PROPOSED DEVELOPMENT NORTH OF NIGHTINGALE WAY SUTTON BRIDGE, SPALDING, PE12 9RG

FLOOD RISK ASSESSMENT

View from north east corner of site

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This flood risk assessment has been prepared solely to support the planning application for a development north of Nightingale Way Sutton Bridge. 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 made to South Holland District Council for Planning Permission to carry out a residential development on land north of Nightingale Way at Sutton Bridge. The land is at present agricultural land and is west of the centre of Sutton Bridge and north of Bridge Road.

The site is within Flood Zone 3 as shown on the Environment Agency's Flood Zone Map. These 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 shown within the defended area of the South Holland District Council's Strategic Flood Risk Assessment (SHDC SFRA) map 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 the whole of this area on the western side of Sutton Bridge is in Flood Zone 3.

Application Site

The development is located on the western side of the River Nene. The National Grid Reference of the site is 546840 321910.

The location 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 detailed on the Environment Agency's flood zone maps without defences, as defined in Table 1 of the Technical Guidance.

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 *	✗	✗	✗	✓*

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.

The whole of this area on the west side of Sutton Bridge, 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 within the town boundary 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 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. Therefore

there is a requirement for further land to be brought forward and used for residential development.

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.

Strategic Flood Risk Assessment

Consultants have produced a Strategic Flood Risk Assessment (SFRA) 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:

For the present day	Depth of flooding … zero
	Extent of flooding .. Low or medium
	Hazard……. zero
	Velocity ……. Nil
For year 2115	Depth of flooding … 500mm – 1.0m
	Extent of flooding .. Medium or high
	Hazard…….. Significant
	Peak Velocity …… 0.1 – 0.25 m/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…. 0 – 500mm
Extent of flooding … High
Hazard ……. Danger for some (0.75 – 1.25)
Velocity …….. 0 – 0.3 m/sec

For the year 2115 Depth of flooding ….500mm – 1.0 metre
Extent of flooding …High
Hazard …… Danger for all (Greater than 2.0)
Velocity ……. 0 – 0.3 m/sec

Figure 16 of the general maps shows that the site is not within the rapid inundation zone for the present day or in 2115.

Maximum flood level and bank levels in the River Nene

The maximum levels in this tidal section of the River Nene 1.4km east of the site are as follows:

	2007	2115
Peak 1 in 200 year level	5.86m OD	6.20m OD
Peak 1 in 1000 year level	7.00m OD	7.35m OD

The defence level (top of left bank) between South Holland Main Drain and the A17 Bridge is approximately 7.00m OD. However there is a low section adjacent to the bridge itself at a level of 5.95m OD. Levels of the defence north of the A17 bridge are approximately 6.30m OD.

Information from Environment Agency

The Environment Agency has produced mapping which shows the maximum hazard, depth and velocity predicted following breaching of the tidal defences of the tidal River Nene east of the site. The EA have stated that for some locations the breaching maps also include the results of overtopping of the defences.

The maps of breaching show the following predictions for hazard, maximum depth and maximum velocity at the development site:

	Maximum Hazard	Maximum Depth	Maximum Velocity
1 in 200 year in 2006	Less than 0.75	0 – 500mm	0 – 0.3 m/sec
1 in 1000 year in 2006	0.75 -1.25	250 – 500mm	0 – 0.3 m/sec
1 in 200 year in 2115	1.25 – above 2.0	500mm – 1.0m	0 – 0.3 m/sec
1 in 1000 year in 2115	1.25 – above 2.0	500mm – 1.6m	0 – 0.3 m/sec

The maps supplied by the Environment Agency are reproduced on pages 12 – 15 of this report.

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", which is considered to be passive until such time that a flood greater than the defences can withstand occurs. The likelihood of flooding occurring due to overtopping or failures of the defences is considered to be very low.

The site is located approximately 1.4 km from the tidal section of the River Nene, which is maintained by the Environment Agency.

There are watercourses in the area that are maintained by South Holland IDB.

Existing Ground Levels

A topographical study of the site has been carried out and these details will be submitted as part of the planning application. Around half of these levels from the topographical study have been reproduced on a simplified plan which is shown on page 13 of this report.

The level of most of the field is between 3.30m and 3.50m OD, and the lowest level in the centre of the field is 3.26m OD and highest levels of approximately 3.70m OD.

Potential Sources of Flooding

The potential sources of flooding to the site are:-

1. Failure or overtopping of tidal defences of the River Nene.
2. High water levels in IDB drainage channels.
3. Localised flooding from failure of on site drainage.

1. Failure or overtopping of tidal defences of the River Nene

The west bank of the River Nene is approximately 1.4 km east of the site of the proposed development, and the Wash Banks are approximately 8km north of the site at their nearest point. The hazard from the River Nene east of the development site if a breach occurred in the length of bank north of the A17 bridge will be considered to be the major risk to the site.

The maps in the SFRA do not predict any actual flooding to this area of Long Sutton in a 1 in 200 year event for the present day. In the same event in 2115 up to 1.0 metre depth of flooding is predicted.

