

**PROPOSED CHANGE OF USE OF THE BARN TO RESIDENTIAL
USE AT DERENE AT DAMGATE, HOLBEACH, PE12 8QL.
FLOOD RISK ASSESSMENT**



View of barn

Revision A: Recommendations amended and paragraph added on page 9 recommending flood resilient construction. 3rd May 2017

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This flood risk assessment has been prepared solely to support the planning application for the change of use at Derene, Damgate, Holbeach. 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

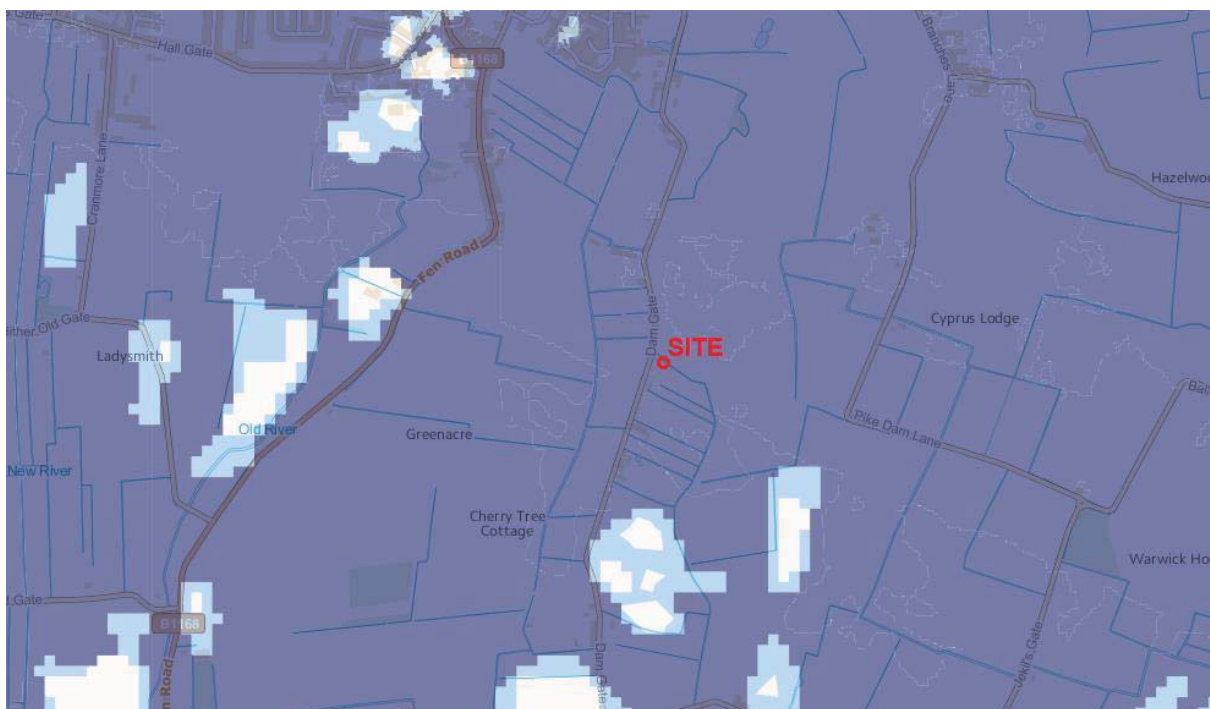
A Planning application is due to be submitted to South Holland District Council to convert an existing barn for residential use to the rear of a property called Derene on Damgate, Holbeach, PE12 8QL.

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 a greater part of this area south of Holbeach is within Flood Zone 3. There are some smaller areas which are slightly higher which are within flood zones 1 and 2.

Application Site

The development is located 1.5km south of Holbeach. The National Grid Reference of the site is 536470 323520.

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 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.

Applying the flood risk vulnerability classification in Table 2 of the Guidance, the development of a dwelling house is classified as “more vulnerable” and Table 3 of the Guidance (see below) states that residential use is only permitted after the sequential and exception test is followed.

<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	✓*

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 greater part of the area south of the Holbeach, 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 the vicinity of Holbeach that is in a lower flood zone.

Taking into account the guidance, it can be seen that it is extremely unlikely that an alternative site with a lower flood risk could be found in this area south of Holbeach.

The safety of the development will be delivered by ensuring the floor level of the proposed new dwellings 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. Some greenfield land will need to be identified to enable the Council to meet the RSS and Structure Plan requirement for 2021. Therefore there is a requirement for additional residential development to be provided in the area.

