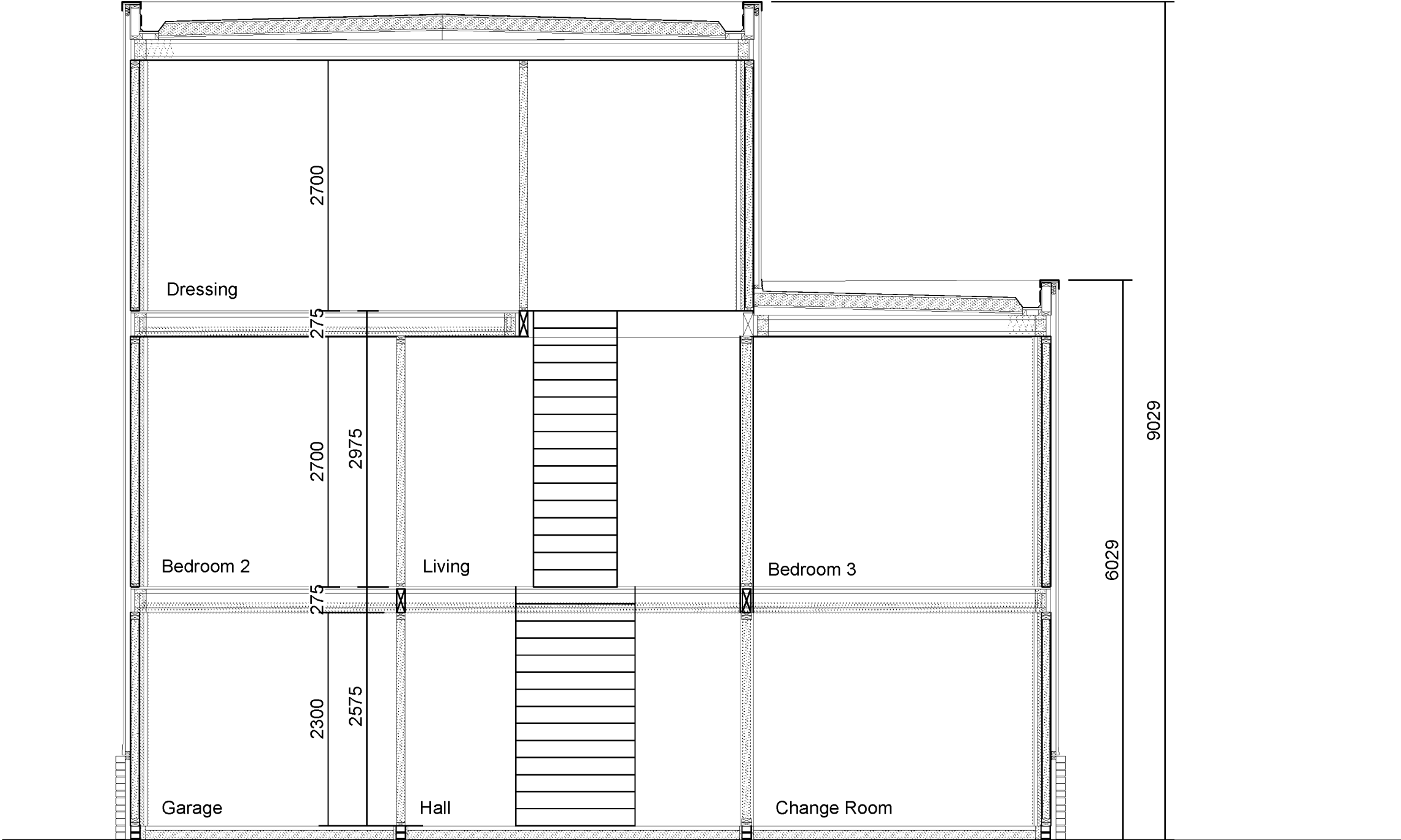


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Great Gransden,
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Fax: 01767 676444
E-mail: sales@potton.co.uk
Web: www.potton.co.uk

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Basic Section A-A

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C	20/05/19	Amends to Initial Planning Drawings	DS	n/a
B	07/02/19	Amends to Initial Planning Drawings	DS	-
A	09/08/18	Initial Planning Drawings	DS	-
Rev:	Date:	Description:	Drawn:	Checked:

Client:
Mr & Mrs Caplin

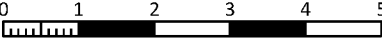
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**Seafever, 188 Elmer Road,
Bognor Regis, West Sussex,
PO22 6JA**

Property Type:
Bespoke Dwelling

Drawing Title:
Basic Sections

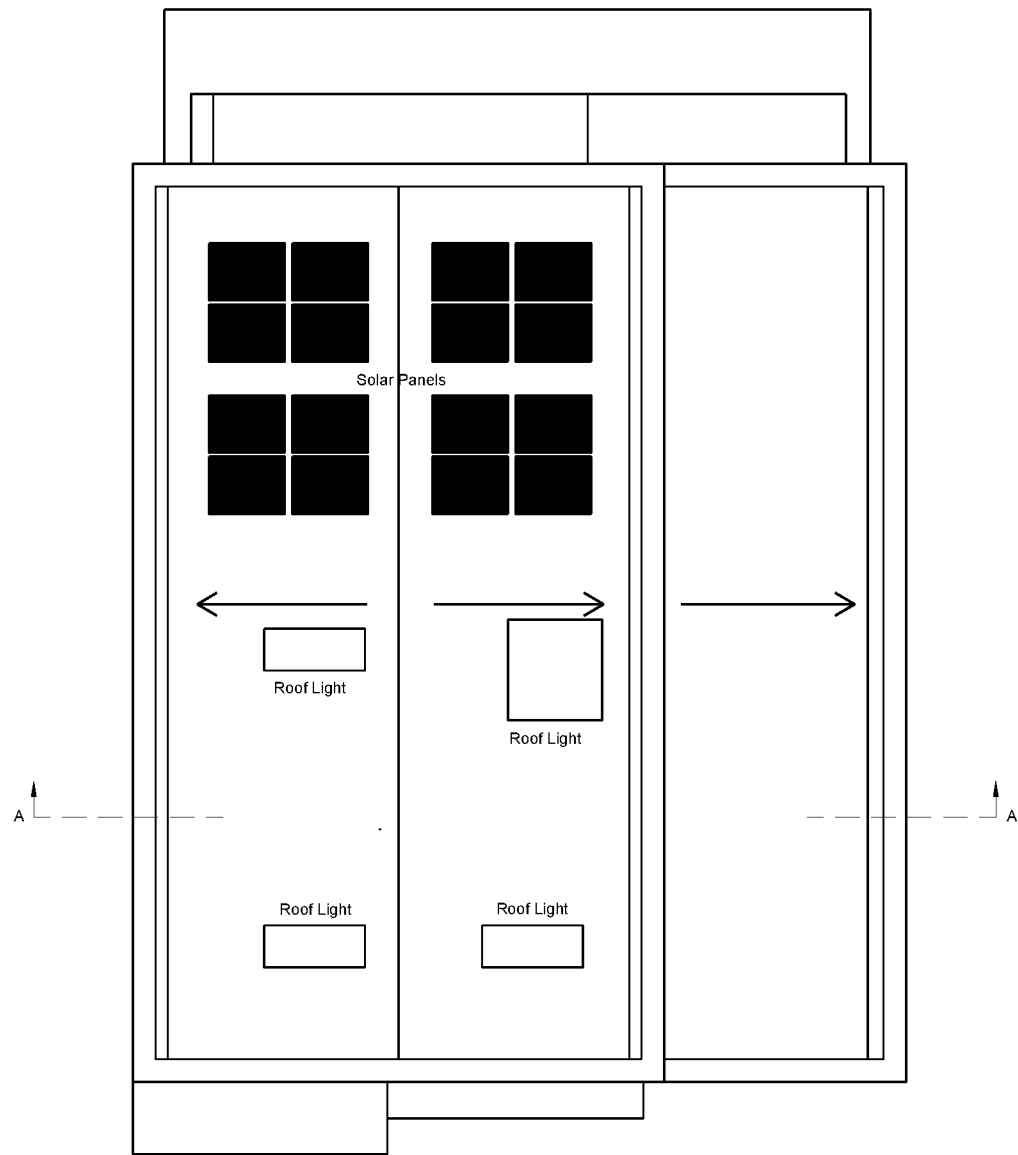
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18-070	SEC	F

