PROPOSED NEW DEVELOPMENT BEHIND WINDMILL COURT, ROMAN BANK, SPALDING, PE11 2HN.

FLOOD RISK ASSESSMENT



View of site from Roman Bank

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This flood risk assessment has been prepared solely to support the planning application for the development at Roman Bank, Spalding. The author has made every effort to provide an accurate assessment of the flood risk but accepts no liability should the information be found to be incorrect or incomplete, or if it is used for any purposes other than for which it was originally commissioned.

Introduction

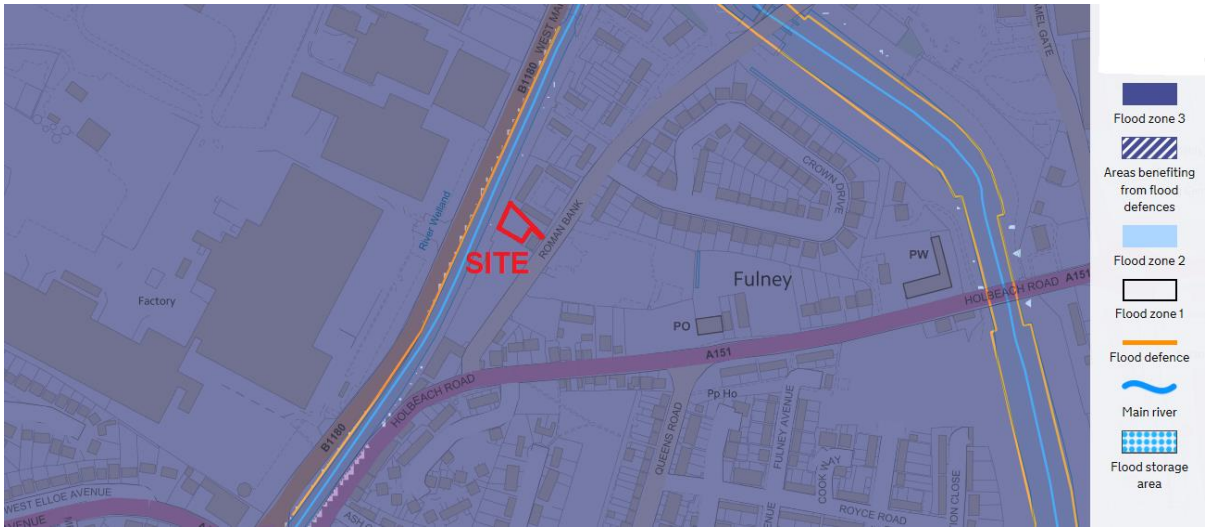
A Planning application is due to be submitted to South Holland District Council to construct a new block of flats behind Windmill Court on the west side of Roman Bank, Spalding, PE11 2HN.

The site is in Flood Zone 3 as shown on the Environment Agency's Flood Zone map. The flood zone maps do not take into account existing flood defences.

For the Planning Application to be valid a flood risk assessment needs to be carried out to conform with the requirements of the Technical Guidance to the National Planning Policy Framework Development and Flood Risk. The site is within a defended area as specified in the South Holland District Council's Strategic Flood Risk Assessment and is located in the South Holland Internal Drainage Board District.

Environment Agency (EA) Flood Zones

The map below is taken from the Environment Agency website and shows the flood zones in the area.



It can be seen that all of the area between the River Welland and the Coronation Channel is within Flood Zone 3 (coloured dark blue).

South Holland District Council Policies

The Council agreed the following relevant policies as part of the South Holland Local Plan in 2006:

Policy SG9 – Development and Flood risk:

In areas of flood risk planning permission will only be granted where a flood risk assessment has been carried out and submitted to the Council. Proposals shall, where necessary, include details of measures designed to reduce the risk and consequences of flooding.

For permission to be granted the Strategic Flood Risk Assessment and site specific assessment will need to demonstrate how the proposed development will be defended from flooding for its proposed life, taking into account proposed mitigation measures.

Built development that would be at high risk of flooding, or which may be subject to rapid inundation, will not normally be permitted unless exceptionally required for operational reasons.

Policy SG11 – Sustainable Urban Drainage Systems (SUDS)

Development generating surface water run-off, likely to result in increased flood risk, will be permitted provided that:

1) The development's surface water management system accords with sustainable development principles and has been designed as part of the development layout; and
2) The system will effectively control and adequately mitigate or attenuate any adverse effects from surface water run-off on people, habitats, of acknowledged importance and property; and
3) Developers can ensure long term maintenance of the drainage systems, where necessary through planning obligations.

