



**UK Flood Risk
Flood Risk Consultants**

Flood Risk Assessment

**Aldwick CC, Brooks Lane, Bognor Regis
PO22 9AT**

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Summary of key changes/modification

In order to address the Environment Agency's comments/advice (28.12.2016), the following changes/modification have been made on this report:

1. **Provision of acceptable means of flood mitigation:** raised finished floor level by 300mm and a range of flood resilient measures have been proposed.
2. **Identified fluvial flood risk:** A brief assessment has been undertaken on the fluvial flood risk from the watercourse.
3. **Increased climate change levels:** Information on the modelled water levels was obtained from the Environment Agency, however, no data/information was available on the fluvial flood model of this watercourse. This watercourse is tidally influenced at this location. So, tidal flood risks are more important than the fluvial risk at this location, which have been further assessed and appropriate mitigations have been proposed.

Executive Summary

UK Flood Risk Consultants has been commissioned to prepare this Flood Risk Assessment (FRA) in support of a proposal consisting of a new single storey building to be utilised as a club house located at Aldwick CC, Brooks Lane, Bognor Regis PO22 9AT.

The proposed development is categorised as 'less vulnerable'.

The site is located in close proximity to the sea with the risk of tidal flooding. There were no records of flooding at the site.

The Environment Agency's Flood shows that the site lies within the Flood Zone 3 (high probability flooding). The Environment Agency's flood risk map indicates that the risk of flooding to the site is low.

The Environment Agency's modelling data indicated that for the defended condition, the site is located outside of the 2115 0.5%AEP (1 in 200 year) flood extent. However, under the undefended condition, the site is located within the flood extent of the 20% AEP and greater events. Also, under the undefended condition, the site is located within the flood extent of the 0.5% AEP in 2070 and 2115. The site is likely to be flooded by the 5%AEP event with a potential flood depth of 0.98m. Similarly, the flood depths for the 0.5%AEP and the 0.5%AEP (2115) events are 1.32m and 2.54m respectively. These flood depths indicate that the flood hazard to the people and the property will be high.

The flood risk from other sources including fluvial, surface water, underground water, sewer and reservoir is low.

In order to afford a level of protection against flooding, it is proposed that the finished floor level of the building will be set at 1.95mAOD which is 300mm above the existing ground level.

A range of flood resilient measures will be implemented in order to minimise the loss and damage and to ensure quick recovery and clean up after a flooding event.

As the site is located within a flood zone area, it will be necessary to make sure that the people are fully aware of the flood risk and flood warning during an extreme event. The residents should sign up to Environment Agency's Floodline Warnings Direct (FWD) and Flood Warning Service available in the area.

The proposed development will not lead to any increase in the surface runoff. The surface runoff will be improved by implementing appropriate SuDS measures. Rainwater harvesting will be implemented to improve the surface runoff.

This report demonstrates that the proposal will be safe, in terms of flood risk, for its design life and will not increase the flood risk elsewhere.

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Abbreviations

Abbreviation	Description
mAOD	Metres Above Ordnance Datum
DEFRA	Department for Environment, Food, and Rural Affairs
EA	Environment Agency
FRA	Flood Risk Assessment
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
SFRA	Strategic Flood Risk Assessment
PFRA	Preliminary Flood Risk Assessment
SuDS	Sustainable Drainage Systems

1.0 Background

UK Flood Risk Consultants has been commissioned to prepare this Flood Risk Assessment (FRA) in support of a proposal consisting of a new single storey building to be utilised as a club house located at Aldwick CC, Brooks Lane, Bognor Regis PO22 9AT.

This FRA has been carried out in accordance with the requirements of the National Planning Policy Framework (NPPF) and the Environment Agency's Flood Risk Assessment (FRA) Guidance Note 3. and the best practices in flood risk management.

The National Planning Policy Framework sets out planning policy in order to avoid inappropriate development in areas at risk of flooding by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.