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

The following information about the flood risk in the location of this development has been sourced from the maps and reports in the South Holland District Council's Strategic Flood Risk Assessment (SHDC SFRA) dated January 2010, which is the information available on the Council's website at the present date.

Report Maps

Map 3 shows that the site is within flood zone 3.

Map 5 shows that the site is at low or medium risk, but reliant on flood defences for this standard.

Map 6 indicates the peak depth is zero for the present day 1% fluvial and 0.5% tidal event probability.

Map 7 indicates the peak velocity is zero for the present day 1% fluvial and 0.5% tidal event probability.

Map 12 indicates the actual risk is low or medium for the year 2055 1% fluvial and 0.5% tidal event probability.

Map 13 indicates the actual risk is low or medium for the year 2115 1% fluvial and 0.5% tidal event probability.

Map 16 shows that the site is not within a rapid inundation zone.

Flood Maps Table D1

The actual flood hazard for the present day and 2115 is as follows:

Depth of flooding..... zero
Extent of flooding..... low or medium, reliant on flood defences
Velocity nil

The residual flood hazard for the present day and 2115 is as follows:

Depth of flooding..... zero
Extent of flooding..... low or medium, reliant on flood defences
Velocity nil

Tables in the SFRA show the following details of the defence bank on the west side of the tidal section of the River Nene south of the A17 road bridge, at chainage 5.2km.

	2007	2055	2115
Peak 1 in 200 year extreme tide level	5.86m OD	6.19m OD	7.00m OD
Peak 1 in 1,000 year extreme tide level	6.20m OD	6.53m OD	7.34m OD

The SFRA states the defence type at this point is “No raised Defence” with a defence crest level of 6.95 m OD and the freeboards are as follows:

	2007	2055	2115
Peak 1 in 200 year freeboard	1870mm	1540mm	730mm
Peak 1 in 1,000 year freeboard	1580mm	1250mm	440mm

Further south the defence is an earth bank with crest levels between 5.3km and 5.7km (the outfall of the South Holland Main Drain) of 7.07, 7.1, 7.04, 7.15 and 7.07m 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.

Environment Agency Tidal Breach Hazard Mapping

The Environment Agency has published mapping which predicts the depths, velocities and hazard following a breach in the tidal defences for a 1 in 200 and 1 in 1000 year event in 2115. The maps have been produced by modelling breaches along the whole length of the tidal defences and combining these into one map.

The map for the 1 in 1000 year event in 2115 shows flood depths of between 500mm and 1.0 metre on the site.

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 10.0 km from the tidal section of the River Nene, 12.5km from the tidal part of the River Welland and 12.0km from the Wash defences to the north at the nearest point. The tidal defence banks to all of these are maintained by the Environment Agency.

The major watercourses in the area are maintained by South Holland IDB, which has carried out improvement schemes so that IDB watercourses generally provide a standard of 1 in 100 years with a freeboard of 300mm in urban areas.

Existing Ground Levels and Proposed Levels of Buildings

A topographical study has been carried out on the site and the results are shown on page 11 of this report. The levels around the building vary between 2.45m and 2.65m OD, which is the level of the whole site and the surrounding farmland.

The floor level of the barn is 2.70mm OD.

Potential Sources of Flooding

The potential sources of flooding to the site are:-

1. Failure or overtopping of tidal defences of the River Welland, River Nene or the Wash
2. High water levels in IDB drainage channels.
3. Localised flooding in the area.

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

The maps in the 2010 SFRA indicate that the east bank of the River Welland, which is approximately 10.0 km from the site, provides a 1 in 200 year standard of protection in 2115.

The west bank of the River Nene is approximately 12.1 km east of the site of the proposed development, and the Wash Banks are at 13.3km north of the site at their nearest point.

The predicted levels in the 2010 SFRA indicate that the west bank of the River Nene between the A17 road bridge and the South Holland Main Drain Outfall Sluice will not be overtopped unless there is an event greater than 1 in 1000 years at the present time. However in 2115 although it will not be overtopped in a 1 in 200 year event, it will be overtopped in a 1 in 1000 year event.

The maps in the SFRA (January 2010) do not indicate any flooding will occur in a 1 in 200 year event in 2115. However maps recently issued onto the South East Lincs Local Plan website indicate flood depths on the site of between 250mm and 500mm.

