

**PROPOSED RESIDENTIAL AND CAMPING DEVELOPMENT AT**  
**SYCAMORE FARM, SYKEMOUTH DROVE, KIRTON, PE20 1TS**  
**FLOOD RISK ASSESSMENT**



S M Hemmings B Sc C Eng MICE MIWEM,  
13 Lea Gardens  
Peterborough  
PE3 6BY

This flood risk assessment has been prepared solely to support the planning application for a residential development at Sycamore Farm, Sykemouth Drove Kirton. 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 other purposes other than for which it was originally commissioned.

## **Introduction**

An application is due to be submitted to Boston Borough Council for planning permission to demolish the existing machine store and construct a new dwelling which will be part of a new business which will also include the formation of a new campsite at Sykemouth Farm, Sykemouth Drove, Kirton Holme, Boston, PE20 1TU.

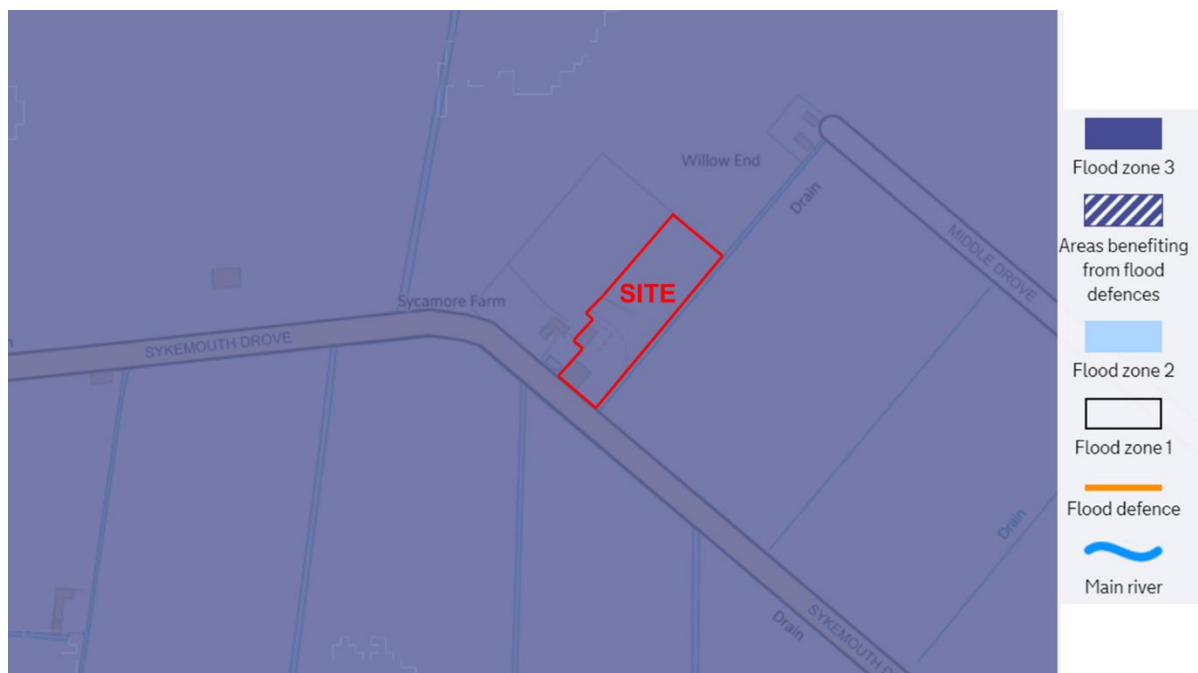
The site is within Flood Zone 3 as shown on the Environment Agency's Flood Zone map. The flood zone maps do not take into account existing flood defences.

The Planning Application requires a flood risk assessment to be carried out as specified in the Practice Guidance to the National Planning Policy Framework Development and Flood Risk. The site is within a defended area as specified in the Boston Borough Council's Strategic Flood Risk Assessment (BBC SFRA) map and is located in the Black Sluice Internal Drainage Board District.

The main flood risk to the Boston area is overtopping and possible breaching of the tidal defences. The Environment Agency have a one hundred year plan to continue to provide a 1 in 200 year standard of flood defence for this area of Boston.

## **Environment Agency (EA) Flood Zones**

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



It can be seen that all of this area north and south of Sykemouth Drove is in Flood Zone 3.

## **Application Site**

The site is located 7.4 km from the tidal section of the Haven. The National Grid Reference of the site is 525470 343040.

The position and extent of the site is shown on the plan at the end of this document.

As the site is within a defended area the proposed development can be considered to be within Flood Zone 3(a) as defined in Table 1 of the Technical Guidance.

Applying the flood risk vulnerability classification in Table 2 of the Guidance, residential development and sites used for holiday or short let caravans and camping are classified as “more vulnerable”.

Table 3 of the Guidance is shown below:

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

Therefore it can be seen that for “More vulnerable” development in flood zone 3(a) 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.

Most of this area west of Boston, 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 a residential development with the business opportunity in this area that is in a lower flood zone. The safety of the development will be delivered by ensuring the floor level of the proposed new dwelling is above the predicted residual flood level for this area.

Referring to the South East Lincolnshire Local Plan 2011-2036 adopted in March 2019, Policy 23 states the re-use and conversion of redundant buildings in the

countryside for residential use will be permitted, subject to conditions on the state of the building and the design of the proposed development.

Policy 9 of the local plan states that small scale developments to support the visitor economy will be supported in the rural communities.

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 Boston Borough 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.

### **Strategic Flood Risk Assessment**

Consultants have produced a Strategic Flood Risk Assessment (SFRA) for the Boston Borough Council (BBC). This document provides details of the flood risk in the Council's area.

This SFRA was updated as part of the South East Lincolnshire Plan which shows the predicted hazard from flooding. These maps show that the greatest hazard in the Kirton area of Boston is flooding following a breach in the tidal defences.