2.0 FRA Requirements

A flood risk assessment should be undertaken for most developments located within one of the flood zones. This included developments:

- in flood zone 2 or 3 including minor development and change of use,
- more than 1 hectare (ha) in flood zone 1,
- less than 1 ha in flood zone 1, including a change of use in development type to a more vulnerable, where they could be affected by sources of flooding other than rivers and the sea (eg, surface water drains, reservoirs),
- in an area within flood zone 1 which has critical drainage problems as notified by the Environment Agency.

The Environment Agency's standing advice should be followed if carrying out a flood risk assessment of a development classed as:

- a minor extension (household extensions or non-domestic extensions less than 250 square metres) in flood zone 2 or 3
- 'more vulnerable' in flood zone 2 (except for landfill or waste facility sites, caravan or camping sites)
- 'less vulnerable' in flood zone 2 (except for agriculture and forestry, waste treatment, mineral processing, and water and sewage treatment)
- 'water compatible' in flood zone 2.

3.0 General Description of the Site and the Proposals

3.1. Description of the site

The proposal site is located at Aldwick CC, Brooks Lane, Bognor Regis PO22 9AT centred on the OS NGR (**Appendix A Figure 1**). Arun District Council is the Local Planning Authority.

The access to the site is via Brooks Lane. The site is located at the eastern corner of the playing field. The area to the east comprises residential dwellings (**Appendix A Figure 2**).

The nearest Main River from the site is Aldingbourne Rife. The site is located in an area located within the tidal floodplain. The topography is relatively level with the general elevation of 1.65mAOD. Further details about the existing site are provided in **Appendix B**.

3.2. Proposed Development

The proposed plan consists of a new single storey building to be utilised as a club house. The total area of the building footprint is approximately 88.5m². The club house comprises changing rooms, kitchen and a veranda at the front. Further details about the proposals have been provided in **Appendix B**.

4.0 Development and Flood Risk Policy

4.1. National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) is the main driving policy which was issued by the Department for Communities and Local Government in March 2012. The NPPF sets out planning and policies related to development planning and flood risk using a sequential characterisation of risk based on planning zones and the Environment Agency's Flood Maps. The aim of the flood risk assessment is to identify which Flood Zones the site is located in and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.

4.2. Flood Zones

The Flood Zones refer to the probability of river and sea flooding which ignores the presence of defences. The national flood maps have been developed by the Environment Agency that shows the risk of tidal and/or fluvial flooding across England and Wales for different return period events. The Environment Agency's Flood Maps are the maps which have been developed using broad scale hydraulic modelling. It is therefore important to understand that the flood maps may not be very accurate at a site-specific level which may need further field observation and measurements. The Flood Zones do not take into account of the climate change impacts which must be considered in any flood risk assessment as required by the NPPF.

4.3. Sequential and Exception Tests

As set out in the NPPF, the overall aim of the Sequential Test should be to steer new development to Flood Zone 1 (Low Probability Flooding). Where there are no reasonably available sites in Flood Zone 1, the Local Authority should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2, applying the Exception Test if required. Where there are no reasonably available sites in Flood Zones 1 or 2, the suitability of sites in Flood Zone 3 should be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required. As the proposal consists of development of a Club House which is related to the existing playing field, the Sequential Test will not be required.

The Exception Test, as set out in paragraph 102 of the Framework, is a method to demonstrate and help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where

suitable sites at lower risk of flooding are not available. There are two requirements to meet for the Exception Tests. The proposed development will provide wider sustainability benefits to the community that outweigh flood risk, and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.

4.4. Vulnerability of Use and Flood Risk Assessment

The proposal development is categorised as 'less vulnerable' development which will not have any residential use (**Table 2**). The site is located in Flood Zone 3. The proposed development is therefore appropriate at this location (**Table 3**). It should be ensured that all types of flood risk are considered as part of the Flood Risk Assessment: *'A site-specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall'*.

This FRA aims to demonstrate that the proposal will remain safe for its lifetime and will not increase flood risk elsewhere.