The maps in the updated SFRA and the maps supplied by the Environment Agency predict flood depths of up to 1.0 metre if a breach were to occur in a 1 in 200 year event in 2115. It is also likely that the EA will undertake further bank raising within the

next 100 years to ensure that there is a continuing 1 in 200 year defence to Long Sutton and Sutton Bridge.

The predicted hazard will be mitigated by raising ground floor levels of the proposed building above the predicted flood level in a 1 in 200 year event in 2115.

2. **High Water Levels in IDB drains**

Although the whole of this area is below high tide level in the Wash and the River Nene, the retained water levels in the drainage channels ensure that the risk of flooding is extremely low. South Holland IDB maintains a system of sluices, pumping stations, and drainage channels which convey surface water into the River Nene and the wash and control water levels throughout the South Holland IDB area.

This area of Sutton Bridge is within the Westmere catchment which outfalls through Westmere Sluice into the tidal River Nene during low tide levels. There is an IDB drain on the opposite side of the track on the north east corner of the site which flows northwards and discharges into the Westmere Creek. The ground levels around Westmere Creek are lower than the levels on the development site. Westmere Creek flows north eastwards to the outfall sluice on the bank of the River.

The channels maintained by South Holland IDB in urban areas are classified as high priority watercourses and as such receive a higher maintenance priority.

There are possibilities of failure of outfall sluices, but these are mitigated by the high level of maintenance given to these structures by the IDB. If a failure did occur the IDB would immediately be warned of the problem by their telemetry system and take action to repair the fault or to bring in temporary pumps to reduce the risk of any flooding in the area. Similarly any failures of culverts or other blockages would be dealt with immediately.

IDB systems are designed to provide a freeboard of between 600mm and 1000mm to all land in a 1 in 10 year return period rainfall event. This normally provides a standard of service of between 1 in 50 years and 1 in 100 years against flooding. In an extreme event water levels will rise but this will be a slow process and it would be at least 24 hours before levels were high enough to begin to flood low land in the area, and after this the level of the flood water would need to rise another 1.0 metre before the development site would be affected.

Therefore the risk of flooding from IDB drainage channels can be considered to be extremely low, and will be adequately mitigated by the raising the ground floor levels to the levels required to be above the 1 in 200 year tidal flood.

3. **Localised Flooding due to failure of surface water drainage on the site**

It is anticipated that the surface water from the houses will be discharged into soakaways, and a suitable surface water drainage system will be designed and constructed to dispose of the surface water from the roads and pavements on the site. The soakaways and the road drainage will be designed to BRE digest 365 using

rainfall values for a 1 in 100 year event with 30% increase for climate change and approved under the Building Regulations.

This surface water disposal system along with the raising of ground floor levels will adequately mitigate the risk of surface water flooding to this development.

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 past.

Probabilities and Trends of Flooding

The probability of this development flooding from Environment Agency main river is very low. In an extreme event any effect on this location would not be sudden and there would be time for residents to take precautionary measures to limit the impact of any flooding that may occur.

Residual Risk – Extreme Events

The residual risk from extreme events is very low on this site. The major risk to the site is from a breach or overtopping of the tidal defences

The risk of this happening in this case is low and the hazard from any flooding is also low.

