

**PROPOSED CONSTRUCTION OF A SPORTS PAVILION AT THE CURLEW
CENTRE, BRIDGE ROAD, SUTTON BRIDGE, SPALDING, PE12 9SA**

FLOOD RISK ASSESSMENT



View of Curlew Centre and Existing Changing Room

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 the proposed development at the Curlew Centre at 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 purpose other than for which it was originally commissioned.

Introduction

An application is due to be submitted to South Holland District Council for planning permission to construct a sports pavilion at the Curlew Centre south of Bridge Road, Sutton Bridge, PE12 9SA. The Curlew Centre and parking facilities are located immediately south of Bridge Road and south of the centre are two football pitches and the existing sports pavilion.

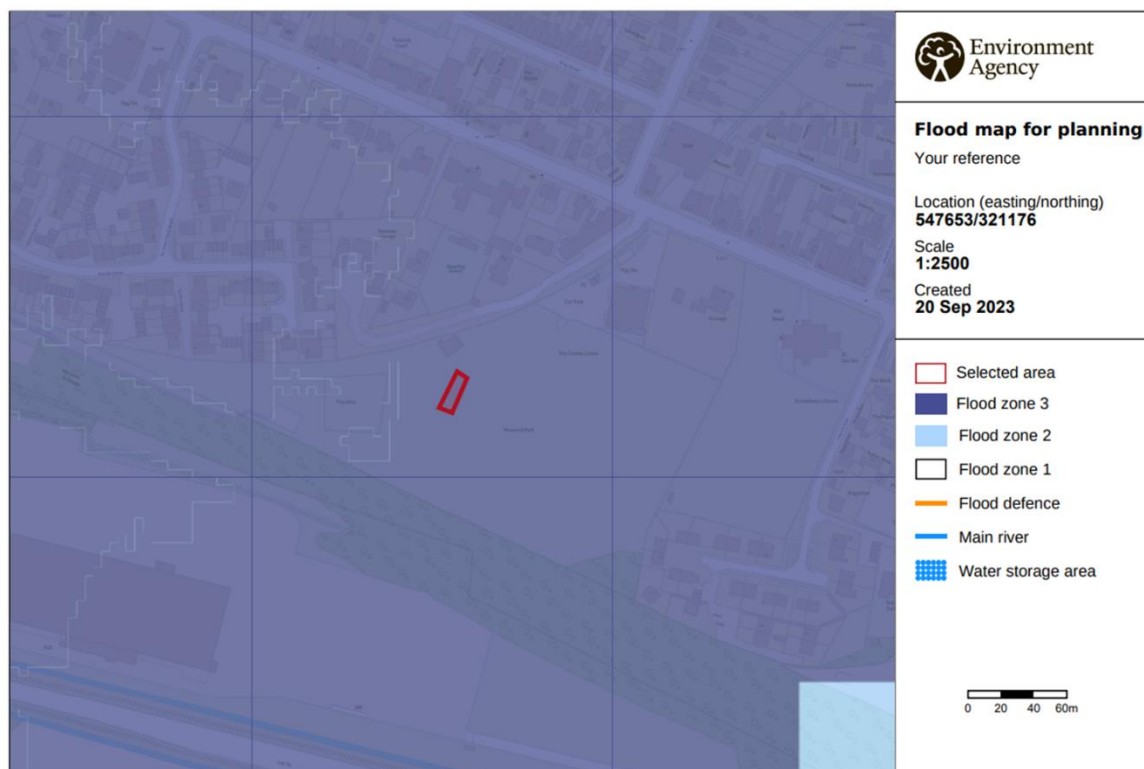
The site is within Flood Zone 3 as shown on the Environment Agency's Flood Zone Map. These maps do not take into account existing flood defences.

The Planning Application requires a Flood Risk Assessment to be carried out as required in the Technical Guidance to the National Planning Policy Framework.

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 this area.



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Application Site

The site of the proposed development is located on the southern side of the Curlew Centre in Sutton Bridge. The National Grid Reference of the site is 547650,321180.

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

The site can be considered to be within flood zone 3(a) because it is within a defended area as defined in Table 1 of the Technical Guidance.