4.5. NPPF Flood Zones

Table 1 below shows the NPPF Flood Zones and the requirements and policy aims in terms of undertaking site-specific flood risk assessment.

Table 1 - NPPF Flood Zones and Requirements (NPPF Technical Guidance Table 1)

Zone 1: Low Probability Flood Zone	This is defined as the land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
Appropriate uses	All uses of land are appropriate in this zone.
FRA requirements	For development proposals on sites comprising 1 ha or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA.
Policy aims	Developers and local authorities should seek opportunities to reduce the overall level of flood risk through the layout and form of the development, and the



	appropriate application of sustainable drainage techniques.
Zone 2: Medium Probability Flood Zone	This is defined as the 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.
Appropriate uses	The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table 2 are appropriate in this zone. Highly vulnerable uses in Table 2 are only appropriate in this zone if the Exception Test is passed.
FRA requirements	All proposals in this zone should be accompanied by a FRA.
Policy aims	Developers and local authorities should seek opportunities to reduce the overall level of flood risk through the layout and form of the development, and the appropriate application of sustainable drainage techniques.
Zone 3a: High Probability Flood Zone	This is defined as the 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.
Appropriate uses	The water-compatible and less vulnerable uses of land in Table 2 are appropriate in this zone. The highly vulnerable uses (Table 2) should not be permitted in this zone. The more vulnerable and essential infrastructure uses in Table 2 should only be permitted in this zone if the Exception Test is passed.
FRA requirements	All proposals in this zone should be accompanied by a FRA.
Policy aims	Developers and local authorities should seek opportunities to:



	❖ reduce the overall level of flood risk through the layout and form of the development and the appropriate application of sustainable drainage techniques; ❖ relocate existing development to land with a lower probability of flooding; ❖ create space for flooding to occur by allocating and safeguarding open space for flood storage.
Zone 3b: Functional Floodplain	This is the land where water has to flow or be stored in times of flood. This zone is generally defined as the land which would flood with an annual probability of 1 in 20 (5%AEP) or greater in any year. The Local Council may define the Functional Floodplain area with a different annual probability of event.
Appropriate uses	Only the water-compatible uses and the essential infrastructure listed in Table 2 that has to be there should be permitted. It should be designed and constructed to: ❖ remain operational and safe for users in times of flood; ❖ result in no net loss of floodplain storage; ❖ not impede water flows; ❖ not increase flood risk elsewhere.
FRA requirements	All proposals in this zone should be accompanied by a FRA.
Policy aims	In this zone, developers and local authorities should seek opportunities to: ❖ reduce the overall level of flood risk through the layout and form of the development and the appropriate application of sustainable drainage techniques; ❖ relocate existing development to land with a lower probability of flooding.

Table 2 - Flood Risk Vulnerability Classification (NPPF Technical Guidance Table 2)

Essential Infrastructure	Essential transport infrastructure and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
Highly Vulnerable	❖ Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations and emergency dispersal points. ❖ Basement dwellings, caravans, mobile homes and park homes intended for permanent residential use. ❖ Installations requiring hazardous substances consent.
More Vulnerable	❖ Hospitals, residential institutions such as residential care homes, children's homes, ❖ Social services homes, prisons and hostels. ❖ Buildings used for: dwelling houses, student halls of residence, drinking establishments, nightclubs, hotels and sites used for holiday or short-let caravans and camping. ❖ Non-residential uses for health services, nurseries and education. ❖ Landfill and waste management facilities for hazardous waste.
Less Vulnerable	❖ Buildings used for shops, financial, professional and other services, restaurants and cafes, offices, industry, storage and distribution, and assembly and leisure. ❖ Land and buildings used for agriculture and forestry. ❖ Waste treatment (except landfill and hazardous waste facilities), minerals working and processing (except for sand and gravel). ❖ Water treatment plants and sewage treatment plants (if adequate pollution control measures are in place).