Where this is not possible the developer will be required to implement an alternative method of surface water disposal that is to the Council's satisfaction

Application Site

The development site is located between the River Welland and the Coronation Channel. The National Grid Reference of the site is 525770 323850.

The location of the site is shown on the plan at the end of this document.

Applying the flood risk vulnerability classification in Table 2 of the Guidance, a development consisting of dwelling houses is classified as "more vulnerable".

Table 3 of the Guidance is shown below:

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓*

As the site is within a defended area the proposed development can be designated to be within Flood Zone 3(a) "High Probability" as detailed on the Environment Agency's flood zone maps without defences, as defined in Table 1 of the Technical Guidance.

Therefore it can be seen that for “More vulnerable” development the sequential and the exception tests need to be applied to the development.

Sequential Test

The aim of the Sequential Test, as set out in the Planning Practice Guidance, is to ensure that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. The flood zones as defined in the Strategic Flood Risk Assessment for the area provide the basis for applying the Test. The aim is to steer new development to Flood Zone 1 (areas with a low probability of river or sea flooding). Where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of river or sea flooding), applying the Exception Test if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas with a high probability of river or sea flooding) be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

All of the area between the River Welland and the Coronation Channel, as can be seen from the map on page 2 of this report, is in Flood Zone 3. Therefore it would be difficult to find a similar site for development in this area of Spalding that is in a lower flood zone. The safety of the development will be delivered by ensuring the floor level of the proposed new dwellings is above the predicted residual flood levels for this area.

The South Holland District Council Core Strategy states that there is a limited number of sites outside the town of Spalding available for residential development. The Council encourages development of brownfield land inside the town boundary to meet the RSS and Structure Plan requirement for 2021.

Therefore I consider that the sequential test has been passed.

Exception Test

The Sequential Test has demonstrated that it is not possible, consistent with wider sustainability objectives, for the development to be located in zones with a lower probability of flooding. Therefore the Exception Test must be applied and for this to be passed:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risks, informed by the Strategic Flood Risk Assessment; and
- A site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking into account of the vulnerability of its users, without increasing flood risk elsewhere, and where possible will reduce flood risk overall.

Both parts of this test must be satisfied in order for the development to be considered appropriate in terms of flood risk. There must be robust evidence in support of every part of the test.

The first section will be demonstrated by the Supporting Planning Statement and compliance with South Holland District Council's planning policies.

This flood risk assessment will demonstrate that the development will be safe for its lifetime and it will not increase flood risk elsewhere.

South Holland DC Strategic Flood Risk Assessment (2010)

Consultants produced a Strategic Flood Risk Assessment (SFRA) in 2010, which has recently been updated, for the South Holland District Council (SHDC). This document provides details of the flood risk in the Council's area. Reference to the maps in this document give the following information for the flood risk and hazard at the site for the 1% fluvial event and 0.5% tidal event.

The maps illustrate the actual flood hazard which is as follows:

1. **Flood Maps Table D1**

The maps illustrate the actual flood hazard which is as follows:

For the present day	Depth of flooding … zero
	Extent of flooding .. zero
	Hazard …. Nil
	Velocity … Nil
For year 2115	Depth of flooding … 0 - 1.0m
	Extent of flooding …High
	Hazard … Significant
	Velocity .. 0 – 0.1m/sec

The maps showing the residual flood hazard were revised in the 2016 update of the South Holland District Council Strategic Flood Risk Assessment which can be found on the website of the South East Lincolnshire Joint Planning Committee. The hazards are as follows for the 1% fluvial or 0.5% tidal event probability:

For the present day	Depth of flooding ... 500mm – 2.0 metres
	Extent of flooding .. High probability
	Hazard … Danger for most (1.25 – 2.0)
	Velocity .. 0 – 0.3m/sec
For the year 2115	Depth of flooding..... 500mm – 2.0 metres
	Extent of flooding .. High probability
	Hazard … Danger for most (1.25 – 2.0)
	Velocity .. 0 – 0.3m/sec

The hazards are as follows for the 0.1% fluvial or 0.1% tidal event probability:

For the year 2115	Depth of flooding..... 500mm – 2.0 metres
	Extent of flooding .. High probability
	Hazard … Danger for all (More than 2.0)
	Velocity .. 0.3 – 1.0m/sec

Figure 16 of the general maps shows that the site is within the rapid inundation zone for the present day and in 2115.