The flood risk vulnerability classification for the site should next be assessed. The types of development in the “more vulnerable” category is shown Table 2 of the Guidance which is shown below.

- Hospitals
- Residential institutions such as residential care homes, childrens homes, social services homes and prisons and hostels.
- Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.
- Non–residential uses for health services, nurseries and educational establishments.
- Landfill* and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

The types of development in the “less vulnerable” category is shown Table 2 of the Guidance which is shown below.

- Police, ambulance and fire stations which are not required to be operational during flooding.
- Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the ‘more vulnerable’ class; and assembly and leisure.
- Land and buildings used for agriculture and forestry.
- Waste treatment (except landfill* and hazardous waste facilities).
- Minerals working and processing (except for sand and gravel working).
- Water treatment works which do not need to remain operational during times of flood.
- Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.

It can be seen that the proposed building will be used for leisure it should be classified as “less vulnerable”.

Table 3 of the Guidance is shown on the next page:

<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 “Less Vulnerable” development is deemed to be satisfactory development in flood zone 3(a).

Sequential Test

As the proposed development is located in Flood Zone 3(a) the NPPF requires the sequential test to be applied to determine if there are any reasonably available and suitable alternative sites at a lower flood risk for this type of development.

As the building will be used to compliment the existing facilities at the Curlew Centre then it is not reasonable to consider an alternative location.

The safety of the building will be delivered with the safety of the whole curlew Centre site by the receipt of flood warnings which the whole area near the river will receive if a very high tide is predicted.

Therefore the sequential test can be considered to be passed.

Strategic Flood Risk Assessment

The Strategic Flood Risk Assessment (SFRA) written for the South Holland District Council (SHDC) in 2010 provides details of the actual flood risk in the Council's area. This information has not been updated and reference to the maps in this document give the following information for the actual flood risk and hazard at the site for the 1% fluvial event and 0.5% tidal event.

For the present day	Depth of flooding ... Zero
	Extent of flooding ... Low or medium
	Peak Velocity Zero
For year 2115	Depth of flooding ... Greater than 1.5m
	Extent of flooding ... High
	Peak Velocity Greater than 0.25m/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 residual hazards are as follows for the 1% fluvial or 0.5% tidal event probability:

For the present day	Depth of flooding ...zero
	Extent of flooding .. Low or medium
	Hazard..... zero
	Peak Velocity zero
For the year 2115	Depth of flooding ...1.0m – 2.0m
	Extent of flooding .. High
	Hazard..... Greater than 2.0 (danger to all)
	Peak Velocity 0.3 – 1.0m/sec

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

For the year 2115	Depth of flooding ...1.0 m – 2.0m
	Extent of flooding .. High
	Hazard..... Greater than 2.0 (danger to all)
	Peak Velocity 0.3 – 1.0m/sec

Figure 16 of the general maps in the 2010 SFRA show that the site is not within the rapid inundation zone for the present day but will be in the zone in 2115.

Maximum fluvial flood levels in the River Nene at chainage 5.2km south of the road bridge across the river are shown in the reports as follows:

	Present	Present + Climate Change
1 in 100 year	5.86	7.00
1 in 1,000 year	6.20	7.34

The level of the bank of the River Nene at chainage 5.2km stated in the SFRA is 7.00m ODN south of the road bridge.

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.