### **Information Supplied by the Environment Agency**

The Environment Agency have provided maps showing the maximum hazard, depth of flooding and velocity for the 1 in 200 year and 1 in 1000 year breaching events in 2115, and the results of these are shown on the next page.

	Hazard	Flood Depth	Velocity
1 in 200 year event in 2115	0.75 – 1.25	0 – 500mm	0 – 0.3m/sec
1 in 1000 year event in 2115	0.75 – 1.25	0 – 500mm	0 – 0.3m/sec

The maps of the flood risk supplied by the Environment Agency are reproduced on pages 14 and 15 of this report.

### **Existing and Proposed 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", which is considered to be passive until such time that a flood greater than the defences can withstand occurs.

The site is located approximately 7.4 km west of the bank of the Haven which is maintained by the Environment Agency.

The site is located approximately 680 metres south of the South Forty Foot Drain which is maintained by the Environment Agency.

The site is located approximately 850 metres north of the New Hammond Beck which is maintained by the Black Sluice IDB.

There are piped and open watercourses in this area that are maintained by Black Sluice IDB.

### **Levels of the Site**

A number of levels have been taken over the site and these are shown on the plan on page 12 of this report.

The level of the road in front of the property and levels inside the agricultural building which is to be the site of the proposed dwelling are 3.09m and 3.10m ODN. The level of the existing house is similar measured at 3.12m ODN. The level of building north of the proposed dwelling and east of the existing house is 3.28m ODN.

The level of the gravel hardstanding on the south eastern side of the site is 3.16m ODN.

### **Potential Sources of Flooding**

The following sources of flooding have been identified:

- 1) Tidal Flooding due to overtopping or breaching of the south bank of the Haven
- 2) Fluvial flooding from the South Forty Foot Drain
- 3) Flooding from IDB drainage system
- 4) Flooding from local surface water dykes.

## **1. Tidal Flooding due to overtopping or breaching of the south east bank of the Haven**

The south bank of the Haven is 7.4km east of the site. The Environment Agency have stated that the predicted tide levels at the Boston Barrier in a 0.5% (1 in 200 year) event, using the 50% confidence figures from the 2018 Coastal Flood Boundary Extreme Sea levels, is 6.09m ODN and in a 0.1% (1 in 1000 year) event is 6.26m ODN.

The SFRA states that an allowance should be made for a sea level rise of 1.201 metres by 2115. The climate change guidance issued in February 2016 by the Environment Agency increased this allowance by an additional 100mm by 2115.

The breach hazard mapping produced by the Environment Agency predicts that flood depths would be a maximum of 500mm in the lower areas of the development site if a breach occurred in a 1 in 200 year event and a maximum of 1.0 metre in the lower areas in a 1 in 1000 year event in 2115.

The Environment Agency have agreed a one hundred year strategy for the length of the Haven from Tabs Head as far as Grand Sluice. This involves the construction of a Barrier to prevent flooding upstream of Black Sluice Pumping Station, and the raising of bank levels along the Haven as predicted tide levels increase with climate change to ensure that there is always a 1 in 200 year standard of defence along both banks of the Haven.

Mitigation against this flood risk will be provided by raising the ground floor levels above the predicted flood level.

## **2. Fluvial Flooding from South Forty Foot Drain**

The site is 680 metres south of the South Forty Foot Drain, which is the main arterial watercourse which conveys drainage water from the whole of the Black Sluice area to the Haven. The flows are controlled by two large sluices at Black Sluice Pumping Station which allow the water to discharge into the Haven when the tide is low. There are five large diesel driven pumping units at Black Sluice Pumping Station. However recent studies have shown that an adequate water level can be maintained in the South Forty Foot Drain by discharging only through the sluices when tide levels allow and the BSIDB and the EA have agreed that the pumps are not required in the future.

The maximum possible water level in the South Forty Foot Drain is 3.00m ODN at the southern end of the Drain and the predicted maximum water level in the section north of the site in a 1 in 1000 year event with 20% allowance for climate change is 2.80m ODN. The floor level of the proposed refurbished store will be at least 700mm above this level

Therefore it is concluded this will provide satisfactory mitigation against flooding from the South Forty Foot Drain.

### **3. Flooding from IDB Drainage system**

The site is within the Swineshead Catchment of the Black Sluice IDB area. The water levels in this catchment area are controlled by Swineshead Pumping Station which is located on the south bank of the South Forty Foot Drain approximately 1.0km north west of the development site.

There are 3 No electrically driven pumps at the pumping station and the total capacity of the pumping station is 6.8 cumecs. In an emergency there is also the facility to operate the all of the pumps with a generator if the electricity supply fails.

The Black Sluice IDB has modelled the catchment and the results demonstrate there is no predicted flooding to any properties in the catchment in a 1 in 100 year event.

Mitigation against this flood risk will be provided as the ground floor level of the proposed refurbishment will be raised a minimum of 2.0 metres above the predicted flood level in the IDB drainage in this area.

### **4. Surface Water Flooding**

As the finished floor level of the proposed development will be raised above the existing ground level, and a satisfactory surface water drainage scheme will be designed and constructed, this will provide adequate mitigation against the risk of surface water flooding.

#### **Extent of known Flooding**

There was significant flooding to many areas of the east coast in 1953, but there was no flooding due to bank failures on the Haven. Sixty years later a significant high tide event occurred on 5<sup>th</sup> December 2013 and a large area of central Boston was flooded. A short section of sea bank also failed at Slippery Gowt and some flooding and damage occurred in this area. Some flooding also occurred in Boston in 2019. The area around Sykemouth Drove was not affected in any of these events.

#### **Climate Change**

The recommendations for flood depths for this flood risk assessment use information provided by the Environment Agency which was produced in 2006. The EA have issued new guidance on recommended contingency allowances for predicted sea rises, fluvial flows and rainfall intensities which from 19<sup>th</sup> February 2016 needs to be considered in the FRA. The effects of these new recommendations are considered in Appendix A of this report (pages 15 to 18). It is concluded that no extra mitigation measures are necessary to comply with the new guidance on climate change.