2. **Maximum flood levels:**
   Maximum flood levels in the River Welland and the Coronation Channel are shown in the reports as follows:

	Present	Present + Climate Change
1 in 100 year	4.32	4.69
1 in 1,000 year	4.34	4.69

- The minimum freeboard on the east bank of the Coronation Channel is 70mm.
- The maintenance standards of these banks are good and defences are well maintained and regularly inspected.

3. **Extreme tide levels**
   The extreme tide levels in the section of the Coronation Channel and River Welland between Fulney Lock and Marsh Road Sluice are shown in the report as follows:

	2007	2055	2115
1 in 200 year	5.98	6.31	7.12
1 in 1,000 year	6.32	6.65	7.46

The lowest bank level on the left bank of the Coronation Channel is 6.88m OD.

The lowest bank level on the right bank of the tidal River Welland is 7.57m OD.

Existing Flood Alleviation Measures

The site is within a defended flood plain, as defined in Appendix 1 of the Environment Agency's "Policy and Practice for the Protection of Flood Plains" and is considered to be passive until such time that a flood greater than the defences can withstand occurs. The likelihood of flooding due to overtopping or failures of the defences is considered to be very low.

The site is approximately 10 metres from the bank of the River Welland, which is the main river and maintained by the Environment Agency.

The site is approximately 250 metres south of the tidal defences of the River Welland and Coronation Channel.

The area between the River Welland and the Coronation Channel is drained by surface water sewers maintained by Anglian Water, which discharge either into the River Welland or into drainage channels maintained by South Holland Internal Drainage Board. The water levels in the IDB channels are controlled by Clay Lake Pumping Station, which is operated by South Holland IDB, and discharges into the Coronation channel.

Existing Ground Levels

The whole of the Windmill Court site is between Roman Bank and the eastern bank of the River Welland. The existing building (6 flats) is alongside Roman Bank.

The level of Roman Bank in front of the property is 4.10m OD and the level of the parking area behind the building is approximately 4.45m OD. The ground floor level of the building is 4.75m OD. The rear area where the new building is proposed is fenced off and overgrown. The level is similar to the parking area and can be assumed to be approximately 4.50m OD.

These levels are shown on the plan on page 15 of this report.

Potential Sources of Flooding

The following sources of flooding have been identified:

1. Failure or overtopping of the tidal defences.
2. Overtopping of the River Welland.
3. Overtopping or breaching of the Coronation Channel.
4. Failures of Clay Lake Pumping Station (IDB)
5. Blockages in Exeter Drain (IDB)
6. Blockages in local surface water sewers (highway or Anglian Water)

1. Failure or overtopping of tidal defences.

There is a short length of tidal defences on the Coronation Channel west of Marsh Road Sluice and on the River Welland north of Fulney Lock that defends the area between the River Welland and the Coronation Channel from tidal flooding. The SFRA states that the defences are adequate to withstand a 1 in 200 year (0.5%) probability event for present day but in the future (2115) some of the banks would be overtopped in a 0.5% probability event.

Crest levels of this bank have been surveyed and these are shown below. These levels range from 7.28m OD near Fulney Lock to above 8.00m OD on the main section of bank. The low level of 6.88m OD mentioned in the SFRA was not found. All the surveyed levels are higher than the 1 in 200 year extreme tide level in 2115 of 7.12m OD stated in the SFRA.



These banks are well maintained and have a top width of at least 4.0 metres, and it is reasonable to assume that during the next one hundred years, considering the assets that are protected by this bank, further maintenance and capital works will be carried out on the tidal banks to ensure a continuing minimum defence standard of 1 in 200 years.

If a breach occurred in the tidal bank during a 1 in 200 year event in the year 2115 flood water would flow southwards and start to flood the whole area between the Coronation Channel and the River Welland. The hazards of this will be considered later in the report.

2. Overtopping of the River Welland.

The crest level of the east bank of the River Welland is approximately 5.50m OD west of the building. The highest predicted fluvial level for a 1 in 100 year event in the fluvial River Welland in 2115 is 4.69m OD. The level of the east bank of the River Welland varies between 5.10 and 5.30m OD through the town of Spalding.