2. High Water Levels in IDB drains

Although the whole of this area is below high tide level and levels in the rivers, 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, the Wash and the River Welland and control water levels throughout the South Holland IDB area.

The development site is located south of Holbeach which is in the Little Holland catchment area. The Board's drain on the west side of Damgate flows southwards to discharge into the Little South Holland Drain. The level of this watercourse is controlled by the Little Holland Pumping station which is a further 3.0km south east, which lifts the water into the South Holland Main Drain. The South Holland IDB have advised that the maximum 1 in 100 year predicted level at the pumping station is 0.30m OD. and the maximum 1 in 100 year level in IDB drainage channels near the site is not likely to exceed 1.70m OD.

The water level in the South Holland Main Drain is controlled by the sluice alongside Nene Way 1.5km south of Sutton Bridge, where the water discharges into the tidal River Nene at low tide.

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. South Holland IDB watercourses generally state that their watercourses provide a standard of 1 in 100 years with a freeboard of 300mm in urban areas. 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.

3. Localised Flooding in the area

Although there is a risk that surface water could accumulate on the site, the floor level will be raised in the barn which will ensure there is no possibility of flooding from this source.

Extent of known Flooding

During the preparation of this assessment, no evidence was discovered of the existing house or garden 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.

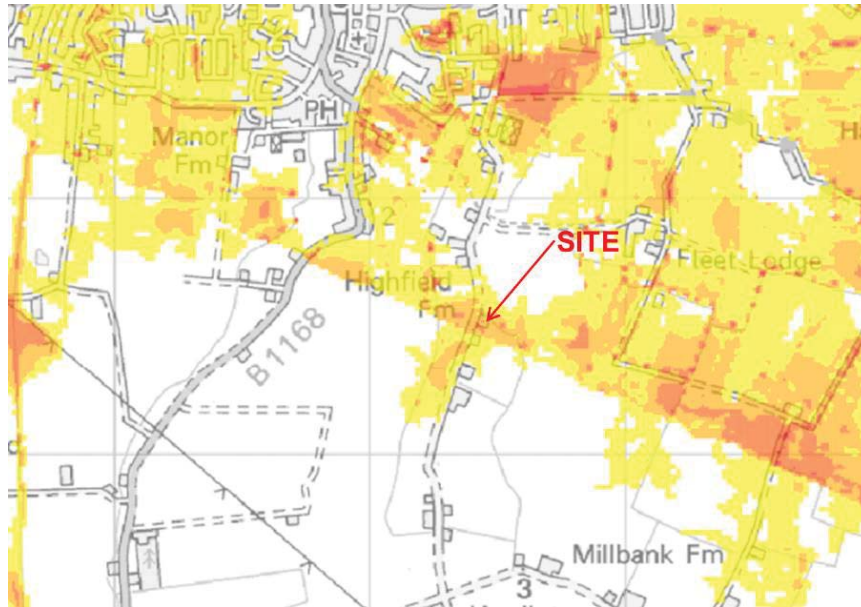
Climate Change

The 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 the FRA. The effects of these new recommendations are considered in Appendix A of this report (pages 12 to 15). It is concluded that no extra mitigation measures are necessary to comply with the new guidance on climate change.

Conclusions

The latest SFRA map which has recently been issued onto the South East Lincs website showing 1 in 200 year residual flood depths in 2116 indicate flood depths of between 250mm and 500mm on the site.

An extract from this map is shown on the next page.



The Environment Agency map for the 1 in 1000 year event in 2115 shows flood depths of between 500mm and 1.0 metre on the site.

Therefore as the building is designed with bedrooms on the ground floor the finished ground floor level of the building should be set at least 1.0 metre above the ground level outside the building.

The Environment Agency have stated that their policy is to continue to maintain tidal banks in the future with at least a 1 in 200 year standard of service, and therefore the risk of flooding to the site is extremely low.

The risk of flooding to the building from IDB drains can be considered low, especially with the floor level of the proposed building being 1.0 metre above ground level on the site.

The IDB have adequate arrangements to bring in contractors and use their own staff if a failure of any part of the sluices occurred. If drains become full any flooding that occurs would happen very slowly and affect land at levels below 3.0m OD before the site of the proposed development.

The proposed development is not in a functional flood plain.