Drawing Scale (UNO):
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ROOF PLAN

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C	20/05/19	Amends to Initial Planning Drawings	DS	n/a
B	07/02/19	Amends to Initial Planning Drawings	DS	-
A	09/08/18	Initial Planning Drawings	DS	-
Rev:	Date:	Description:	Drawn:	Checked:

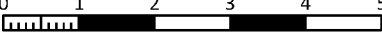
Client:
Mr & Mrs Caplin

Site Address:
**Seafever, 188 Elmer Road,
Bognor Regis, West Sussex,
PO22 6JA**

Property Type:
Bespoke Dwelling

Drawing Title:
Roof Plan

Job Number:	Drawing Number:	Revision:
18-070	R	F

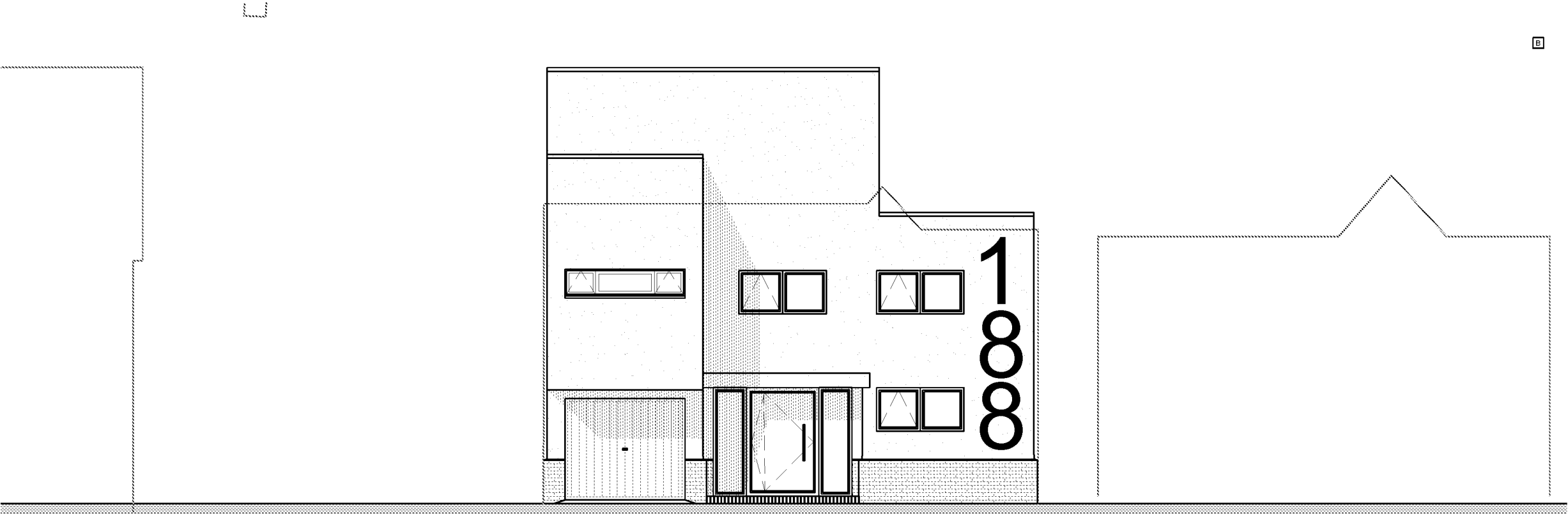
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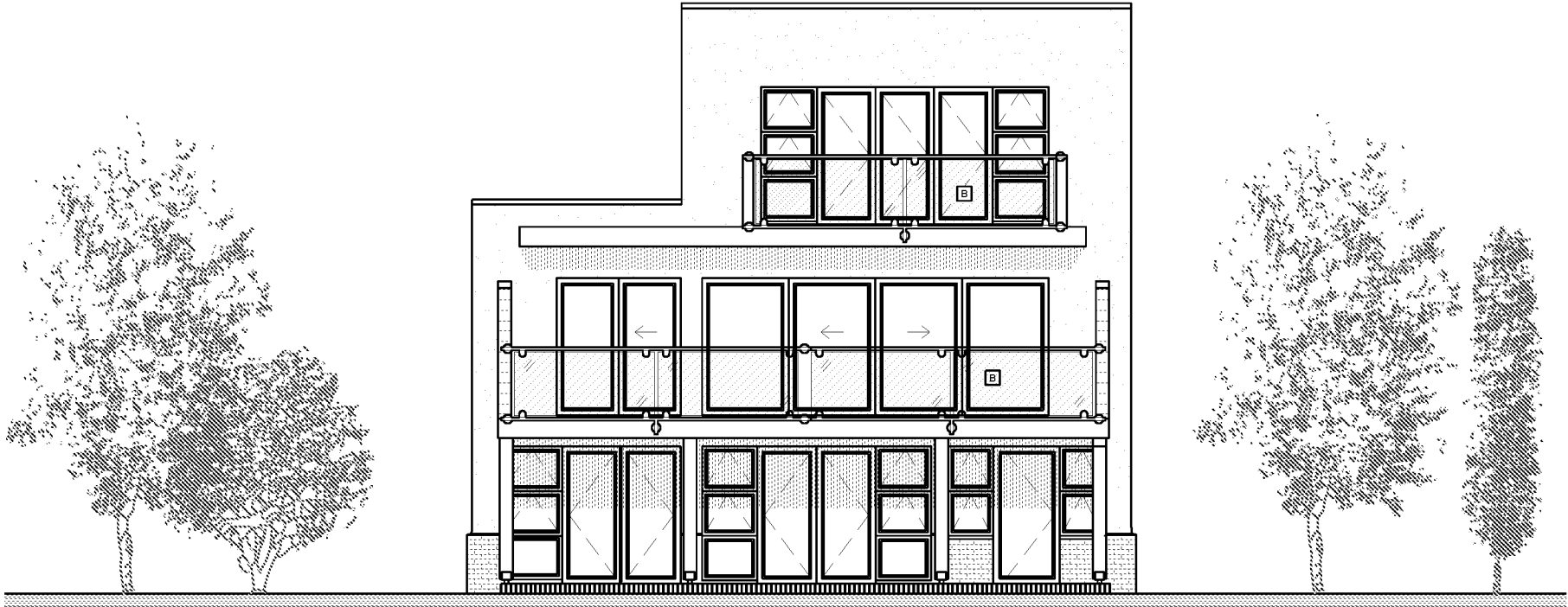
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Front Elevation (Street View)