#### **South East Lincs Advice Matrix for Proposed House**

Advice can be found on the recommended mitigation required by referring to a spreadsheet on the South East Lincolnshire website. As the refurbished store has bedrooms on the ground floor then the 1 in 1000 year event in 2115 should be used to work out the required mitigation.

The development is in flood zone 3, the flood hazard (see above) is shown to be 0.75 - 1.25 (danger for some), and the predicted flood depth is 0 – 250mm and 250mm – 500mm bands. The standing advice for this hazard is shown in column E and row 8 which is shown below.

*The NPPF requires that the proposal is accompanied by a Flood Risk Assessment which contains evidence that appropriate mitigation measures / flood resilience techniques have been incorporated into the development.*

*The applicant is advised to refer to the document “Improving Flood Performance of New Buildings Flood Resilient Construction (DCLG2007).*

*FFL should be informed by the predicted flood depth maps (refer to the relevant 2115 1% fluvial or 0.5% tidal maximum depth map) and set as required below (single storey proposals must use the 0.1% event, 2115 scenario for setting FFL).*

*Depths 0.25m - 0.5m:*

*FFL must be set 500mm above ground level, with flood resilient construction to a height of 300mm above the predicted flood depth.*

*Depths 0 - 0.25m:*

*FFL must be set 300mm above ground level.*

Therefore as the maximum predicted flood depth is 500mm then the FFL should be set 500mm above the lowest ground level in this area.

### **South East Lincs Advice Matrix for Proposed Campsite**

Advice can be found on the recommended mitigation required by referring to a spreadsheet on the South East Lincolnshire website. The main flood risk to the site is tidal flooding emanating from the tidal Haven in Boston. It is assumed the campsite will fall within the category “short let camping and caravan sites”, which is row 5 on the matrix. It will also be assumed that the 1 in 1000 year event in 2115 should be used to provide the required mitigation.

The development is in flood zone 3, the flood hazard (see above) is shown to be 1.25 – 2.0 (danger for most), and the predicted flood depth is 500mm – 1.0 metre. The standing advice for this hazard is shown in column D and row 5 which is shown below.

*The NPPG requires that proposals for holiday or short let caravans and camping sites are accompanied by a flood warning and evacuation plan, undertaken and agreed in consultation with the LPA’s Emergency Planning Officer.*

*It is recommended that static caravans are secured to the ground using an adequate mechanism such as chains and ground anchors and the finished floor level should be set at a minimum of 300mm above ground level.*

*The Environment Agency requires the imposition of the following condition:*



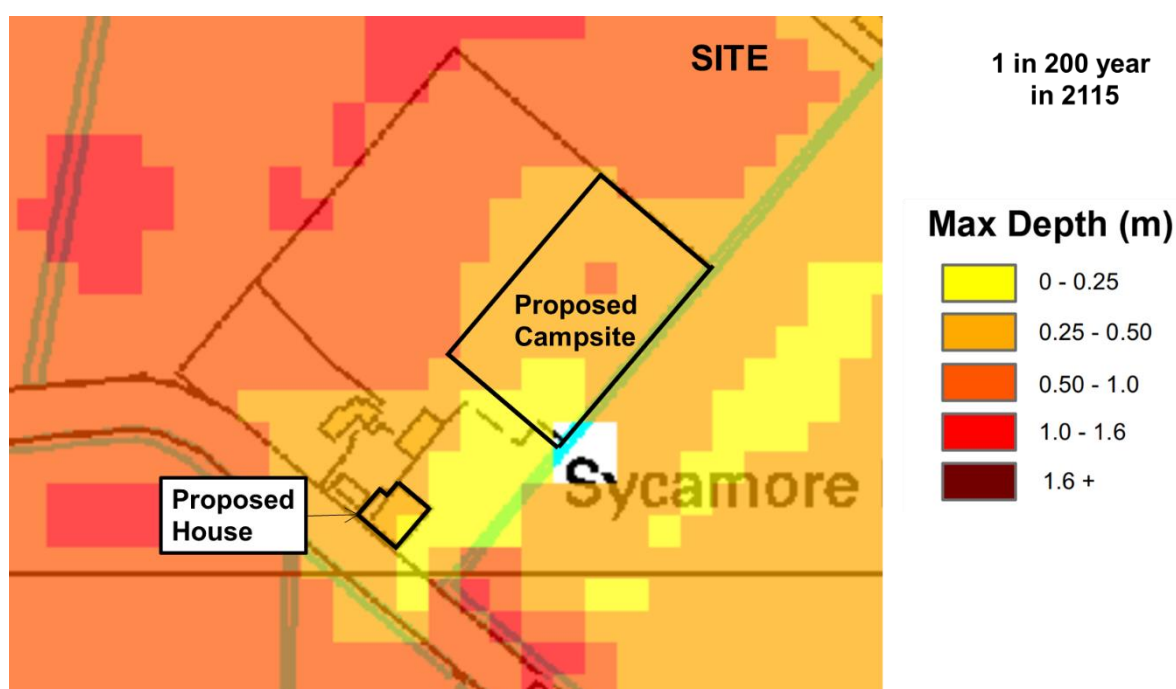
*No caravans or chalets or log cabins on the site shall be occupied between 1<sup>st</sup> November (or the following Sunday if half term extends into November) in any one year and 14<sup>th</sup> March in the succeeding year.*

*The reason for this is to reduce the impact of flooding.*

*If the application is for occupancy outside these dates, please refer the application to the Environment Agency, together with the FRA, for site specific assessment of the risks and the bespoke advice.*