Although the site is in flood zone 3, and the actual risk of the site flooding from any Environment Agency or IDB watercourse is very low. The site is only likely to flood if a breach occurs in the east bank of the River Welland or the west bank of the River Nene during a 1 in 1000 year high tide in 2115. No flooding would be likely to occur if a breach did not occur.

If any flooding were to occur it would happen very slowly and residents would have adequate time to prepare themselves for the event.

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

If the building is converted so that there are two floors with all bedrooms on the first floor then the ground floor level should be raised by 300mm above the existing floor level so that it is 500mm above the level of surrounding ground.

If the building is converted with bedrooms on the ground floor then these rooms should be raised by at least 800mm above the existing ground floor so that they are a minimum level of 1.0 metre above surrounding ground levels. In addition access should be provided to a boarded loft space on the first floor and escape windows should be provided for use in an emergency.

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

The building should be designed incorporating flood resistant and resilient techniques to allow it to be refurbished after being flooding to a depth of approximately 300mm above all finished ground floor levels of the building.

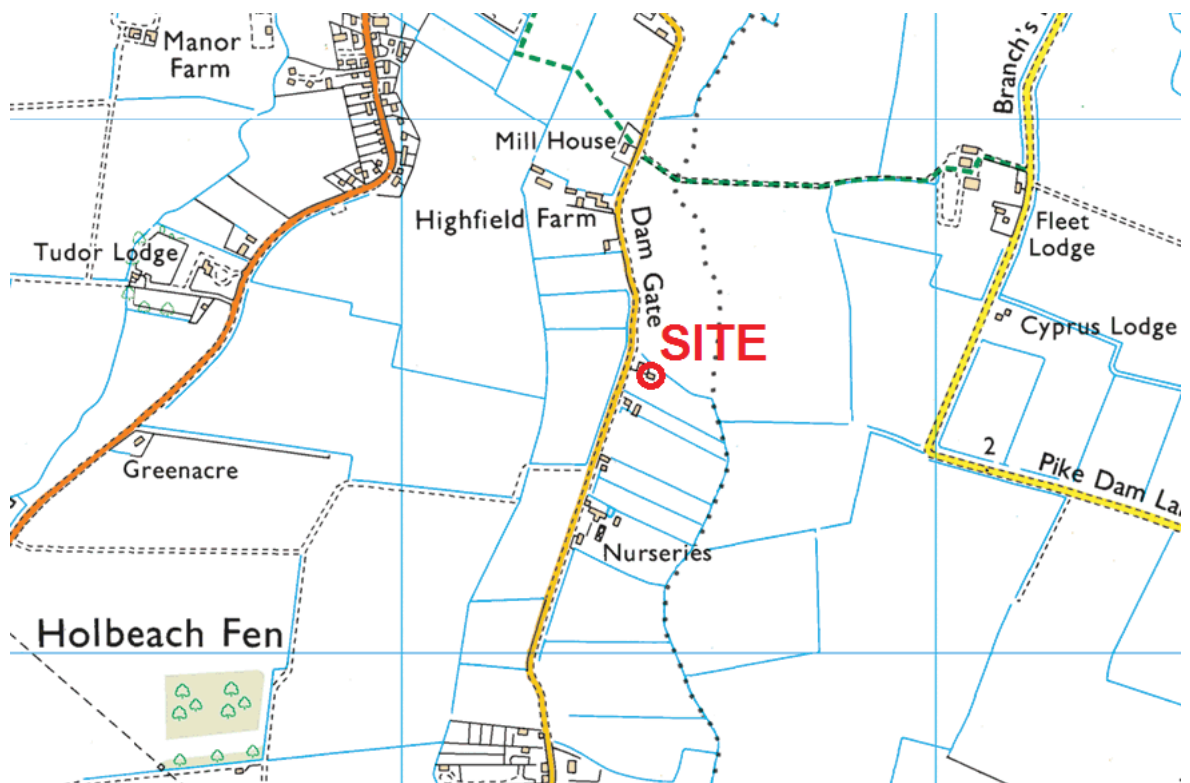
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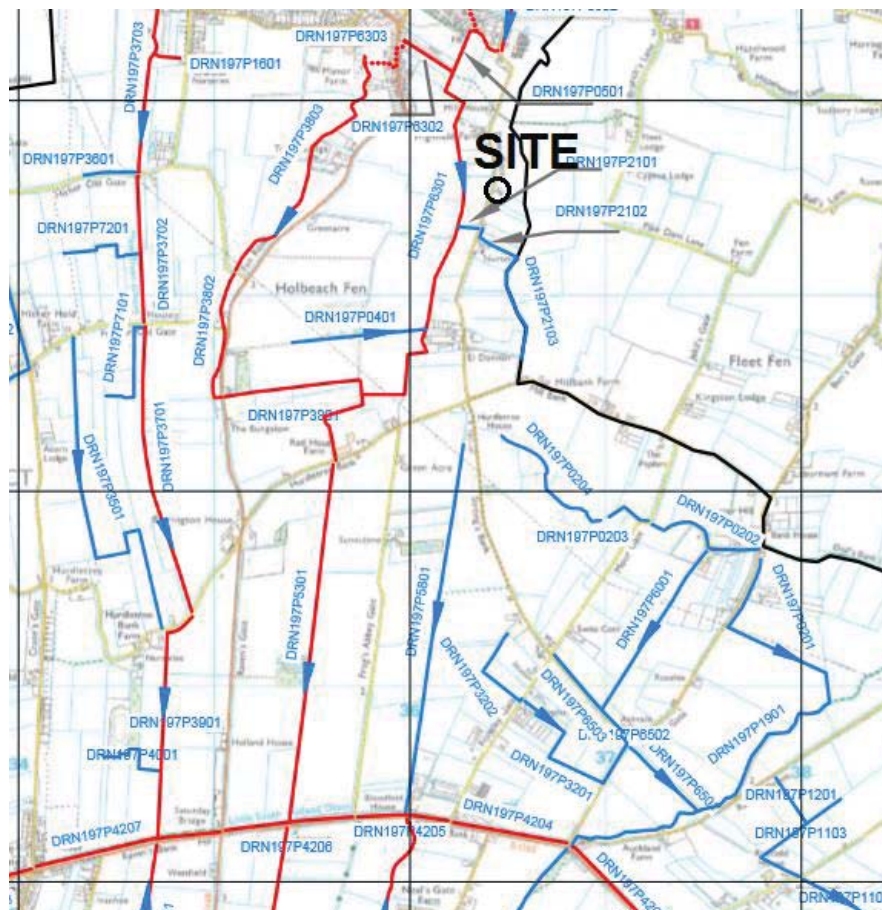
11th April 2017