Rear Elevation (Sea View)

B Guarding height to balcony to be 1.1m, constructed to prevent 100mm sphere passing through balusters and such that children may not readily climb over (not by Potton).

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C	20/05/19	Amends to Initial Planning Drawings	DS	n/a
B	07/02/19	Amends to Initial Planning Drawings	DS	-
A	09/08/18	Initial Planning Drawings	DS	-
Rev:	Date:	Description:	Drawn:	Checked:

Client:

Mr & Mrs Caplin

Site Address:

Seafever, 188 Elmer Road,
Bognor Regis, West Sussex,
PO22 6JA

Property Type:

Bespoke Dwelling

Drawing Title:

Front & Rear Elevations

Job Number:

18-070

Drawing Number:

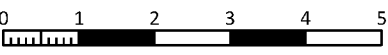
E1

Revision:

F

Drawing Scale (UNO):

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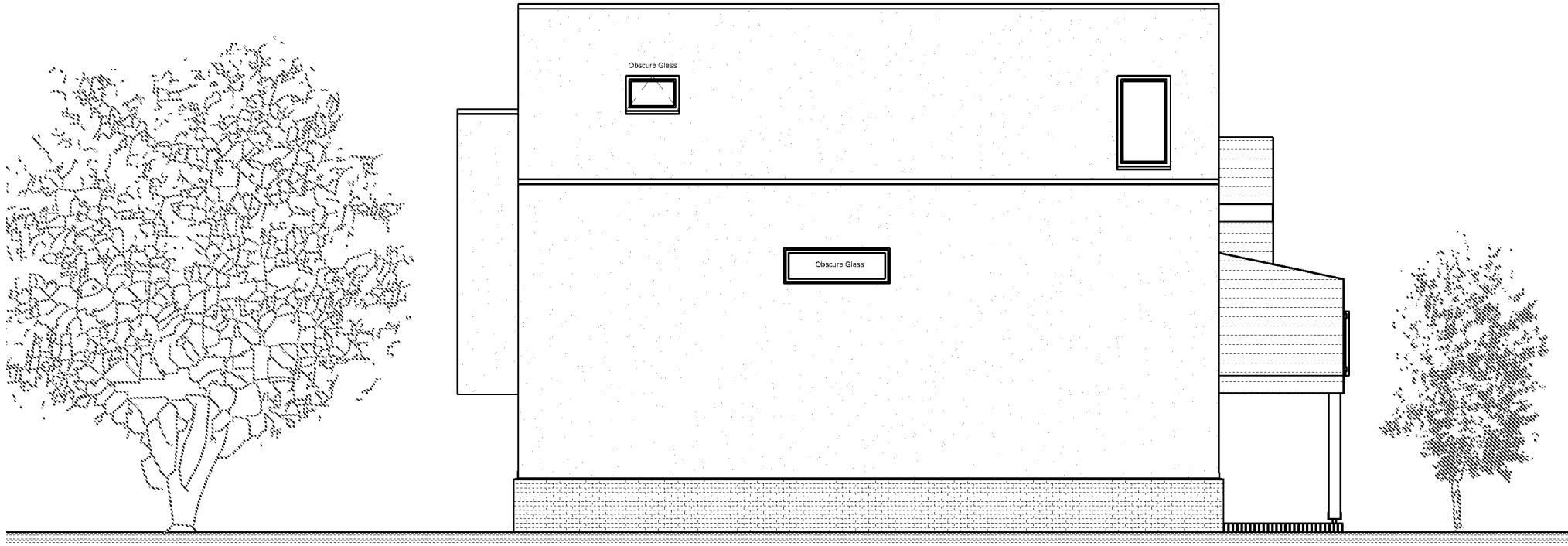
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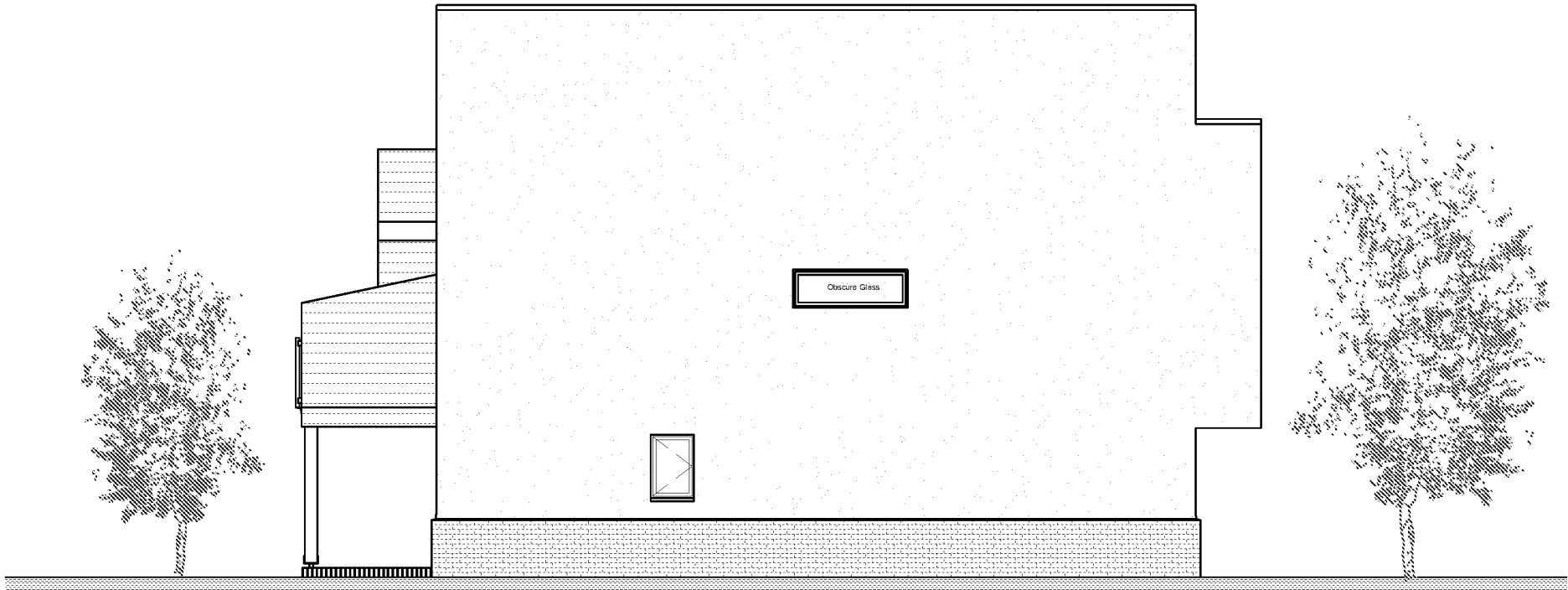
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West Elevation