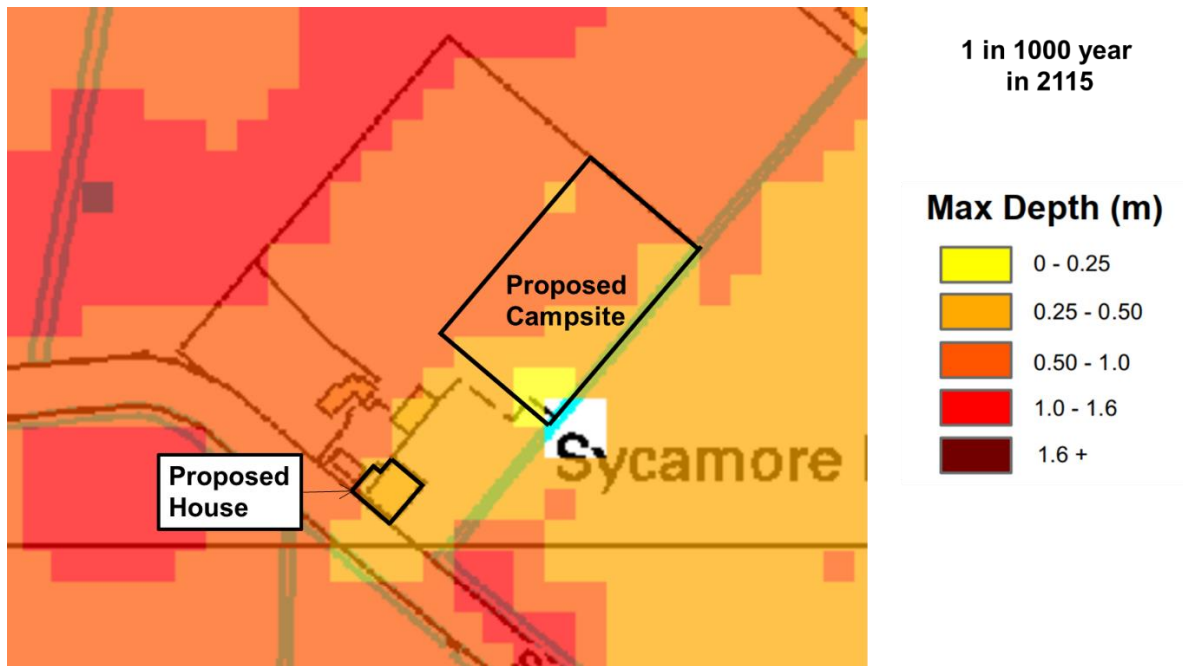
## **Conclusions**

The relevant part of the Environment Agency map showing predicted flood depths in a 1 in 200 year event in 2115 is shown below.



It can be seen that the proposed house is located on the boundary between the 0 – 0.25m and the 0.25m – 0.5m band. Therefore it can be deduced that the flood depth at this location is 250mm in a 1 in 200 year event with 20% allowance for climate change.

The relevant part of the Environment Agency map showing predicted flood depths in a 1 in 1000 year event in 2115 is shown on the next page.



Ground levels around the farm building, the existing house and along Sykemouth Drove are all between 3.00m ODN and 3.15m ODN. On the plan showing the predicted flood depths in a 1 in 1000 year event in 2115 above it can be seen that the predicted flood depth in the area of the barn and the gravel area east of the barn is between 250mm and 500mm (coloured orange). The area near the existing house and south east along Sykemouth Drove have a predicted flood depth of between 500mm and 1.0 metre. Therefore it can be concluded that the predicted flood level in a 1 in 1000 year event with 20% allowance for climate change is 3.60m ODN.

### **Recommendations**

In any area at risk of flooding it is preferable that 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 buildings were to become flooded after a major breach of the tidal bank, and ensure there is no danger to residents when they are asleep.

However in this instance there is a requirement that there should be bedrooms on the ground floor.

Therefore it is recommended that the level of the new ground floor of the refurbished barn should be raised a minimum of 500mm above the existing ground level on the site.

Flood resilient construction should be included to a height of 300mm above the predicted flood depth.

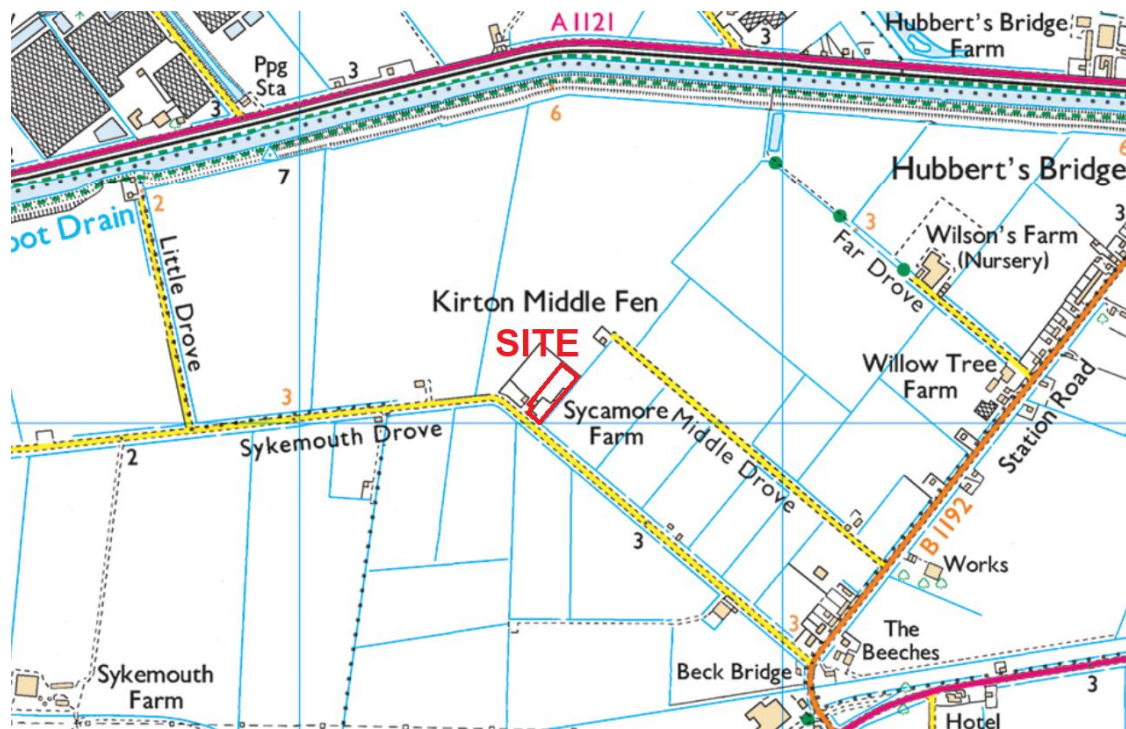
The occupiers of the barn conversion should register with the Environment Agency's Floodline Warnings Direct Service to receive flood warnings.