The ground floor level of the proposed building will be higher than the maximum predicted level in the fluvial River Welland and therefore flooding from this source can be discounted.

3. Overtopping or Breaching of the Coronation Channel

The area between the River Welland and the Coronation Channel is protected from flooding by banks on the west side of the channel, which are approximately 2.0m to 3.0m above the land. The top levels of these banks are at a level of 5.40m OD, which gives a freeboard of at least 700 mm above the 1 in 1,000 year maximum design level in the channel.

If a breach occurred in the channel the maximum water level in the flooded area could reach between 4.0 m and 4.1 m OD for the present day situation and between 4.3m and 4.4 m OD if climate change is allowed for.

The ground floor level of the proposed building will be higher than the maximum predicted level in the Coronation Channel and therefore flooding from this source can be discounted.

4. Failure of Clay Lake Pumping Station

The South Holland IDB estimate that the Clay Lake Pumping Station provides a 1 in 50 year standard with a freeboard, which in effect provides a 1 in 100 year protection against flooding. The pumping station is maintained in good condition and should a failure occur the Drainage Board would quickly deploy temporary pumps to alleviate the situation. It is highly unlikely that any flooding from this source would extend as far as this site, as the flood water would need to rise above 3.40m OD, which is higher than the ground levels around the pumping station itself which would flood first.

Therefore flooding from this source can be discounted.

5. Blockages in Exeter Drain

The South Holland IDB has a regular annual maintenance programme and they remove weed growth from channels such as these twice each year. However, any flooding from this channel will not cause any flooding to the development site, as explained in (4) above.

Therefore flooding from this source can be discounted.

6. Blockages in local surface water sewers

Both Anglian Water and the Highways Authority maintain surface water drainage systems in this area. The floor levels of the proposed new building will be raised a significant height above the level of Roman Bank which will provide adequate mitigation against flooding from this source.

Extent of known Flooding

During the preparation of this assessment, no evidence was discovered of the site or any of the adjoining properties having been flooded in the last 50 years.

Probabilities and Trends of Flooding

The probability of this development being flooded from Environment Agency main river is very low. In an extreme tidal event the site would be affected by flood water very soon after a breach occurred.

Climate Change

The recommendations for flood depths for this flood risk assessment use information mostly taken from the South Holland DC SFRA which was last updated in 2010. The EA have issued new guidance on recommended contingency allowances for predicted sea rises, fluvial flows and rainfall intensities which from 19th February 2016 needs to be considered in this FRA. The effects of these new recommendations are considered in Appendix B of this report (pages 16 to 19). The notes in Appendix B conclude that no extra mitigation measures are necessary to comply with the new guidance on climate change.

Summary of Residual Risk to the Site

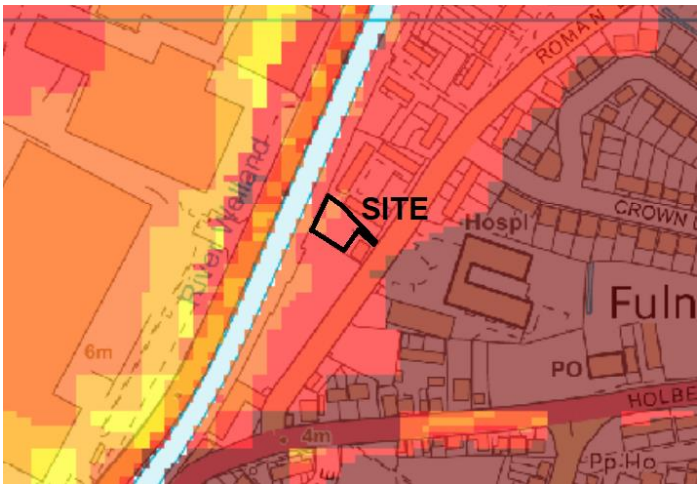
The SFRA has calculated the consequences arising from a possible breach occurring at any point along the raised defences. Also considered were scenarios in which gates or other assets fail to operate allowing water to flow inland and cause flooding.

Updated maps showing predicted flood depths were issued on the South East Lincolnshire Local Plan website in March 2017. An extract of the map showing predicted residual flood depths for the 0.5% tidal and 1% fluvial event probability on the development site is shown on the next page.