**Water-compatible
Development**

- ❖ Flood control infrastructure, water transmission infrastructure and pumping stations.
- ❖ Sewage transmission infrastructure and pumping stations.
- ❖ Sand and gravel workings.
- ❖ Docks, marinas and wharves, navigation facilities.
- ❖ MOD defence installations.
- ❖ Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location
- ❖ Water-based recreation (excluding sleeping accommodation).
- ❖ Lifeguard and coastguard stations.
- ❖ Amenity open space, nature conservation and biodiversity, outdoor sports and recreation.
- ❖ Essential sleeping or residential accommodation for staff required by uses in this category, subject to a warning and evacuation plan.



Table 3 - Flood Risk Vulnerability and Flood Zone 'compatibility'

Vulnerability Classification (Refer Table 2)		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zones	Flood Zone 1	✓	✓	✓	✓	✓
	Flood Zone 2	✓	✓	Exception Test	✓	✓
	Flood Zone 3a	Exception Test	✓	✗	Exception Test	✓
	Flood Zone 3b	Exception Test	✓	✗	✗	✗



Development is appropriate

✗ Development should not be permitted

5.0 Assessment of Flood Risk

5.1. History of Flooding

The Arun District Council's Strategic Flood Risk Assessment (SFRA, February 2008) has provided a brief summary of the historical flooding events within the borough. The SFRA reported flooding incidents in the area, however there were no records of flooding events at the site.

In addition, information on historic flood event was also obtained from the Environment Agency (**Appendix C**). There were no records of any flooding event at the site.

According to the information available from the clients they were not aware of any previous flooding incidents at the site.

5.2. Risk of Tidal Flooding

The site is located in close proximity to the sea with the risk of tidal flooding. The Environment Agency's Flood Map around the site is shown in **Appendix A Figure 3** which shows that the site lies within the Flood Zone 3 (high probability flooding). The Flood Zone 3 is defined as the land assessed as having a 1 in 200 or greater annual probability of tidal flooding ($>0.5\%$) in any year. The flood maps also show that the site is located in an area not benefiting from any flood defences. **Figure 4** shows the Environment Agency's flood risk map which indicates that the site is located in 'low' flood risk zone.

5.3. Modelled Water Levels

Information on modelled water levels was obtained from the Environment Agency (**Appendix C**). The site-specific modelled flood levels at the proposed development site have been taken from the River Arun to East Head 2016, completed by JBA Consulting using TUFLOW (2D) software. The modelled flood extent map for a range of events is shown in **Appendix C**. The flood maps show that for the defended condition, the site is located outside of the 2115 0.5%AEP (1 in 200 year) flood extent. However, under the undefended condition, the site is located within the flood extent of the 20% AEP and greater events. Also, under the undefended condition, the site is located within the flood extent of the 0.5% AEP in 2070 and 2115.

The location map showing the model nodes near the site are shown in **Appendix C**. The map shows that the nearest model node from the site is 1. The modelled water

levels near the site are summarised in a Table which shows that the 5%, 0.5%, 0.5% (2070) and 0.5% (2115) water levels are 2.63mAOD, 2.97mAOD, 3.56mAOD and 4.19mAOD respectively.

Comparison of Modelled Water Levels and Site Levels

The modelled water levels (floodplain) have been compared with the existing site levels (**Table 4**). The information on site levels have been taken from the topographic map (**Appendix B**).

Table 4 below shows that the site is subject to flooding from the 5% and higher events. The site is likely to be flooded by the 5%AEP event with a potential flood depth of 0.98m. Similarly, the flood depths for the 0.5%AEP and the 0.5%AEP (2115) events are 1.32m and 2.54m respectively. These flood depths indicate that the flood hazard to the people and the property will be high.