**S M HEMMINGS B Sc C Eng MICE MIWEM**

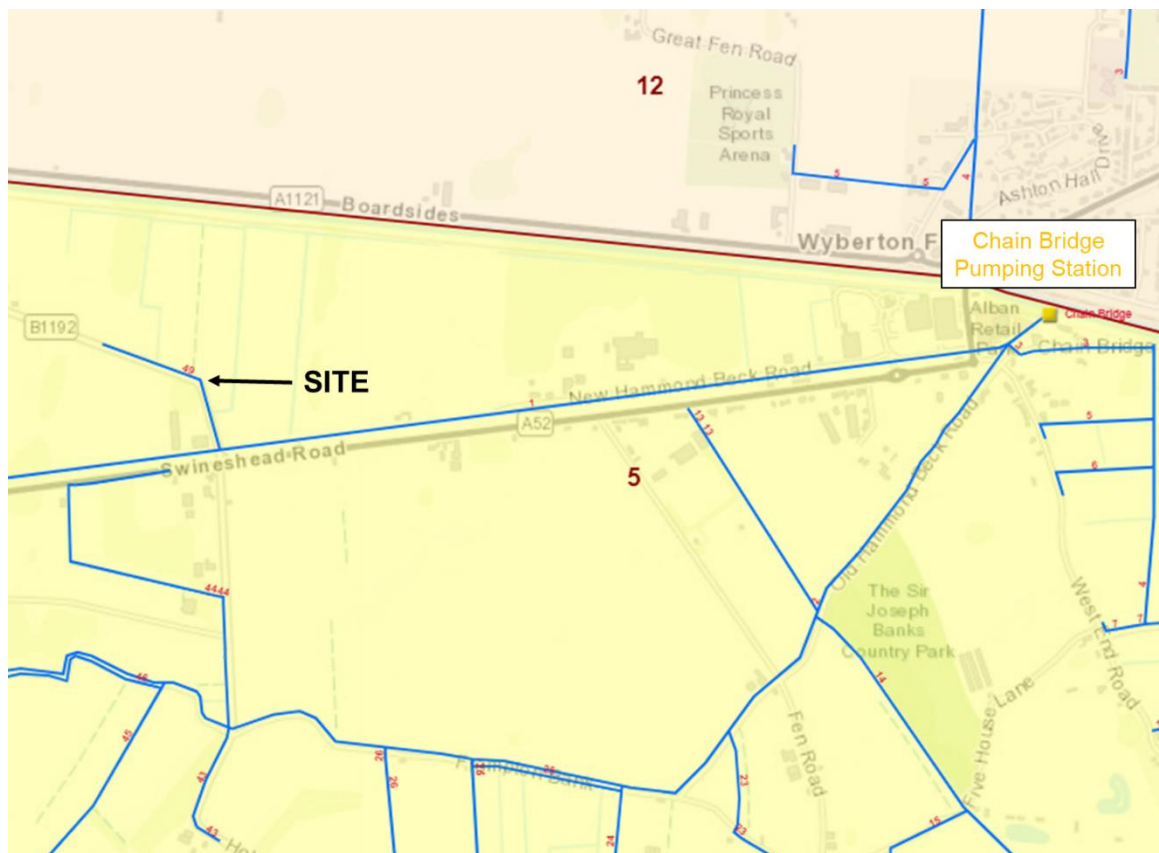
[stuart.hemmings@btinternet.com](mailto:stuart.hemmings@btinternet.com)