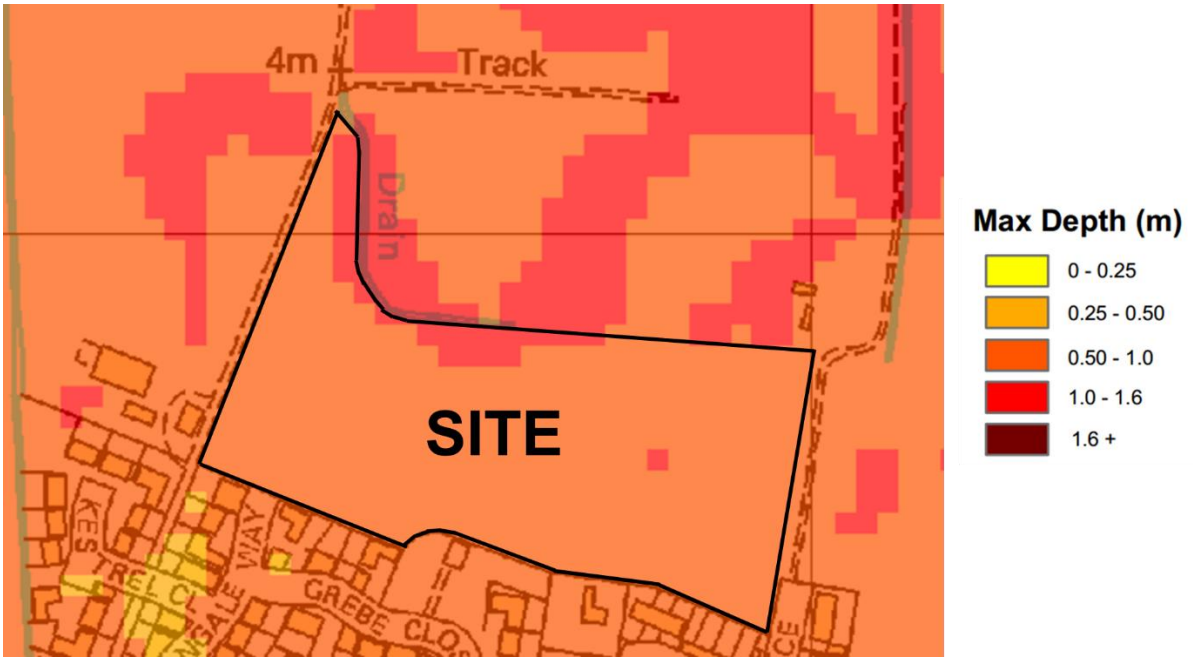
Climate Change

The predictions of 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 level rises, fluvial flows and rainfall intensities which from 19th February 2016 needs to be considered in the FRA. The effects of these new recommendations are considered in Appendix A of this report (pages 17 to 20). It is concluded that no extra mitigation measures are necessary to comply with the new guidance on climate change.

Summary of Risk of Flooding to the Site

The main risk of flooding to the site is if a breach were to occur in the west bank of the tidal River Nene. The risk of this happening along this section of bank can be considered to be low. The bank has a wide top and bank slopes are not steep.

The relevant part of the map in the SFRA showing the predicted peak depths in this area if a breach occurred in the west bank of the River Nene in 2115 in a 1% fluvial and 0.5% tidal event probability is identical to the map supplied by the Environment Agency, which is shown on the next page.



The map above predicts flood depths of between 500mm and 1.0 metre across a greater part of the site. There is some red shading on the north west boundary of the site which indicates predicted flood depths in these areas of between 1.0 and 1.6 metres.

The area shown in orange where the flood depths are between 500mm and 1.0 metre is shown on the topographical study to be between 3.30m and 3.50m OD. The areas coloured red are generally below 3.30m OD, with some levels below 3.00m OD in the north west corner of the site. Therefore it can be estimated that the maximum flood level in a 1 in 200 year tidal event in 2115 will be 4.30m OD.

As the floor levels will be raised above 4.30m OD the possibility of any the proposed buildings flooding from IDB systems can be considered to be remote.

<u>South East Lincs Advice Matrix</u>

Advice can be found on the recommended mitigation required by referring to a spreadsheet on the South East Lincolnshire website. As the development is in flood zone 3 and the flood hazard is “danger for all” (greater than 2.0) reference should be made to Category C8 which states:

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.

Finished floor levels (FFL) should be informed by the predicted flood depth maps and set as required below (single storey proposals must use the 0.1% event, 2115 scenario, for setting FFLs).

Depths 1.0m to 1.6m

> *Proposals should have a minimum of 2 storeys, with FFL set 1.0 metre above existing ground level, with flood resilient construction to a height of 300mm*

above the predicted flood depth, and demountable defences to 600mm above FFL.

Depths 500mm to 1.0m

FFL must be set 1.0m above ground level with flood resilient construction to a height of 300mm above the predicted flood depth.

Recommendations

In any area at risk of flooding it is recommended that all new dwellings should be of two story construction with all bedrooms at first floor level. This will 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.

The ground floor level of the proposed new houses should be a minimum of 4.35m OD.

It is recommended that all houses should be located in the area where the predicted flood depth is between 500mm and 1.0m (in the area coloured orange on the map showing predicted flood depths).

Flood resilient construction should be incorporated to a minimum height of 300mm above the predicted flood level, and all of the electrical installation should be a similar height above finished floor level.

Occupiers of the property should register with the Environment Agency's Floodline Warnings Direct Service.

Surface water from the roofs of the proposed properties should be discharged into soakaways and these should be designed to BRE Digest 365 and approved under Building regulations.

A suitable surface water drainage system should be designed and constructed to dispose of the surface water from the roads and pavements on the site.

All future owners and occupiers of the building should be given a copy of the Flood Risk Assessment so that they are fully aware of the risk of flooding in this area.