The map indicates that the predicted maximum flood depth on the eastern part of the site is between 1.0 metres and 2.0 metres and adjacent to the River Welland the map shows an area with predicted flood depths between 500mm and 1.0 metre.

An extract of the map showing predicted residual flood depths for the 0.1% tidal and fluvial event probability on the development site is shown below.



This map indicates similar predicted flood depths with the maximum flood depth on the eastern part of the site being between 1.0 metres and 2.0 metres and adjacent to the River Welland the map shows an area with predicted flood depths between 500mm and 1.0 metre.

If a breach occurred in the tidal bank of the River Welland or the Coronation Channel between Fulney Lock and Marsh Road Sluice flood water would flow into the area between the Coronation Channel and the River Welland. It is possible that the water level could reach a level of 5.20m OD, but it is unlikely to rise above this level as flood water would then flow into the River Welland as soon as the flood level increased above 5.00m OD. The risk of a breach occurring in this short length is extremely low. Breaches are more likely to occur during an event with return period of 1 in 200 years or greater. However a breach could occur in any part of the tidal defences between Spalding and the Wash, and this would reduce water levels in the tidal Welland during the event.

It can be seen that the flood depths shown adjacent to the fluvial River Welland on the maps in the SFRA seem to overestimate the depths of flooding. This may be because the LIDAR levelling used to produce the maps is not as accurate as actual levels on the ground, and levels of development land change after a site is cleared.

If evidence is reviewed from other flood risk assessments in the area, it can be seen that the Environment Agency has accepted evidence that the maximum flood level in this area will be 4.90m OD if a breach occurred in tidal bank north of the site in a 1 in 200 year or a 1 in 1000 year event in 2115. Further details of this evidence is given in Appendix A of this report.

Therefore it is recommended that the finished ground floor level of the proposed building on this site should be at a level of 5.20m OD, which provides a freeboard of 300mm above the predicted level after a breach in a 1 in 1000 year event in 2115. This complies with guidance from the Environment Agency that if sleeping accommodation is provided on the ground floor the floor level of a building should be 300mm above the 1 in 1000 year flood level in 2115.

Conclusions

The proposed development is not in a functional flood plain as defined by PPS 25.

Although the site is in flood zone 3(a), the actual risk of the site flooding from any Environment Agency water course is low.

There is no actual risk of flooding at the present time in a 1 in 1000 year event.

There is a risk of the defences being overtopped in a 1 in 1000 year event in 2115. One would also expect that the Environment Agency will if necessary increase the levels of these defences sometime in the next 100 years, considering how many properties are protected by this defence.

The SFRA states there is a residual risk that the site could flood if a breach occurs in the tidal defences. Although the risk of a breach occurring is very low, it can be shown that if a breach 50 metres wide and 3.0 metres deep is assumed to form within minutes, then water levels in the area between the River Welland and the Coronation Channel could eventually reach 5.30m OD.

If a breach occurred then the whole area between the Coronation Channel and the River Welland would start to fill with flood water. A major emergency would be called by the Authorities as there would be hundreds of houses at risk.

If flooding were to occur in an extreme event, residents of the buildings will be able to leave the area by walking south along Roman Bank and crossing the bridge to access the east side of the River Welland. From here they would be able to walk to the central part of Spalding where the land levels are higher, and the risk of flooding is lower.

In a flood risk area there is always a risk of an event occurring of greater magnitude than has been considered in this flood risk assessment.

Recommendations

In any area at risk of flooding all new dwellings should be of two story construction with all bedrooms at first floor level. This is to provide a refuge for residents if the

building becomes flooded after a major breach of the tidal bank, and ensure there is no danger to residents when they are asleep.

If sleeping accommodation is required on the ground floor, as it is in this development, then the ground floor level should be at least 300mm above the 1 in 1000 year flood level in 2115.

In making a recommendation for the habitable floor levels of the proposed building on this site, the following evidence that is included in this report will be considered:

a) The Environment Agency have approved a predicted flood level of 4.90m OD for a very recent planning application located south of the proposed development on the west side of Roman Bank. Further details of this are shown on page 16 of the report (Appendix A).

b) The maps in the updated SFRA indicate the predicted residual flood level in a 1 in 1000 year event in 2115 will be higher than 5.80m OD.

c) When the flood level reaches 5.00m OD in the area flood water will begin to flow back into the fluvial River Welland preventing the flood level increasing above a level of between 5.20m and 5.30m OD.