15<sup>th</sup> March 2021

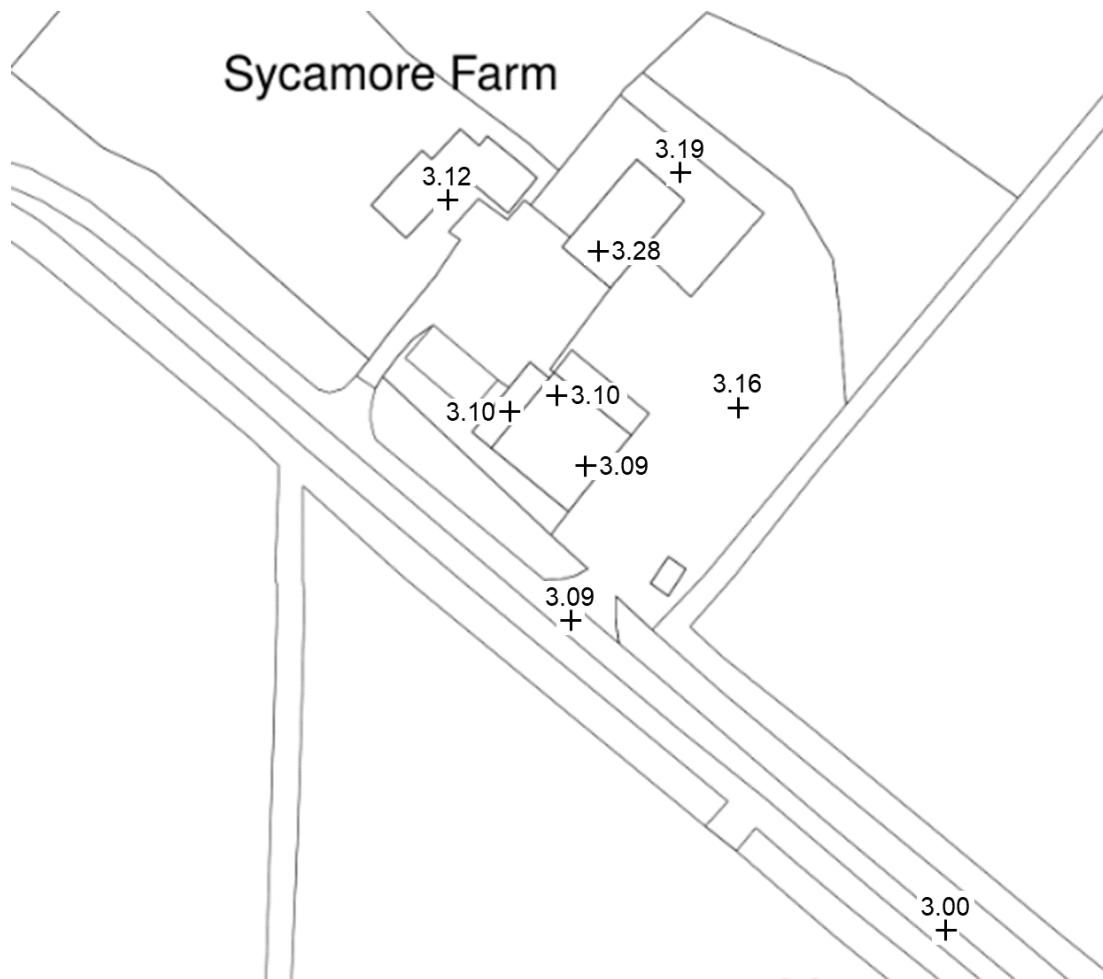
## LOCATION PLAN



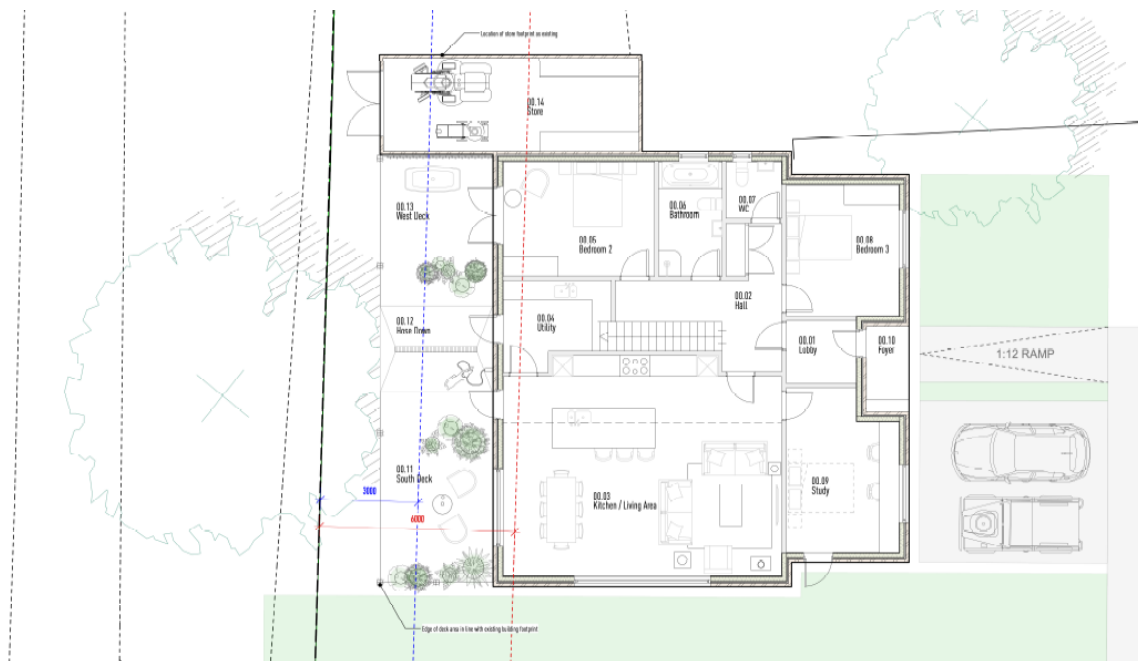
## PLAN OF BLACK SLUICE IDB DRAINAGE NETWORK