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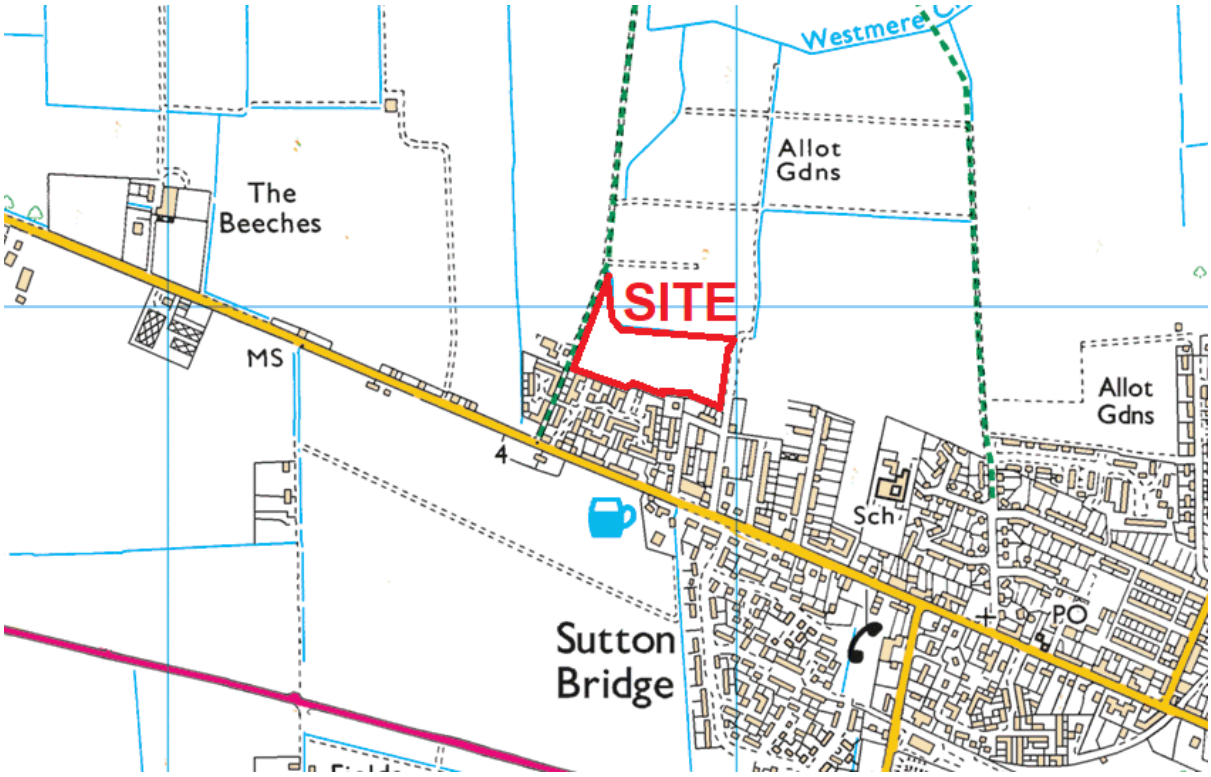
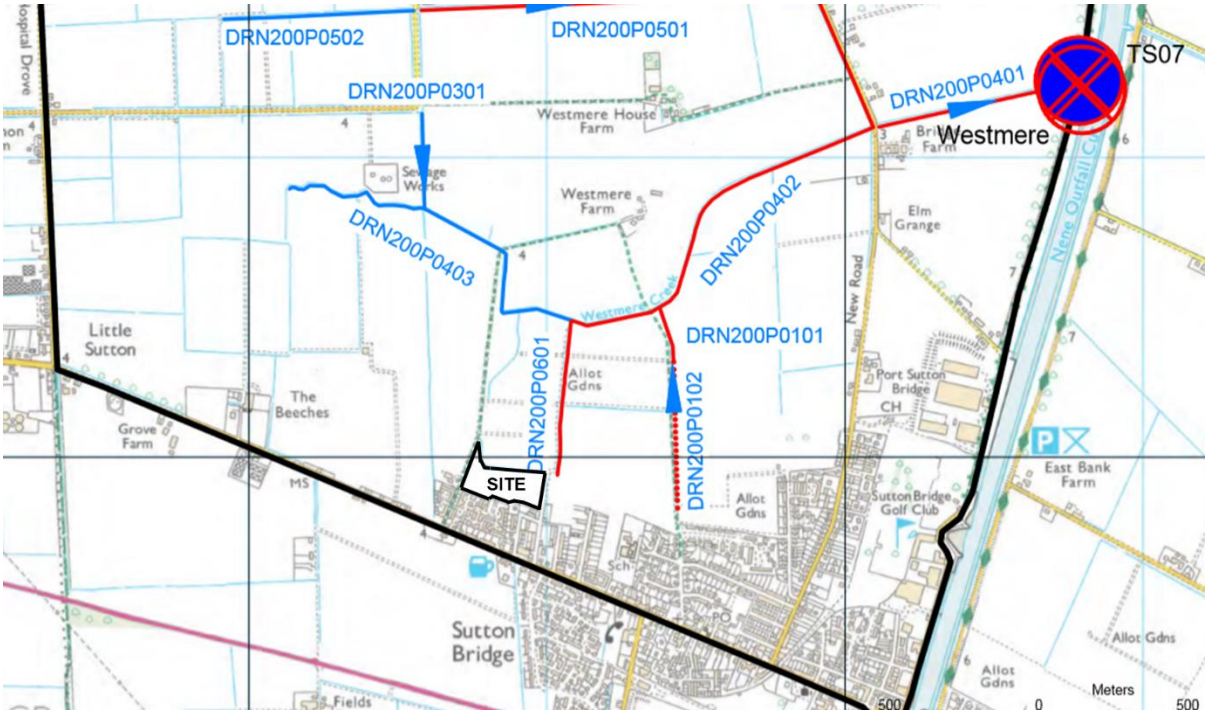
15th February 2018