It is recommended that the ground floor level of the proposed building should be at a level of 5.20m OD which is 300mm above the predicted flood level of 4.90m OD agreed by the Environment Agency.

Demountable defences should be installed at all ground floor door openings and these should be 600mm above the finished ground floor level.

The buildings should be designed incorporating flood resistant and resilient techniques to allow it to be refurbished after being flooding to a depth of approximately 600mm above the floor level of the new building.

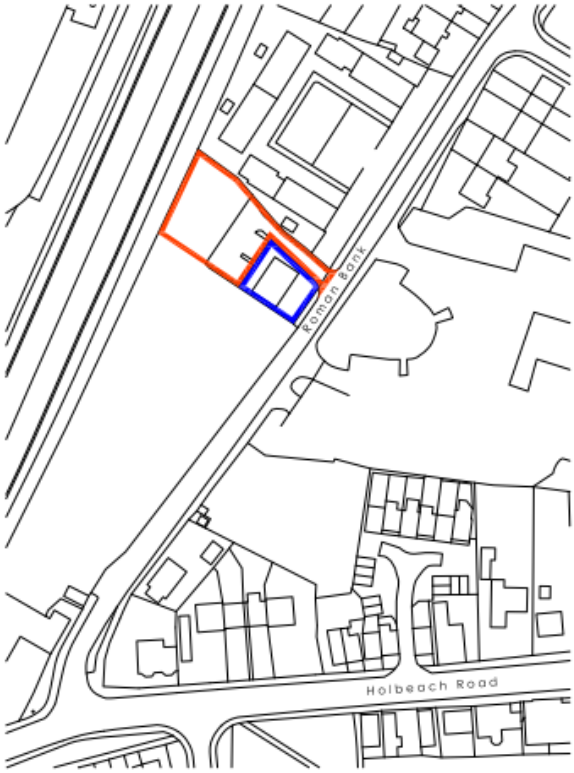
The developer should advise owners and occupiers of the properties to register with the Environment Agency's Floodline Warnings Direct Service.

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15th November 2017

LOCATION PLAN



PLAN LAYOUT OF PROPOSED DEVELOPMENT



PLAN SHOWING SITE LEVELS



APPENDIX A

PLANNING APPLICATION No H16-0138-17

A planning application has been approved by South Holland District Council (Reference H16-0138-17) to construct a care home on the west side of Roman Bank immediately south of the proposed development. This development includes sleeping accomodation on the ground floor.

The Environment Agency have been consulted on the application, and have advised the Council in a letter dated 9th March 2017 (Reference AN/2016/124433/03-L01) this development will only meet the requirements of the National Planning Policy Framework (NPPF) if the following measures are implements:

1) Finished floor levels are set no lower than 5.20m OD
2) Further flood resilient construction is built into the design.

This development is designed with sleeping accomodation for elderly people at ground level. The Environment Agency normally advise that the the finished floor level of buildings with sleeping accomodation on the ground floor should be 300mm above the 1 in 1000 year predicted flood level in 2115. Therefore it can be deduced that the 1 in 1000 year predicted flood level at this location is 4.90m OD.

Therefore as the proposed development is in a similar location (immediately north) to the above development then the finished ground floor level of the development should be 5.20m OD.

APPENDIX B CLIMATE CHANGE

The Environment Agency has issued revised guidance on climate change and have now stated that the new predictions should be considered and incorporated into all flood risk assessments produced after 19th February 2016.

Listed below are the climate change allowances in three documents:

- South Holland SFRA
- EA guidance (2013)
- Revised EA guidance

The recommendations in each document are shown below.

2010 South Holland DC SFRA

The SHDC SFRA states that the the following allowances have been made for climate change:

4.4 Climate Change

Scenarios for the years 2055 and 2115 include for climate change contingency allowances to the amount suggested by PPS25[1]. These allowances are expressed in *Table 2*. Percentage increases are relative to the present-day.

Table 2 – Adopted Climate change contingency allowances

Parameter	Year 2055	Year 2115
Sea level rise (m)	+ 0.33	+ 1.14
Extreme wave height	+ 10%	+ 10%
Peak river flow and volume	+ 20%	+ 20%
Peak rainfall intensity	+ 20%	+30%

Where flows arise from pumping rather than natural run-off, notably in the Vernatt's Drain and for the Fenland subcatchments of the South Forty Foot Drain, peak flow rates for future eras have been taken as equal to current rates since this SFRA assumes all flood risk management measures will remain in their current state.