## PLAN SHOWING LEVELS ON THE SITE



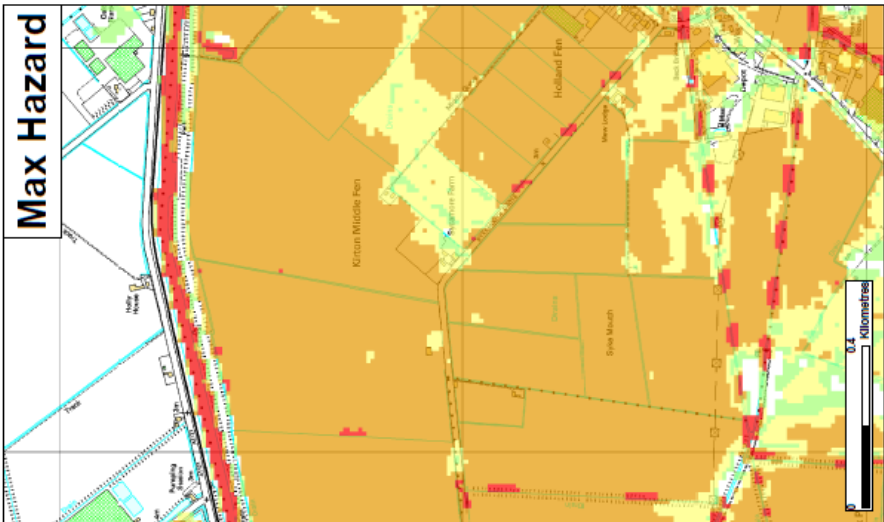
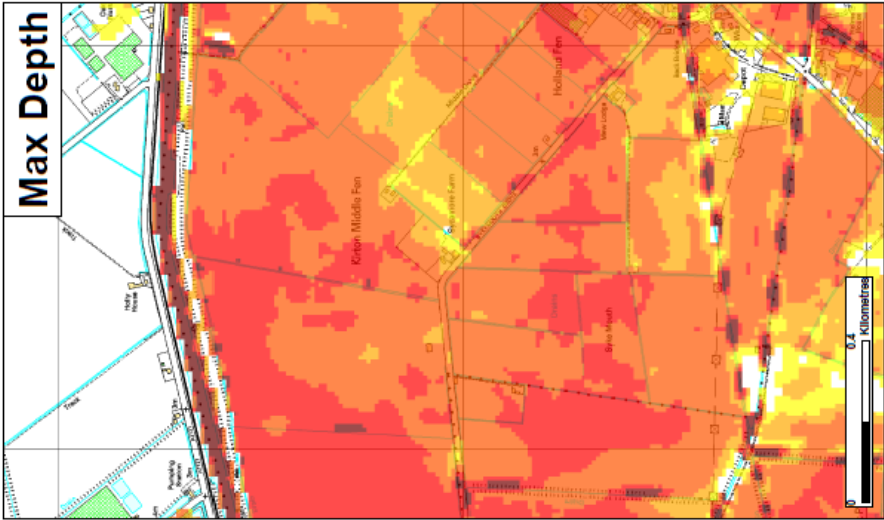
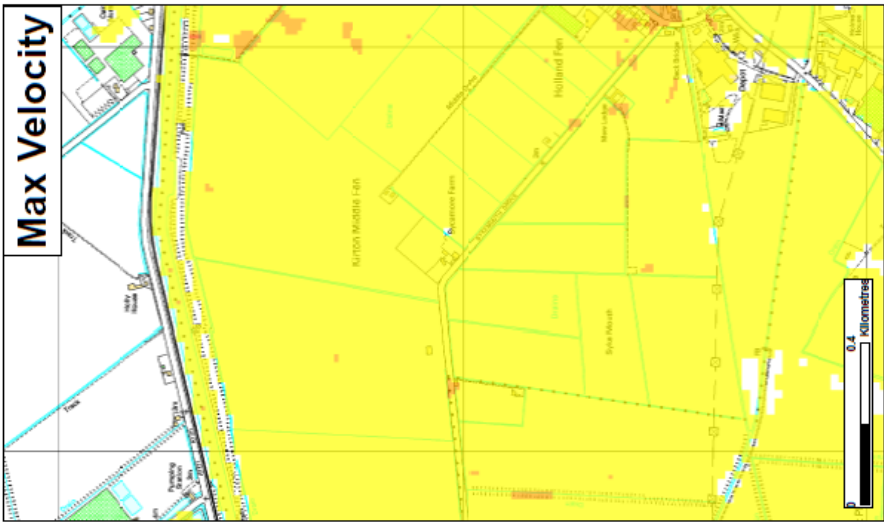
## PLAN OF PROPOSED DEVELOPMENT





ENVIRONMENT AGENCY FLOOD HAZARD MAPPING

1 IN 200 YEAR EVENT IN 2115



Lincolnshire and Northamptonshire  
Tidal Hazard Mapping

Map Centred on TF 25463 43046

This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

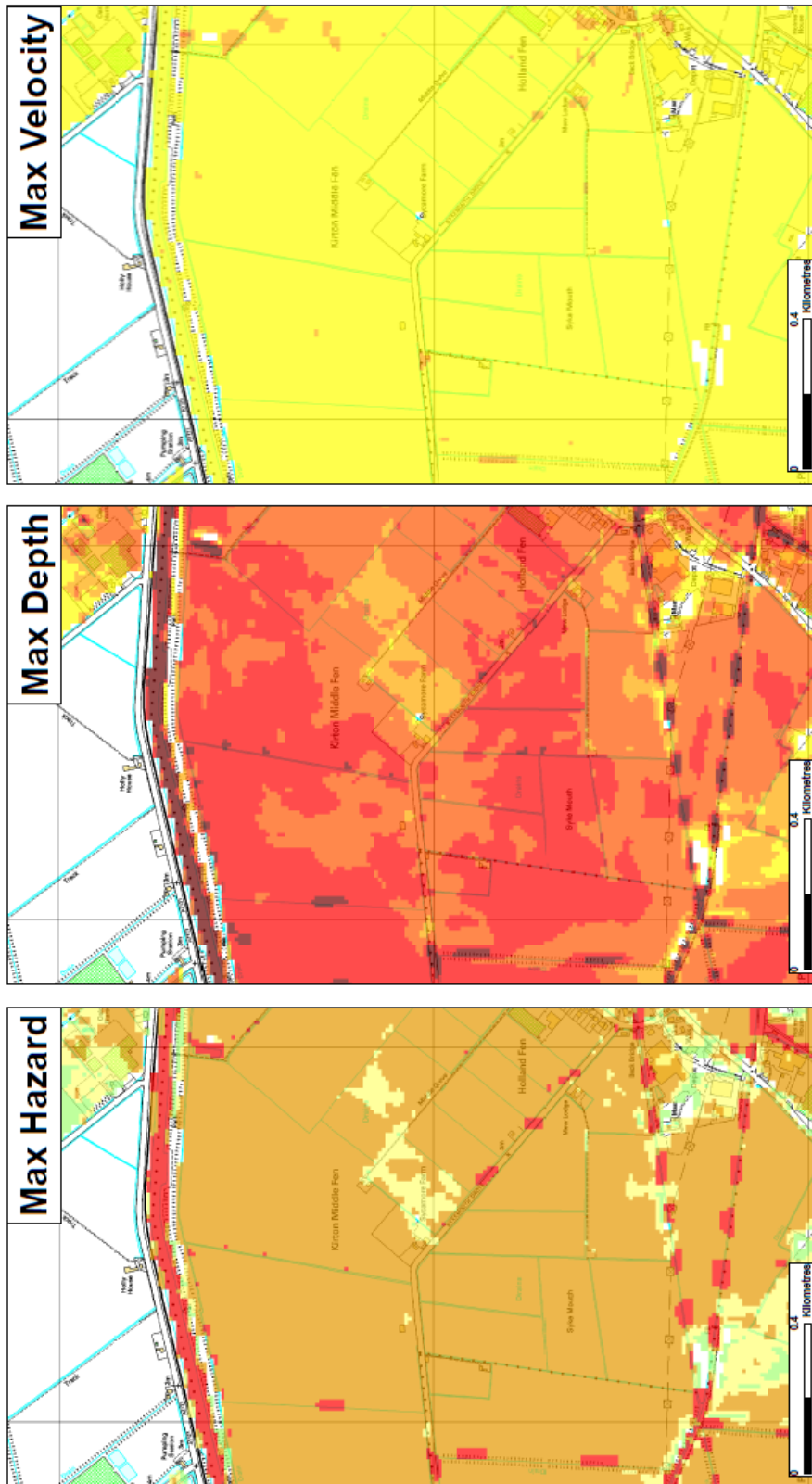
This map only considers the consequences of a breach. It does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.