Information on Surface Water Flooding on Environment Agency Website

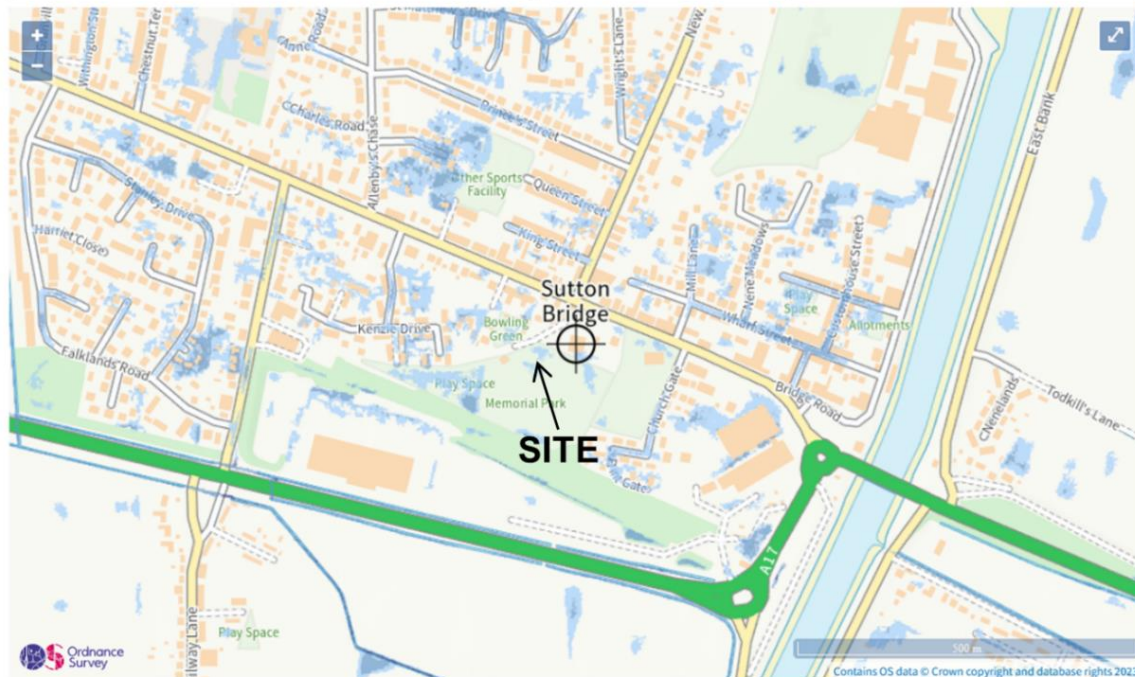
The map below shows areas around the site where there is a low risk of surface water flooding. The light blue areas indicate the low risk of up to 300mm of surface water flooding, and the darker blue areas indicate that between 300mm and 900mm of surface water flooding could occur.

Flood risk

Low risk: depth

Location

PE12 9SA



Surface water flood risk: water depth in a low risk scenario

Flood depth (millimetres)

Over 900mm 300 to 900mm Below 300mm Location you selected

It can be seen there are a few areas where the map predicts up to 300mm of surface water flooding to the site. These are probably low areas on the football fields where surface water will not soakaway quickly after heavy rainfall.

Existing Ground Levels

The level of the football fields and the surrounding area is between 3.40m and 3.50m ODN. The finished floor level of the Curlew Centre is 3.94m ODN. At the proposed location of the Sports Pavilion the topographical survey indicates existing ground levels of between 3.45m and 3.50m ODN.

The level of the car parking area around the Centre is approximately 3.60m ODN. Bridge Road is at a level of 4.37m ODN and the entrance roadway from the road to the centre slopes down from the road to the car parking area.

The drawing of the topographical survey will be included with the documents submitted for the planning application.

Potential Sources of Flooding

The following sources of flooding have been identified:

1. Failure or overtopping of the west bank of the River Nene.
2. Flooding from IDB Drains.
3. Flooding from surface water.

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

The west bank of the River Nene is approximately 600 metres 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 issued in 2010 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 1.5 metres depth of flooding is predicted.

The maps that can be found on the South East Lincolnshire Local Plan website which model predicted flood depths if a breach were to occur in the flood bank do not predict any flooding for the present day, but predict flood depths of between 1.0 metre and 2.0 metres on the football fields if a breach were to occur in a 1 in 200 year event in 2115. It is 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.

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 Free Discharge catchment which outfalls southwards into the South Holland Main Drain, which in turn discharges into the tidal River Nene during low tide levels. A plan of the drainage channels maintained by South Holland IDB is shown on page 13 of this report. It is assumed that excess surface water in this area of Sutton Bridge is collected by the piped IDB drain west of Railway Lane.

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 roof of the proposed building will be discharged into a soakaway adjacent to the new building.

The raising of ground floor levels above the level of the playing fields 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 last 50 years.

Probabilities and Trends of Flooding

The probability of this site flooding from Environment Agency main river is very low. An extreme tidal event would be forecast a number of days before it was due to take place which would allow managers of the centre take precautionary measures to limit the impact of any flooding that may occur.