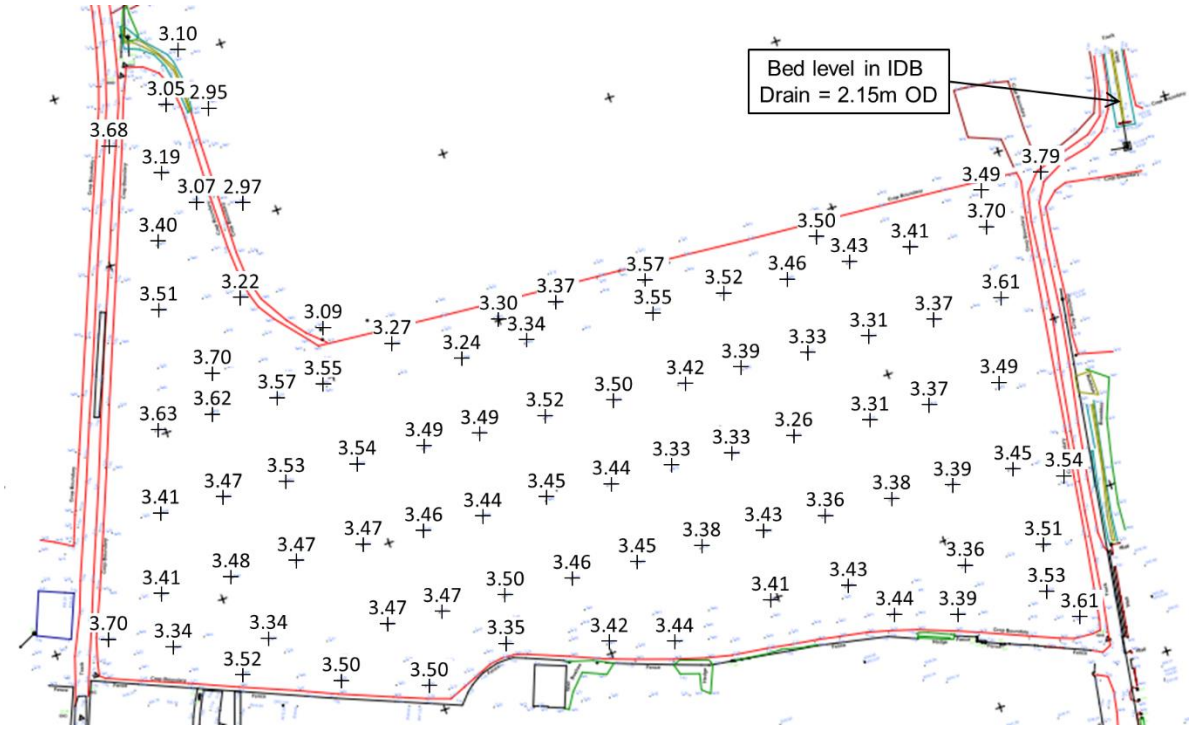
LOCATION PLAN



PLAN OF IDB DRAINS



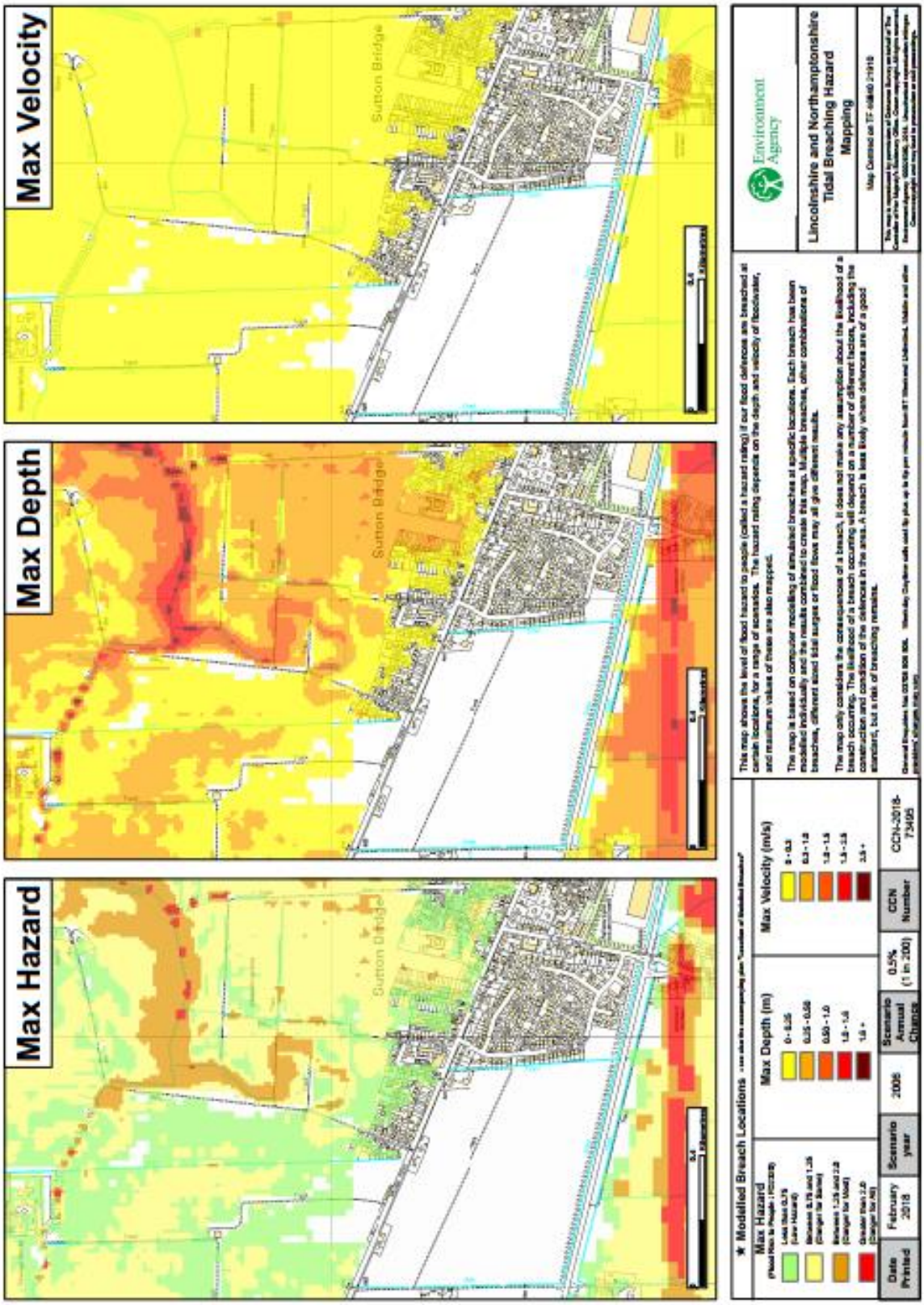
PLAN OF LEVELS ON THE SITE