Revision A: Recommendations amended and paragraph added on page 9 recommending flood resilient construction. 3rd May 2017

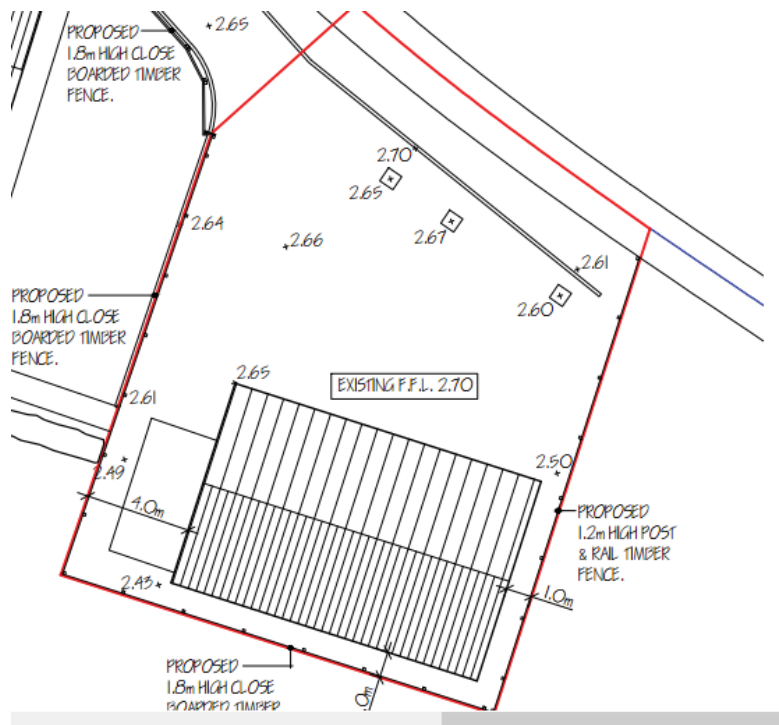
LOCATION PLAN



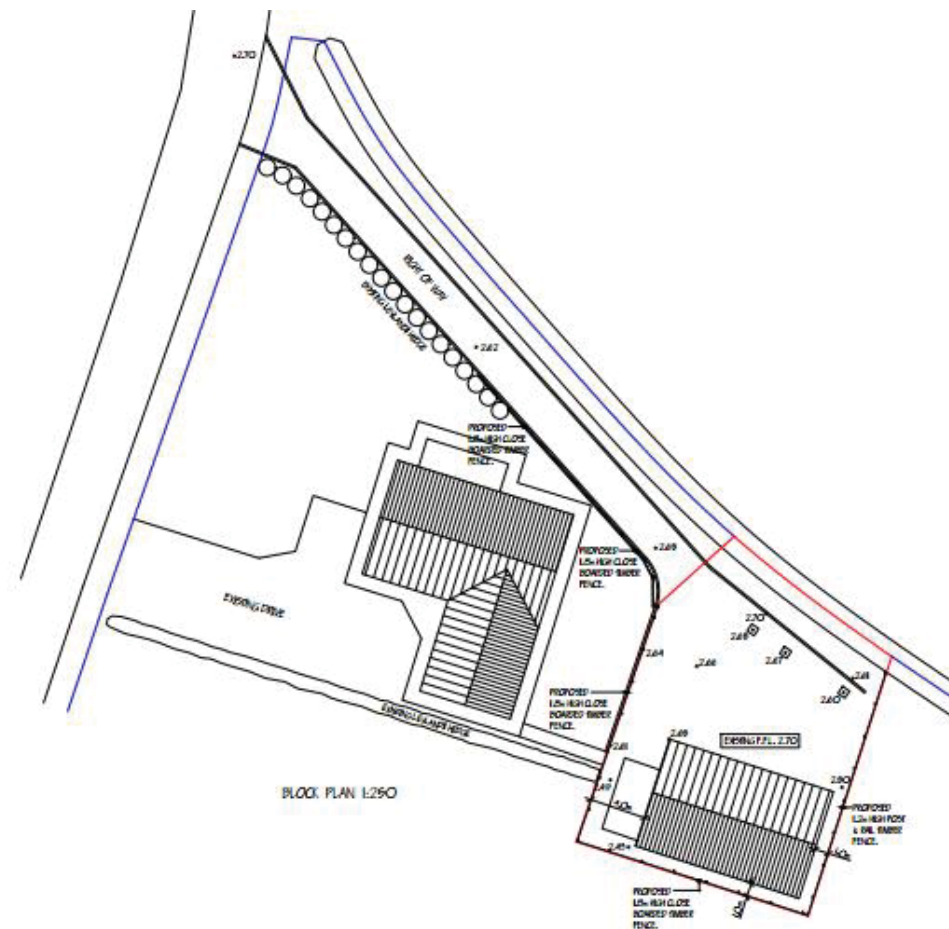
PLAN OF AREA SHOWING IDB WATERCOURSES



PLAN SHOWING SITE LEVELS



SITE PLAN



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 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, Nene, or the Wash,.
- 2) Flooding from IDB drainage system.

1) Flooding from a breach in the tidal banks.

The FRA has identified the main source of flooding to be from the tidal River Nene or the Wash. The new climate change recommendations could affect the predictions of flood levels in 2115 at the development site:

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

It is assumed that the latest plans on the South East Lincs website incorporate the latest guidance. Therefore the new guidance increases the maximum predicted sea level in 2115 by 100mm compared with the allowance made in the SFRA, and presumably in the subsequent maps produced by the Environment Agency.

A 100mm increase of maximum tide levels is unlikely to increase flood depths on the site by as much as 100mm. When the flood maps are revised it is unlikely that flood depths are likely to significantly change.

It is assumed that the latest plans on the South East Lincs website incorporate the latest guidance. Therefore the recommendation that proposed ground floor level of the property should be raised by 500mm will provide satisfactory mitigation at this site.

Flooding from IDB watercourses

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 generally 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 the allowance provides a 1 in 100 year standard to most urban areas.

to ensure that they have adequate plans to comply with the latest recommendations on climate change.

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 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 for a two story conversion that the floor levels should be a minimum level of 3.00m OD, which is 500mm above the existing ground level, is satisfactory.

If bedrooms are designed on the first floor then the mitigation proposed for the development, with the recommendation that the floor levels for the bedrooms should be a minimum level of 3.50m OD, which is 1.0 metre above the existing ground level, is satisfactory.