Residual Risk

There is a residual flood risk to the site if the west bank of the tidal River Nene were to breach when river levels are very high due to a very high tide.

Climate Change

The predictions of flood depths for this flood risk assessment use information in the SHDC SFRA which was produced in 2010, and further information provided by the Environment Agency. 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 14 to 17). It is concluded that no extra mitigation measures are necessary to comply with the new guidance on climate change.

South East Lincs Advice Matrix

Advice can be found on the recommended mitigation required by referring to a spreadsheet on the South East Lincolnshire website. As the proposed development is classified as “Less Vulnerable” and the flood hazard is “greater than 2.0” (danger for all) reference should be made to category C4 which is shown below.

The proposal must be referred to the Environment Agency with a supporting Flood Risk Assessment, which contains evidence to justify the chosen finished floor

level. This should be as high as practicable (minimum 300mm above the existing ground level).

The Flood Risk Assessment should also include confirmation that appropriate mitigation measures/flood resilience techniques are incorporated into the development.

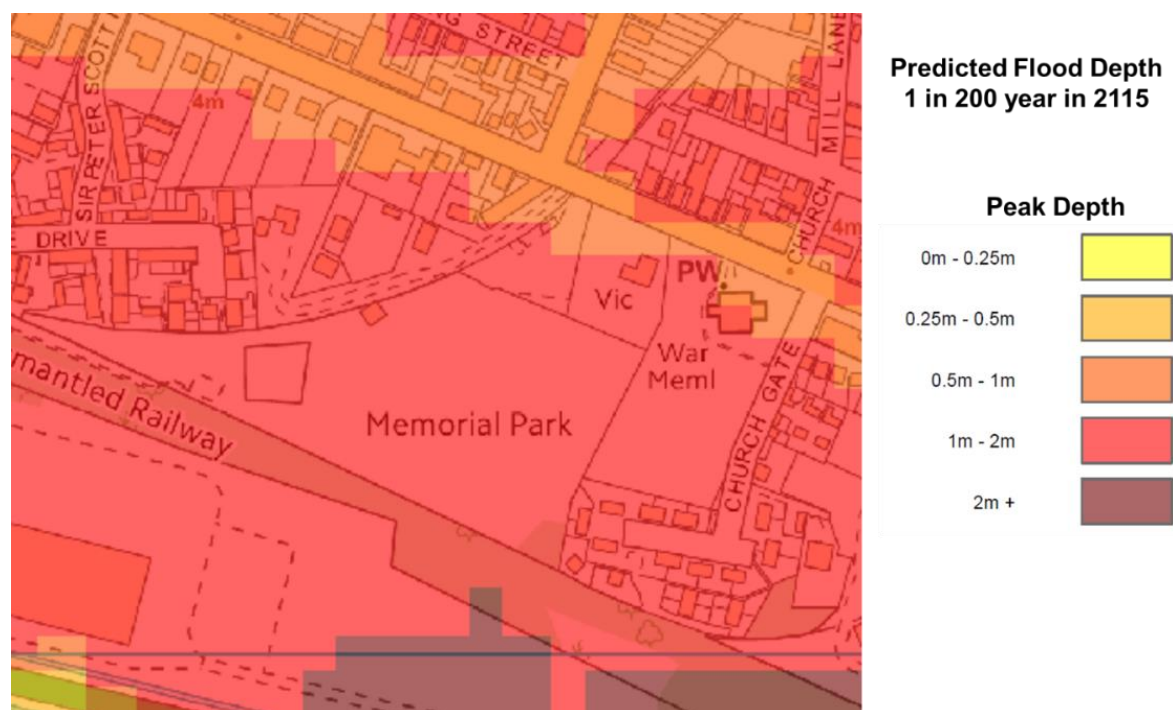
Please refer to the following document for information on flood resilience and resistant techniques to be included. "Improving Flood Performance of New Buildings Flood Resilient Construction (DCLG2007).

Single storey buildings should be built with FFL's above the predicted flood depth (refer to the relevant 2115 1% fluvial and 0.5% tidal maximum depth map). If this is not practicable an area of safe refuge will need to be provided or an appropriate flood warning and evacuation plan will need to demonstrate how this risk will be managed. It is the responsibility of the Local Planning Authority to determine the adequacy of the plan.