2013 Guidance to Planners

Guidance to planners was issued by EA in September 2013

Table 1: Recommended contingency allowances for net sea level rises (Net sea level rise (mm per year) relative to 1990)

	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
East of England, east midlands, London, south-east England (south of Flamborough Head)	4.0	8.5	12.0	15.0
South-west England	3.5	8.0	11.5	14.5
North-west England, north-east England (north of Flamborough Head)	2.5	7.0	10.0	13.0

document is out of date e.g.

Table 2: Recommended national precautionary sensitivity ranges for peak rainfall intensity, peak river flow, offshore wind speed and wave height

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		
Offshore wind speed	+5%		+10%	
Extreme wave height	+5%		+10%	

s been withdrawn (19

Revised 2016 EA Guidance

Table 1 peak river flow allowances by river basin district (use 1961 to 1990 baseline)

River basin district	Allowance category	Total potential change anticipated for '2020s' (2015 to 39)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
Anglian	Upper end	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%

For more vulnerable development in flood zone 3(a) the higher central and upper end should be used to assess the range of allowances.

Table 2 peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

Table 3 sea level allowance for each epoch in millimetres (mm) per year with cumulative sea level rise for each epoch in brackets (use 1990 baseline)

Area of England	1990 to 2025	2026 to 2050	2051 to 2080	2081 to 2115	Cumulative rise 1990 to 2115 / metres (m)
East, east midlands, London, south east	4 (140 mm)	8.5 (212.5 mm)	12 (360 mm)	15 (525 mm)	1.24 m

Table 4 offshore wind speed and extreme wave height allowance (use 1990 baseline)

Applies around all the English coast	1990 to 2050	2051 to 2115
Offshore wind speed allowance	+5%	+10%
Offshore wind speed sensitivity test	+10%	+10%
Extreme wave height allowance	+5%	+10%
Extreme wave height sensitivity test	+10%	+10%

Effects on Predictions of Flood Risk in FRA

The FRA has identified two sources of flooding where the new climate change recommendations could affect the predictions of flood levels in 2115 at the development site:

1) Flooding from the tidal River Welland
2) Flooding from the fluvial section of the River Welland, the Coronation Channel or IDB drainage system

1) Flooding from the tidal River Welland

The contingency allowance in metres for the years 2055 and 2115 using 1990 as a baseline in the SFRA compared with the guidelines is as follows

Year	SFRA	2013 guidance	Revised 2016 guidance
2055	0.33	0.395	0.412
2115	1.14	1.205	1.24

Therefore it can be seen that the revised guidance increases the maximum allowance for sea rise in 2115 by 100mm. This may slightly increase the risk of a breach

occurring in the tidal bank north of the site. It may also slightly increase the flow of water into the area between the Coronation Channel and the River Welland. However it will not change the conclusions and recommendations in this report.

Fluvial Flooding.

As the development is in flood zone 3 and is classed as more vulnerable, the advice from the Environment Agency is that the higher central climate change allowance, which is 35%, should be considered. After considering the effects of this increase the upper end allowance, which is 65%, should be considered to assess the effect of this.

Maximum flood levels in the River Welland and the Coronation Channel will not be increased by the increase in flows projected in the new climate change allowances. If flows increase by 65% in these systems it will have the affect of flooding over the long sections of bank between Spalding and Market Deeping and the maximum levels will not increase significantly.

IDB's have been using an allowance of 20% for climate change over the past few years in their assessments and modelling of their systems. Generally IDB's are happy that their systems provide a 1 in 100 year standard to most urban areas at the present time.

South Holland IDB, and all IDB's, are aware that climate change will affect the operations of pumping stations, sluices and drainage channels. Pumping stations and sluices only have a 30 year life and will need to be refurbished or rebuilt within this timespan. It is assumed that South Holland IDB will continue to review the modelling they have already carried out and when the Board consider these refurbishments adequate arrangements will be made to incorporate the latest climate change projections in order that the Board continues to provide the same standard of service as the present day.

Therefore as the major flood risk to the site in Roman Bank is from tidal flooding then any increases in flow from fluvial sources do not need to be considered further.

Therefore it is considered that the mitigation proposed for the development, with the recommendation that the ground floor level should be a minimum level of 5.20m OD is satisfactory.