East Elevation

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B	07/02/19	Amends to Initial Planning Drawings	DS	-
A	09/08/18	Initial Planning Drawings	DS	-
Rev:	Date:	Description:	Drawn:	Checked:

Client:
Mr & Mrs Caplin

Site Address:
**Seafever, 188 Elmer Road,
Bognor Regis, West Sussex,
PO22 6JA**

Property Type:
Bespoke Dwelling

Drawing Title:
Side Elevations

Job Number:	Drawing Number:	Revision:
18-070	E2	F

Drawing Scale (UNO):
1:100@A3



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Appendix II - EA Data

Lydia Sayers
Ambiental Consulting,
Science Park Square,
Brighton,
BN1 9SB

Our ref: SSD218698
Date: 25/05/2021

Dear Lydia Sayers,

Enquiry Regarding Product 4 for Flood Risk Assessment for Seafever, 188 Elmer Road, Bognor Regis, PO22 6JA.

Thank you for your enquiry which was received on 12 May 2021.

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

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

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

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

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

Flood Defences

There is a tidal wall (Asset ID 127642) maintained by the Environment Agency. The current standard of protection is 100 years from 2006, and its effective crest level is 5.5m.

Model Information

The model used was the River Arun To East Head Model which was completed by JBA Consulting in 2016.

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 Seafever, 188 Elmer Road, Bognor Regis, PO22 6JA.
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 2021 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,

Edward Conway
Partnership & Strategic Overview - West Sussex
Guildbourne House, Chatsworth Road, Worthing, BN11 1LD

Legend

 Please see page 2 for asset symbology



Structures

-  Control Gate
-  Draw Off Tower
-  Fish Pass
-  Hydrobrake
-  In Channel Stoplogs
-  Inspection Chamber
-  Jetty
-  Outfall
-  Screen
-  Spillway
-  Stilling Basin
-  Weir

Beach Structures

-  Breakwater
-  Ramp
-  Slipway
-  Steps
-  Groyne

Instruments

-  Active Monitoring
-  Passive Monitoring

Channel Crossings

-  Bridge
-  Utility Services

Aids to Navigation

-  Beacon
-  Buoy
-  Dolphin
-  Signage
-  Signal

Building Assets

-  Pump House

Major Civils

-  Abutment
-  Central Pier

Defences

-  Embankment
-  Wall
-  Flood Gate
-  Demountable defence
-  Bridge abutment
-  High Ground
-  Beach
-  Barrier Beach
-  Promenade
-  Quay
-  Cliff
-  Dunes

Channels

-  Open channel
-  Simple culvert
-  Complex culvert

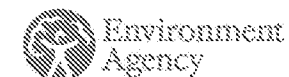
Land

-  Mudflats
-  Saltmarsh
-  Washland

Sites

-  Amenity
-  Control Structure
-  Erosion Protection
-  General
-  Harbour
-  Monitoring
-  Navigation Lock
-  Pumping Station
-  Reservoir
-  Tidal Barrier

Flood Map for Planning (Rivers and Sea). Centred on PO22 6JA. Generated 25/05/2021.



1: 10,000

0 Metres 250



Flood Map for Planning (Rivers & Sea)

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

Flood Map Areas (assuming no defences)

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

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

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



Environment
Agency

N



Legend



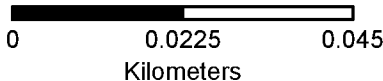
Site Nodes



Site Boundary

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

Scale: 1:1,000



Product 4 Flood Risk Data Requested by: Ambiantal Consulting

Site: Seafever, 188 Elmer Road, Bognor Regis, PO22 6JA

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	498597	100038	-	4.41	5.01	4.11
2	498596	100028	-	4.40	5.01	4.11
3	498596	100015	3.92	4.40	5.01	4.11