It is recommended that proposals are referred to the Environment Agency at the pre-application stage in the process.

Summary of Predicted Flood Depths to the Site

The plan below is an extract from the map of predicted residual peak depths of flooding in a 1 in 200 year event in 2115 in the South East Lincolnshire Strategic Flood Risk Assessment (March 2017) Appendix A – Fluvial & Tidal Hazard Mapping which shows the predicted residual flood depths on the site.



The plan on the next page of predicted depths of flooding in a 1 in 1000 year event in 2115 in the South East Lincs SFRA shows the bands of residual flood depths on the site.



Both the 1 in 200 year event map in 2115 and the 1 in 1000 year event map in 2115 indicates flood depths of between 1.0 metre and 2.0 metres in the area south of the Centre, and flood depths of between 500mm and 1.0 metre on Bridge Road.

An estimate of the predicted maximum flood level can be worked out by looking at the boundary between the red and orange band where the flood depth is 1.0 metre. From the topographical survey the ground level along this line is approximately 3.80m ODN and therefore the estimated predicted maximum flood level would be 4.80m ODN.

Conclusions

The risk of flooding from a breach in the west bank of the River Nene is extremely low. However the consequence of a breach in this bank is predicted to be flooding on the development site, with a depth of flood water of approximately 800mm if the bank of the River Nene breached during a 1 in 100 year tidal event in 2115.

The flood depths resulting in high levels in IDB drains can be considered low compared with the predicted flood depths resulting from a breach in the bank of the River Nene.

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

Recommendations

The minimum finished floor level of the proposed sports pavilion should be 4.00m ODN, which is approximately 500mm above the existing ground level around the football fields.

Occupiers of the property should register with the Environment Agency's Floodline Warnings Direct Service. As soon as there is a warning that a greater than normal is expected the management should closely monitor the situation and be prepared to close down all the activities in the Curlew Centre and the sports activities on the

football fields. This close down would be activated by the Environment Agency issuing a flood warning for this area of Sutton Bridge.

Management of the Curlew Centre should prepare a flood plan which will detail how the situation would be managed in an emergency.

Consideration should be given to the following for the construction of the new building

- a) All of the floors should be constructed with concrete and all floor coverings should be capable of withstanding being flooded for a period of a few days.
- b) All electrical equipment, including wall and water heaters, sockets and other equipment should be at least 800mm above the finished floor level of the building.
- c) Wall coverings should be either easily replaceable or capable of withstanding a depth of 800mm of flood water for a few days.

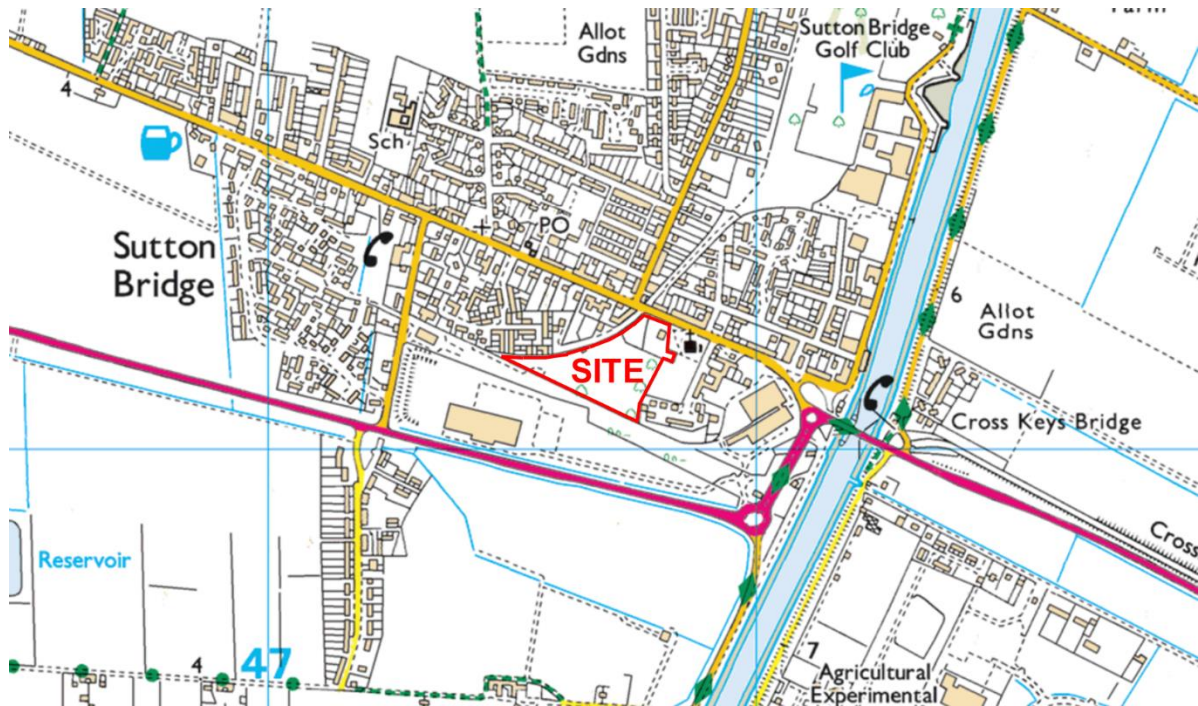
Rainwater from the roofs of the building should be discharged if possible into soakaways and these should be designed to BRE Digest 365 and approved under Building regulations. Hardstandings around the building should be constructed with permeable paving.