Table 4 – Comparison of modelled water levels against the finished floor level

Events	Modelled levels, mAOD	Site Level, mAOD	Potential flood depth, m
5% AEP	2.63	1.65	0.98
0.5% AEP	2.97	1.65	1.32
0.5% AEP (2070)	3.56	1.65	1.91
0.5% AEP (2115)	4.19	1.65	2.54
0.1 %AEP	3.23	1.65	1.58

5.4. Risk of Fluvial Flooding

The nearest Main River from the site is the Aldingbourne Rife (**Appendix A**) which is tidally influenced at this location.. Information on the modelled water levels for the fluvial flooding was obtained from the Environment Agency. However, no information was available on the fluvial flood model of this watercourse. The site is located approximately 140m east from the watercourse. This watercourse is a small watercourse comprising small-scale local field ditches mostly originating from A27 Road to the north of the site.. The risk of fluvial flooding is therefore relatively small compared with the tidal flood risk which has been assessed in Sections 5.2 and 5.3 above.

5.5. Risk of Flooding From Artificial Water Bodies

There were no known flood risks from any artificial water bodies near the site.

5.6. Risk of Groundwater Flooding

In recent years groundwater has been recognised as a significant source of flooding in the UK. According to the British Geological Survey, groundwater flooding occurs when the water table in permeable rocks rises to enter basements/cellars or comes up above the ground surface. Groundwater flooding is not necessarily linked directly to a specific rainfall event and is generally of longer duration than other causes of flooding (possibly lasting for weeks or even months).

There were very limited information available on the SFRA about the ground water flooding incidents in the area. It is important to note that the risk of groundwater flooding is highly variable and heavily dependent upon local conditions at any particular time. Groundwater flooding usually occurs following a prolonged period of low intensity rainfall and although there are no records of significant groundwater flooding around the site. The future risk from this source is more uncertain than surface water as the climate change predictions indicate that although sea levels will rise, thus possibly raising groundwater levels, overall summer rainfall will decrease, therefore having a long-term effect of lowering the groundwater levels. However, long periods of wet weather are predicted to increase: these are the type of weather patterns that can cause groundwater flooding to occur. According to the information obtained from the land owners, there were no records of any groundwater flooding incidents near the site. Based on these information, it is reasonable to conclude that the risk of groundwater flooding to the site is low.

5.7. Risk of Surface Water Flooding

The surface water flooding arises when the infiltration capacity of land or the drainage capacity of a local sewer network is exceeded and the excess rainwater flows overland. The severity of surface water flooding depends on several factors such as the degree of saturation of the soil before the event, the permeability of soils and geology, hill slope steepness and the intensity of land use.

Information on the risk of surface water flooding is held by the Environment Agency. The Environment Agency's Surface Water Flood Risk Maps are provided in **Appendix A Figure 5 and Figure 6** which indicate that the risk of surface water flooding is low.

5.8. Risk of flooding from Reservoirs

The Environment Agency's reservoir flood map in **Appendix A Figure 7** indicated that the proposed development site is located outside of the maximum extent of flooding from reservoir. According to the Environment Agency, the reservoir flooding is extremely unlikely to happen. It is also noted that no loss of life has been recorded from reservoir flooding since 1925. The Reservoirs Act 1975 has made provision for the Environment Agency to work as the enforcement authority for the Act in England. All large reservoirs are regularly inspected and assessed by the relevant reservoir experts and repair and maintenance work is carried out with priority if required.

5.9. Flood Risk from Sewers

Sewer flooding is often caused by excess surface water entering the drainage network causing sewers to surcharge. The underground drainage systems in many towns and cities of England are being progressively upgraded from the Victorian sewers. However, they often remain under capacity and subject to relatively frequent 'overload' (i.e. resulting in flooding on the surface).

During the SFRA study, it was not possible to pinpoint known capacity problems and/or infrastructure at risk of structural failure.

According to the information obtained from the landowner, there were no records of any sewer flooding around the site. However it is important to note that previous sewer flood incidents or the lack thereof do not indicate the current or future risk to the site as upgrade work could have been carried out to alleviate any issues or conversely in areas that have not experienced sewer flooding incidents the local drainage infrastructure could deteriorate leading to future flooding.