These levels are a sample taken from the topographical study

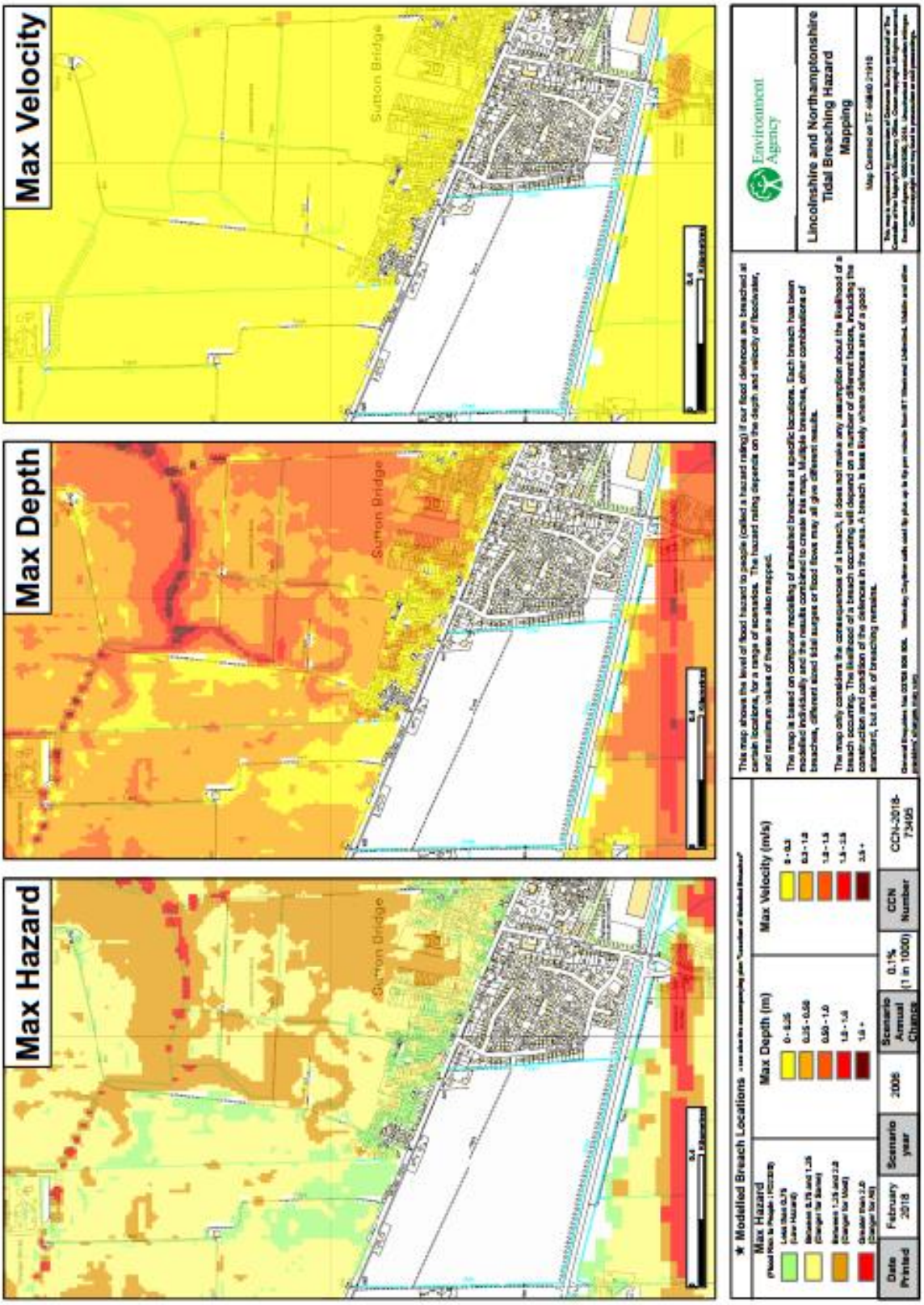
EA MAP SHOWING TIDAL BREACHING HAZARDS IN