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	498597	100038	-	-	4.14	-
2	498596	100028	-	-	4.23	-
3	498596	100015	-	-	4.59	-

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	498597	100038	-	0.40	1.00	0.10
2	498596	100028	-	0.31	0.92	0.07
3	498596	100015	0.02	0.50	1.11	0.20

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	498597	100038	-	-	0.13	-
2	498596	100028	-	-	0.12	-
3	498596	100015	-	-	0.01	-

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

Produced on: 26/05/2021

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



Environment
Agency



N

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



00.2250.45

Kilometers





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



00.2250.45

Kilometers



Recorded Flood Outlines. Centred on PO22 6JA. Generated 25/05/2021.

Legend

 All recorded flood outlines



Risk of flooding from Surface Water. Centred on PO22 6JA. Generated 25/05/2021.



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
- Flood Extent 1 in 30
- Flood Extent 1 in 100
- Flood Extent 1 in 1000

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.

Appendix III - Supplementary Information

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Sophie Isaacs
Site name:	6299 Seafever
Site location:	Bognor

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details	
Latitude:	50.79154° N
Longitude:	0.60251° W
Reference:	697927959
Date:	Jun 14 2021 16:44

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha):	1
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Methodology

Q _{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Calculate from dominant HOST
HOST class:	22
BFI / BFIHOST:	0.374
Q _{MED} (l/s):	4.25
Q _{BAR} / Q _{MED} factor:	1.14

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Hydrological characteristics

	Default	Edited
SAAR (mm):	708	708
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Greenfield runoff rates

	Default	Edited
Q _{BAR} (l/s):	4.82	4.82
1 in 1 year (l/s):	4.1	4.1
1 in 30 years (l/s):	11.1	11.1
1 in 100 year (l/s):	15.39	15.39
1 in 200 years (l/s):	18.04	18.04

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.



Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:

Site name:

Site location:

Site Details

Latitude:

Longitude:

Reference:

Date:

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site characteristics

Total site area (ha):	0.01
Significant public open space (ha):	0
Area positively drained (ha):	0.01
Impermeable area (ha):	0.01
Percentage of drained area that is impermeable (%):	100
Impervious area drained via infiltration (ha):	0
Return period for infiltration system design (year):	10
Impervious area drained to rainwater harvesting (ha):	0
Return period for rainwater harvesting system (year):	10
Compliance factor for rainwater harvesting system (%):	66
Net site area for storage volume design (ha):	0.02
Net impermeable area for storage volume design (ha):	0.01
Pervious area contribution to runoff (%):	30

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the 'net site area' and the estimates of Q_{BAR} and other flow rates will have been reduced accordingly.

Design criteria

Climate change allowance factor:

Urban creep allowance factor:

Volume control approach:

Interception rainfall depth (mm):

Minimum flow rate (l/s):

Methodology

Q_{MED} estimation method:

BFI and SPR method:

Soil characteristics

	Default	Edited
HOST class:	--	
BFI HOST:	--	0.374
SPR HOST:	--	0.6

Hydrological characteristics

	Default	Edited
Q_{MED} :	--	0.08
Q_{BAR} / Q_{MED} conversion factor:	--	1.136
Rainfall 100 yrs 6 hrs:	--	55
Rainfall 100 yrs 12 hrs:	--	74.97
FEH / FSR conversion factor:	1.19	1.19
SAAR (mm):	708	708
M5-60 Rainfall Depth (mm):	17	17
'r' Ratio M5-60/M5-2 day:	0.4	0.4
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 10 year:	1.62	1.62
Growth curve factor 30 year:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Q_{BAR} for total site area (l/s):	0.05	0.05
Q_{BAR} for net site area (l/s):	0.1	0.1

Site discharge rates

	Default	Edited
1 in 1 year (l/s):	1	1
1 in 30 years (l/s):	1	1
1 in 100 year (l/s):	1	1

Estimated storage volumes

	Default	Edited
Attenuation storage 1/100 years (m^3):	1	1
Long term storage 1/100 years (m^3):	0	0
Total storage 1/100 years (m^3):	1	1

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This report was produced using the storage estimation tool developed by HRWallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at <http://uksuds.com/terms-and-conditions.htm>. The outputs from this tool have been used to estimate storage volume requirements. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.