5.10. Impact of Climate Change

The Environment Agency released new a climate change guidance for flood risk assessments on 19th February 2016 outlining the allowances for the impact of climate change on peak river flows, peak rainfall intensities, sea level rise, offshore wind speeds and extreme wave height. They are based on climate change projections and different scenarios of carbon dioxide (CO₂) emissions to the atmosphere. There are different allowances for different epochs or periods of time over the next century.

The range of allowances in **Table 5** below 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. The central

allowance is based on the 50th percentile, higher central is based on the 70th percentile and the upper end is based on the 90th percentile.

Table 5 - Peak river flow allowances by river basin district (use 1961 to 1990 baseline)

River basin district	Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Northumbria	Upper end	20%	30%	50%
	Higher central	15%	20%	25%
	Central	10%	15%	20%
Humber	Upper end	20%	30%	50%
	Higher central	15%	20%	30%
	Central	10%	15%	20%
Anglian	Upper end	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%
South East	Upper end	25%	50%	105%
	Higher central	15%	30%	45%
	Central	10%	20%	35%
Thames	Upper end	25%	35%	70%
	Higher central	15%	25%	35%
	Central	10%	15%	25%
South West	Upper end	25%	40%	85%
	Higher central	20%	30%	40%
	Central	10%	20%	30%
Severn	Upper end	25%	40%	70%

	Higher central	15%	25%	35%
	Central	10%	20%	25%
Dee	Upper end	20%	30%	45%
	Higher central	15%	20%	25%
	Central	10%	15%	20%
North West	Upper end	20%	35%	70%
	Higher central	20%	30%	35%
	Central	15%	25%	30%
Solway	Upper end	20%	30%	60%
	Higher central	15%	25%	30%
	Central	10%	20%	25%
Tweed	Upper end	20%	25%	45%
	Higher central	15%	20%	25%
	Central	10%	15%	20%

Using peak river flow allowances for flood risk assessments

The guideline suggests to consider the flood zone and the appropriate flood risk vulnerability classification to decide which allowances applies to the development or plan.

In flood zone 2

Essential infrastructure – use the higher central and upper end to assess a range of allowances

Highly vulnerable – use the higher central and upper end to assess a range of allowances

More vulnerable – use the central and higher central to assess a range of allowances

Less vulnerable – use the central allowance

Water compatible – use none of the allowances

In flood zone 3a

Essential infrastructure – use the upper end allowance

Highly vulnerable – development should not be permitted

More vulnerable – use the higher central and upper end to assess a range of allowances

Less vulnerable – use the central and higher central to assess a range of allowances

Water compatible – use the central allowance

In flood zone 3b

Essential infrastructure – use the upper end allowance

Highly vulnerable – development should not be permitted

More vulnerable – development should not be permitted

Less vulnerable – development should not be permitted

Water compatible – use the central allowance

The site is located within the South East River Basin District. As the proposed development is categorised as ‘less vulnerable’ and is located in Flood Zone 3, the guideline recommends to use the central and higher central allowances in the fluvial flood risk assessments. The central and higher central allowances for the South East River Basin District are 35% and 45% respectively for the period between 2070 and 2115. These allowances are greater than that currently used and incorporated into the Environment Agency’s existing Fluvial Flood Model Levels where allowance of 20% was used. The model of the watercourses in this area should be updated by taking into account of these new climate change allowances in the site-specific flood risk assessments.

For the proposal site, as the watercourse is influenced by the tidal flood risk, the future flood risk has been assessed based on the modelling output considering the future scenarios in 2070 and 2115 as presented in Section 5.3 above.

6.0 Mitigation Measures

6.1. Recommended Finished Floor Level

In order to afford a level of protection against flooding it is normally recommended that finished floor levels are set a nominal 300mm above the 1 in 200 year annual probability tidal flooding (0.5%) in any year (including an allowance for climate change). The modelling output indicated that the 0.5% AEP flood level at the site is 2.97mAOD and the future 0.5% AEP (2115) water level is 4.19mAOD. However, it is not possible to raise the finished floor level of the proposed building to this level of 4.19mAOD due to other constraints.