1 in 200 YEAR EVENT IN 2006



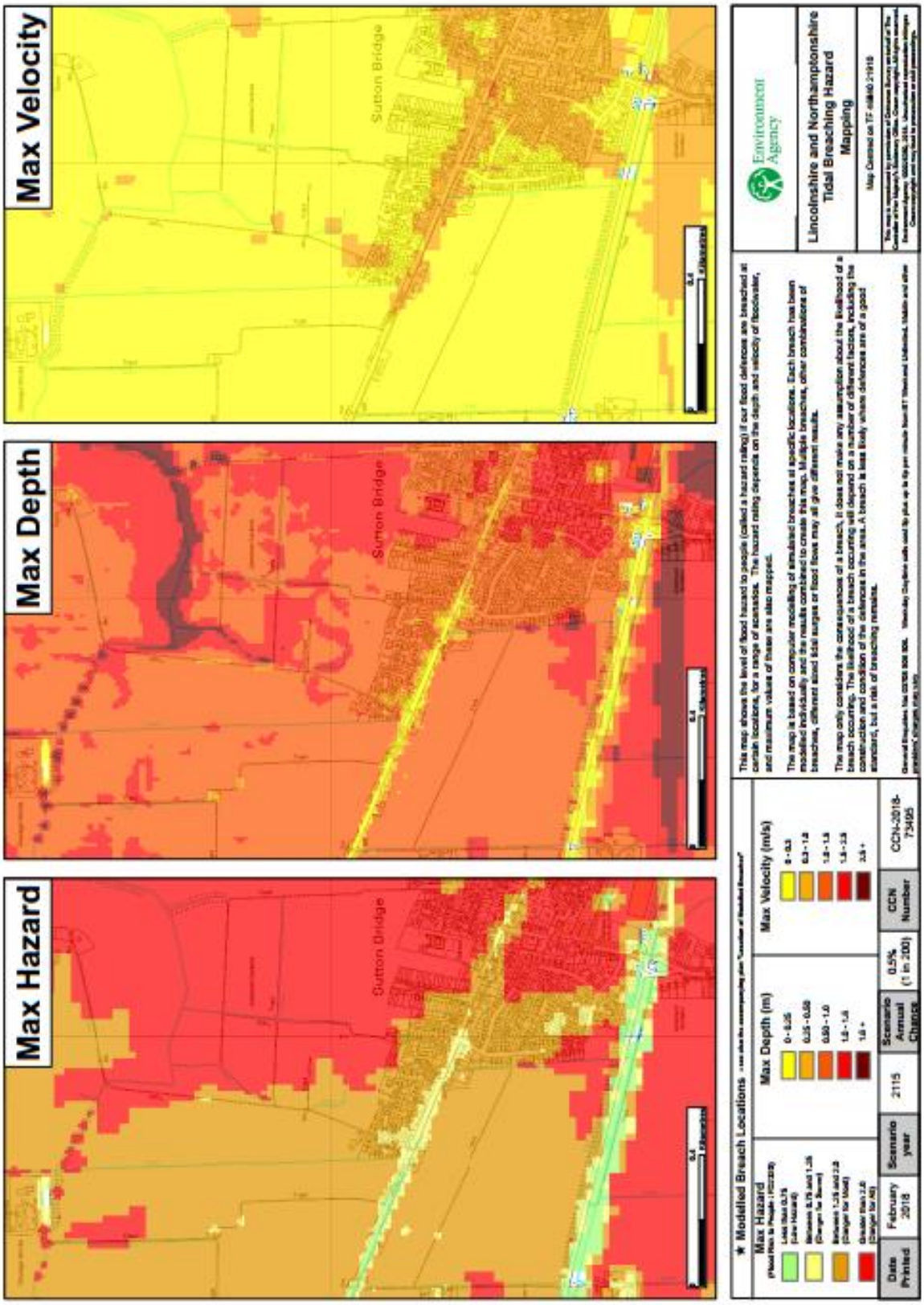
EA MAP SHOWING TIDAL BREACHING HAZARDS IN