General Enquiries No: 03708 505 505. Weekday daytime calls cost 5p plus up to 50p per minute from BT. Weekend Unlimited. Mobile and other providers charges may vary.

★ Modelled Breach Locations - see also the accompanying plan "Location of Modelled Breaches"			
Date Printed	Scenario year	Scenario Annual Chance (1 in 200)	CCN Number
Max Hazard (Flood Hazard Rating CC3320)		Max Velocity (m/s)	
Less than 0.75 (Low Hazard)	0 - 0.25	0 - 0.3	
	Between 0.75 and 1.25 (Danger for Some)	0.3 - 1.0	
	Between 1.25 and 2.0 (Danger for Most)	1.0 - 1.5	
	Greater than 2.0 (Danger for All)	1.5 - 2.5	
		2.5 +	

# ENVIRONMENT AGENCY FLOOD HAZARD MAPPING

## 1 IN 1000 YEAR EVENT IN 2115



		<b>Lincolnshire and Northamptonshire</b> <b>Tidal Hazard mapping</b>		Map Created on TF 25463-43046	
<p>This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.</p> <p>The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.</p> <p>The map only considers the consequences of a breach. It does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.</p>		<p>This map is reproduced by permission of Environment Agency on behalf of the Controller of the Major's Stationery Office. Crown Copyright. All rights reserved. Controller of the Major's Stationery Office. (10002605, 2020). Unauthorised reproduction is illegal.</p>		<p>General Enquiries No: 03708 505 505. Weekday Daytime calls cost 5p plus up to 50p per minute from BT Weekend Unlimited. Mobile and other providers charges may vary.</p>	
<p>★ Modelled Breach Locations - see also the accompanying plan "Location of Modelled Breaches"</p>		<p>CCN-2020-182113</p>		<p>CCN Number</p>	
<p><b>Max Hazard</b> (Flood Risk to People - FD350)</p> <p>Less than 0.75 (Low Hazard)</p> <p>Between 0.75 and 1.25 (Danger for some)</p> <p>Between 1.25 and 2.0 (Danger for most)</p> <p>Greater than 2.0 (Danger for all)</p>		<p><b>Max Depth (m)</b></p> <p>0 - 0.25</p> <p>0.25 - 0.50</p> <p>0.50 - 1.0</p> <p>1.0 - 1.5</p> <p>1.5 - 2.5</p> <p>2.5 +</p>		<p><b>Max Velocity (m/s)</b></p> <p>0 - 0.3</p> <p>0.3 - 1.0</p> <p>1.0 - 1.5</p> <p>1.5 - 2.5</p> <p>2.5 +</p>	
<p><b>Date Printed</b></p> <p>September 2020</p>		<p><b>Scenario year</b></p> <p>2115</p>		<p><b>Scenario</b></p> <p>0.1% Annual Chance (1 in 1000)</p>	

## **APPENDIX A 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 19<sup>th</sup> February 2016.

Listed below are the climate change allowances in three documents:

- Boston BC SFRA
- EA guidance (2013)
- Revised EA guidance

The recommendations in each document are shown below.

### **2010 South Holland DC SFRA**

The BBC 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<sup>1</sup>. 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

**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%	

## **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)**

<a href="#">Area of England</a>	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 Haven in Boston.
- 2) Flooding from the South Forty Foot Drain.
- 3) Flooding from IDB systems.

#### **1) Flooding from the tidal River Haven**

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

The Environment Agency map predicts flood depths of between 250mm and 500mm at the site in a 1 in 1000 year event in 2115.

An increase of 100mm in maximum tidal levels is only likely to increase the maximum flood depths by around 10mm at the location of the development site, and is unlikely to significantly change the predicted flood depths indicated on the maps in the SFRA.

The recommendation that the proposed barn conversion should be a minimum of 500mm above existing ground level is considered to satisfactory.

## 2) Flooding from the South Forty Foot Drain

As the development is in flood zone 3 and is classed as more vulnerable, the upper end climate change allowance, which is 35%, should first 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.

The EA have been using an allowance of 20% for climate change over the past few years in their assessments and modelling of their systems. The increase to 35% will not significantly change the predicted levels of the South Forty Foot Drain. If there are additional flows along the South Forty Foot Drain it will lead to overtopping further south between Black Hole Drove Pumping Station and Donington Bridge rather than any significant increase in levels in the Drain.

The upper end allowance predicting a 65% increase in flows above the 1 in 100 year predicted flows now needs to be considered. The result will be similar to the 35% increase that the increase in flow will lead to overtopping further south between Black Hole Drove Pumping Station and Donington Bridge rather than any significant increase in levels in the Drain.

## 3) Flooding from IDB Systems

Black Sluice 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 Black Sluice IDB will continue to review the modelling they have already carried out and when the Board consider refurbishments adequate arrangements will be made to incorporate the latest climate change projections in order that Board continues to provide the same standard of service as the present day.

Therefore it is considered that the small increases in predicted flood levels that the latest climate change guidance shows will not affect the conclusions in this report, and the mitigation proposed for the development, with the recommendation that the finished ground floor level should be raised by a minimum of 500mm above the existing ground level on the site, is satisfactory.