It is proposed that the finished floor level of the building will be set at 1.95mAOD which is 300mm above the existing ground level of 1.65mAOD and the residual flood risk will be mitigated by implementing a range of resilient measures as discussed below.

6.2. Flood Resilient Measures

The following flood resilient methods will be adopted where practicable to manage the residual risk of flooding:

- Electrical sockets will be installed above the flood level for the ground floor to minimise damage to electrical services and allow speedy re-occupation.
- Water, electricity and gas meters will be located above predicted flood level.
- Non-return valves will be used in the drainage system to prevent back-flow of diluted sewage in situations where there is an identified risk of the foul sewer surcharging.
- All service entries will be sealed (e.g. with expanding foam or similar closed cell material).
- Closed cell insulation will be used for pipes which are below the predicted flood level.
- Underfloor heating will be avoided on ground floor and controls such as thermostats will be placed above flood level.
- Wiring for telephone, TV, Internet and other services will be protected by suitable insulation to minimise damage.

More detailed information about flood resilience can be found on the Environment Agency website (www.environment-agency.gov.uk) and in 'Improving the flood performance of new buildings' (www.planningportal.gov.uk/uploads/br/flood_performance.pdf).

6.3. Flood Warning and Evacuation

As part of the site is located within a flood zone area, it will be necessary to make sure that the people are fully aware of the flood risk and flood warning and evacuation during an extreme event.

6.3.1. Flood Warnings Direct

The Environment Agency operates a free flood warning service called Floodline Warnings Direct (FWD) which can give advance notice of when flooding is likely to happen and time to prepare for a flood event. Property owners on the proposed development site will be able to sign up to FWD online using the following channels (**Table 6**):

Table 6- Contacts for flood warning services

Channel	Details
Online	https://fwd.environment-agency.gov.uk/app/olr/register
Telephone	0345 988 1188

6.3.1. Flood Warning Service

The Environment Agency provides a Flood Warning Service throughout England and Wales in areas at risk of flooding from rivers or the sea. This is provided using up to date rainfall, river level and sea condition monitoring 24 hours a day to forecast the possibility of flooding. If flooding is forecast, the Environment Agency will issue warnings using a set of three different warning types (**Table 7**). Many areas of England are covered by the full four stages of the Environment Agency's Flood Warning Service, including the site (**Appendix A**). The Environment Agency's Flood Warning target lead time; the time between a flood warning being issued and the onset of flooding is approximately two hours. Providing the Environment Agency can meet their target Flood Warning lead time, the occupants of the proposed development will have two hours to ensure that property is relocated to minimise risk and evacuation to safe locations can be carried out.

Table 7 - Environment Agency's Flood Warning Codes

Flood Warning Code	Meaning	Actions to be taken
 FLOOD ALERT	Flooding is possible. Be prepared.	• Be prepared to act on your flood plan. • Prepare a flood kit of essential items. • Monitor local water levels and the flood forecast on our website.
 FLOOD WARNING	Flooding is expected. Immediate action required.	• Move family, pets and valuables to a safe place. • Turn off gas, electricity and water supplies if safe to do so. • Put flood protection equipment in place.
 SEVERE FLOOD WARNING	Severe flooding. Danger to life.	• Stay in a safe place with a means of escape. • Be ready should you need to evacuate from your home. • Co-operate with the emergency services. • Call 999 if you are in immediate danger.
Warnings no longer in force	No further flooding is currently expected in your	• Be careful. Flood water may still be around for several days.

	area.	If you've been flooded, ring your insurance company as soon as possible.
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6.4. Surface Water Runoff (SuDS)

The proposed building will be constructed by replacing an existing shed. Therefore, the proposal will not lead to increase in the impermeable surface area. This means that the surface runoff from the site will not be increased as a result of the development.