1 in 1000 YEAR EVENT IN 2006



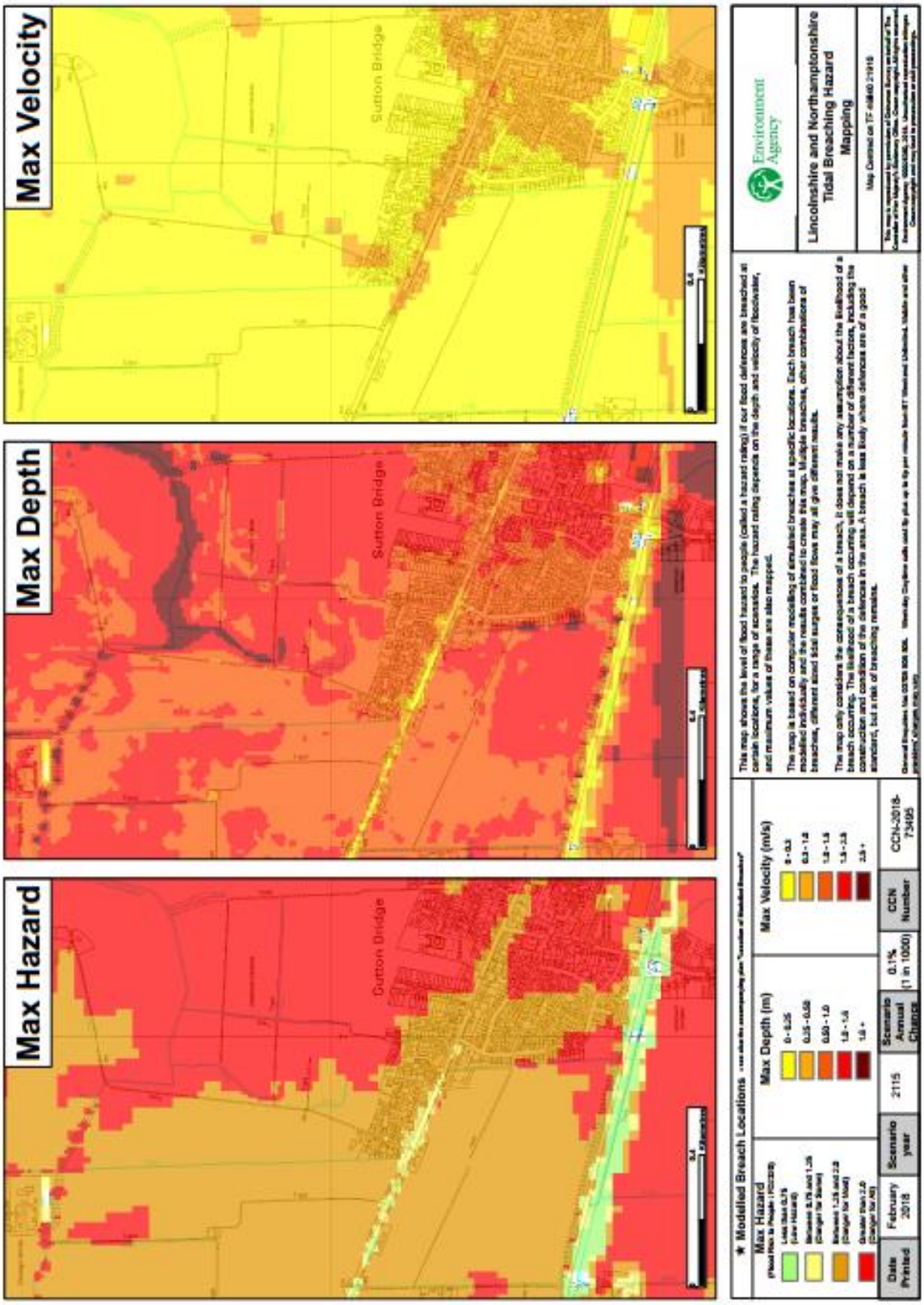
EA MAP SHOWING TIDAL BREACHING HAZARDS IN

1 in 200 YEAR EVENT IN 2115



EA MAP SHOWING TIDAL BREACHING HAZARDS IN

1 in 1000 YEAR EVENT IN 2115



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 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

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%	

has 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 the main source of flooding where the new climate change recommendations could affect the predictions of flood levels in 2115 at the development site is flooding from the tidal River Nene

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 will not have the effect of increasing the predicted flood level at the site in a 1 in 200 year breach event in 2115 by the maximum of 100mm, but it will probably be only between 10mm and 50mm. It is unlikely that this increase will significantly change the maps of flood risk at present issued by the Environment Agency.

Flooding from IDB drainage system

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.

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 it is considered that the mitigation proposed for the development, with the recommendation that the floor levels should be a minimum level of 4.35m OD, is satisfactory.