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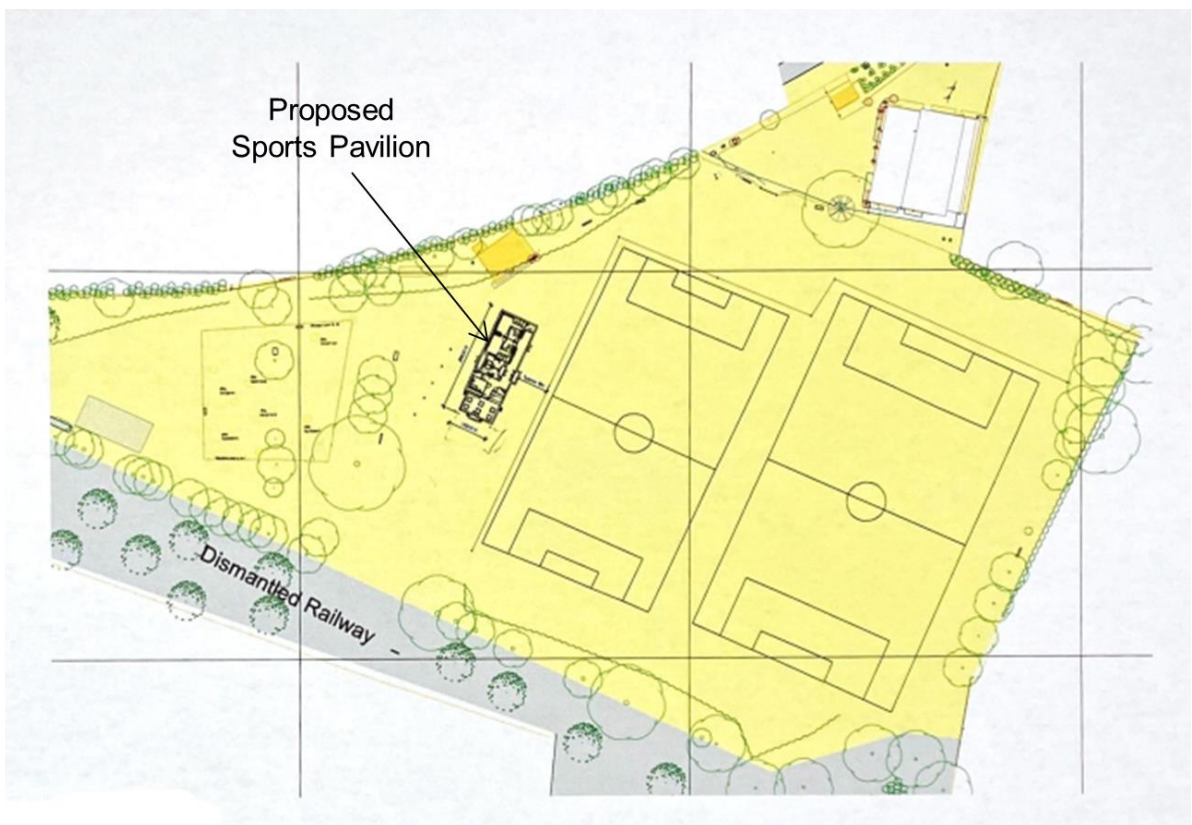
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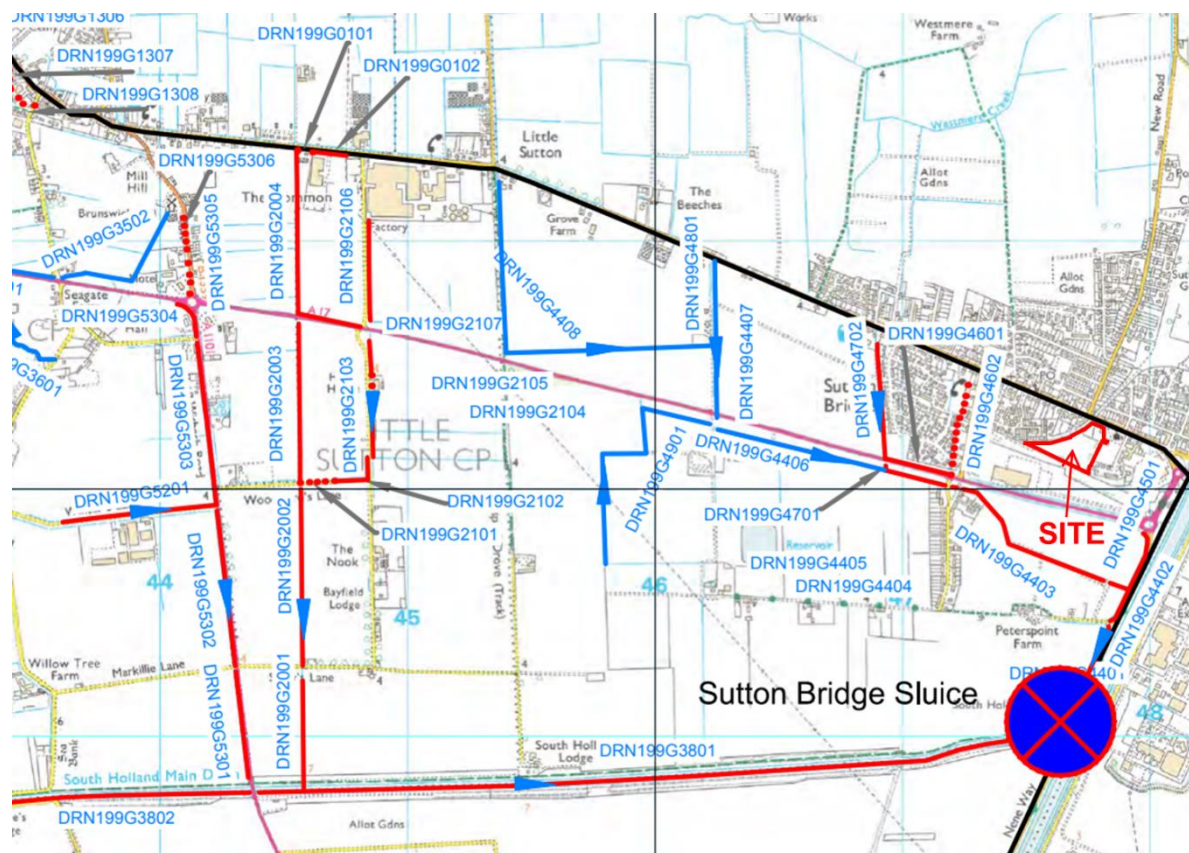
LOCATION PLAN



LOCATION PLAN



PLAN OF SOUTH HOLLAND IDB DRAINS



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 PPS25¹. 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 less vulnerable development in flood zone 3(a) the central and higher central 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 less vulnerable, the advice from the Environment Agency is that the central climate change allowance, which is 25%, should be considered. After considering the effects of this increase the higher central allowance, which is 35%, 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 level of the proposed building should be 4.00m ODN, is satisfactory.