The runoff from the site will be improved by implementing appropriate SuDS. The requirements for SuDS will ensure that any redevelopment or new development does not negatively contribute to the surface water flood risk of other properties and instead provides a positive benefit to the level of risk in the area. It will also ensure that appropriate measures are taken to increase the flood resilience of new properties and developments in surface water flood risk areas, such as those identified as being locally important flood risk areas.

The SuDS hierarchy and management train has been discussed in Paragraph 1.3.2 of the SuDS Manual (C697) which aims to mimic the natural catchment processes as closely as possible. The general hierarchy of the SuDS measures is provided in **Table 8** below.

Table 8 General Hierarchy of SuDS Measures

Measures	Definition/Description
Prevention	The use of good site design and housekeeping measures to prevent runoff and pollution (e.g. rainwater harvesting/reuse).
Source control	Control of runoff at or very near its source (e.g. soakaways, porous and pervious surfaces, green roofs).
Site control	Management of water in a local area on site (e.g. routing water to large soakaways, infiltration or detention basins)
Regional control	Management of runoff from a site or several sites (e.g. balancing ponds, wetlands).

Table 9 below presents the feasibility assessment of the SuDS measures for the site.

Table 9 General Assessment of SuDS measures for the site

SuDS Measures	Issues/Description	Feasibility for the site
Prevention Good site design and housekeeping/rainwater harvesting/infiltration devices/education.	Surface runoff can be improved by implementing rainwater harvesting using water butts.	Yes
Source Control Porous and pervious materials/soakaways/green roof/infiltration trenches/disconnect downpipes to drain to lawns or infiltrate to soakaway.	Presence of fine soil with silt and clay means the infiltration measures may not be appropriate. Feasibility of soakaways or porous pavement will require field infiltration tests.	No
Site and Regional Control Infiltration/detention basins/ balancing ponds/ wetlands/underground storage/swales/retention ponds.	Balancing/ retention pond will not be feasible due to the limited availability of land.	No

7.0 Conclusion

The proposal consists of a new single storey building to be utilised as a club house located at Aldwick CC, Brooks Lane, Bognor Regis PO22 9AT.

The proposed development is categorised as 'less vulnerable'.

The site is located in close proximity to the sea with the risk of tidal flooding. There were no records of flooding at the site.

The Environment Agency's Flood shows that the site lies within the Flood Zone 3 (high probability flooding). The Environment Agency's flood risk map indicates that the risk of flooding to the site is low.

The Environment Agency's modelling data indicated that for the defended condition, the site is located outside of the 2115 0.5%AEP (1 in 200 year) flood extent. However, under the undefended condition, the site is located within the flood extent of the 20% AEP and greater events. Also, under the undefended condition, the site is

located within the flood extent of the 0.5% AEP in 2070 and 2115. The site is likely to be flooded by the 5%AEP event with a potential flood depth of 0.98m. Similarly, the flood depths for the 0.5%AEP and the 0.5%AEP (2115) events are 1.32m and 2.54m respectively. These flood depths indicate that the flood hazard to the people and the property will be high.

The flood risk from other sources including fluvial, surface water, underground water, sewer and reservoir is low.

In order to afford a level of protection against flooding, it is proposed that the finished floor level of the building will be set at 1.95mAOD which is 300mm above the existing ground level.

A range of flood resilient measures will be implemented in order to minimise the loss and damage and to ensure quick recovery and clean up after a flooding event.

As the site is located within a flood zone area, it will be necessary to make sure that the people are fully aware of the flood risk and flood warning during an extreme event. The residents should sign up to Environment Agency's Floodline Warnings Direct (FWD) and Flood Warning Service available in the area.

The proposed development will not lead to any increase in the surface runoff. The surface runoff will be improved by implementing appropriate SuDS measures. Rainwater harvesting will be implemented to improve the surface runoff.

This report demonstrates that the proposal will be safe, in terms of flood risk, for its design life and will not increase the flood risk elsewhere.

Appendix A Collection of Figures

Appendix B Existing Site and Proposed Plans

Appendix C Environment Agency's Data and Information
