PROPOSED DEVELOPMENT NORTH OF LEAVESLAKE DROVE WEST PINCHBECK SPALDING, PE11 3QJ

FLOOD RISK ASSESSMENT



View of site from field on west side

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This flood risk assessment has been prepared solely to support the planning application for a development at Leaveslake Drove, West Pinchbeck. 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

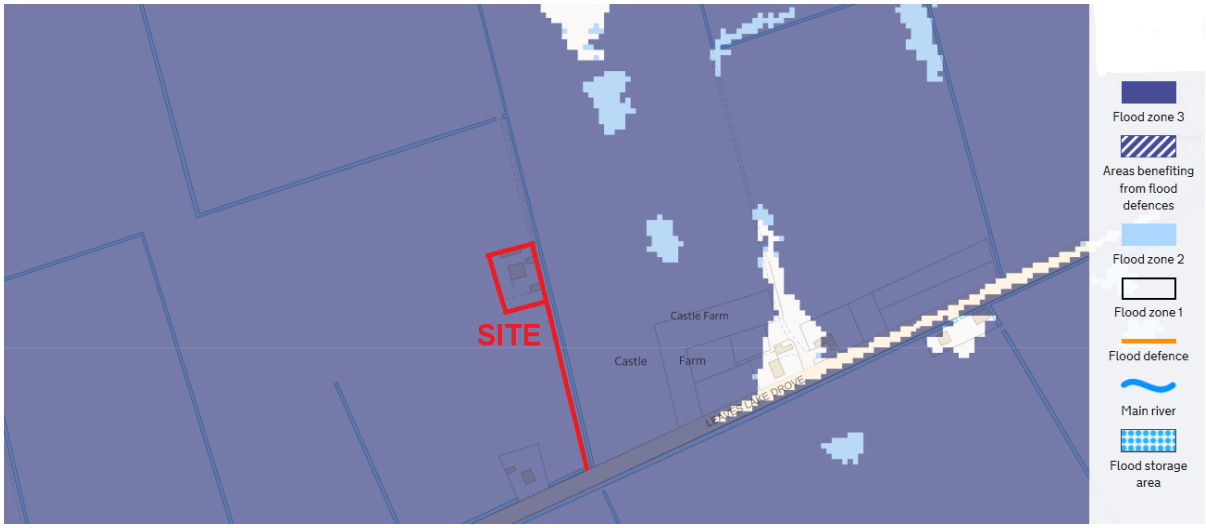
A Planning Application is due to be submitted to South Holland District Council to convert a number of barns on a site north of Leaveslake Drove at West Pinchbeck to residential use and workshops. The site is 200 metres north of Leaveslake Drove and 750 metres west of Six House Bank in West Pinchbeck.

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.

The Planning Application therefore requires a flood risk assessment to be carried out as required in 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 Black Sluice 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 north of Leaveslake Drove, except for a few small areas, is in Flood Zone 3.

Application Site

The development is located west of the village of West Pinchbeck, and is 950 metres north west of the River Glen. The National Grid Reference of the site is 519095 325065.

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 classified as 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 residential housing 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 greater part of the area around West Pinchbeck, 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 the development within flood zones 1 and 2 in this area.

As the proposed development is the conversion of existing barn for residential use an alternative location cannot be considered.

The safety of the development will be delivered by ensuring the ground floor levels of the proposed new dwellings are above predicted residual flood levels for this area.

The South Holland District Council Core Strategy allows for redundant buildings such as these to be brought forward for conversion to residential use.

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 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
	Velocity ……. Nil
For year 2115	Depth of flooding … 0 – 500mm
	Extent of flooding .. High
	Peak Velocity …… 0 – 0.1m/sec

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

For the present day	Depth of flooding…. 0 – 250mm

	Extent of flooding	….high
	Hazard …….	Less than 0.75 (Low Hazard)
	Velocity ……..	0 – 0.3m/sec
For the year 2115	Depth of flooding ….	250 - 500mm
	Extent of flooding …	High
	Hazard …….	0.75 – 1.25 (Danger for some)
	Velocity ……	0 – 0.3m/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 Glen

The maximum levels in this section of the River Glen approximately 1 km south of the site at chainage 11km are as follows:

	2007	2115
Peak 1 in 100 year level	4.73m OD	4.97m OD
Peak 1 in 1000 year level	5.04m OD	5.25m OD

The defence level (top of left bank) south of the site is 5.93m OD which is the average level of this soil bank along this length.

Information from the Environment Agency

The Environment Agency has provided predicted flood levels for the River Welland which are taken from the Welland Catchment Model produced in 2007.

	2007	2115
Peak 1 in 100 year flood level	4.65m OD	5.06m OD
Peak 1 in 1,000 year flood level	5.15m OD	5.40m OD

These levels are higher than the predicted levels in the SFRA, but the maximum predicted level in a 1 in 1000 year in 2115 is still 530mm below the bank of the Glen directly south of the development 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 2.4 km east of the section of the South Forty Foot Drain which is maintained by the Environment Agency. The section north of Black Hole Drove Pumping Station is the main arterial channel which conveys the water to the outfall at Black Sluice Pumping Station at Boston.

The site is located approximately 950 metres from the north bank of the River Glen which is maintained by the Environment Agency.

The internal watercourses in the area, including the Black Hole Drove Pumping Station and the section of the South Forty Foot Drain south of station are maintained by Black Sluice IDB.

Existing Ground Levels and Proposed Levels of Buildings

Ground levels have been taken of the barns and the adjacent fields, and the average ground level of the site itself is between 2.40m and 2.50m OD. The floor levels in the various buildings vary between 2.64m and 2.85m OD. The levels of the field on the west and north sides were approximately 2.25m OD and the field level to the south was higher at 2.65m OD.

All of these levels are shown on the plan on sheet 11 of this report.

Potential Sources of Flooding

The potential sources of flooding to the site are:-

1. Overtopping of the South Forty Foot Drain.
2. Flooding from the River Glen
3. High water levels in IDB drainage channels
4. Surface water flooding

1. Overtopping of the South Forty Foot Drain.

The flood risk from this source will be considered to be the length of the South Forty Foot Drain (SFFD) downstream (north) of Black Hole Drove Pumping Station which is maintained by the Environment Agency (EA).

The SFRA predicts maximum water levels of 3.49m OD in the main river section of the SFFD in a 1 in 100 year event in 2115. However these predicted levels were taken from a study carried out in 2004 and has been superseded by further computer modelling undertaken for a more recent study.

The normal level of the South Forty Foot Drain is approximately 0.00m OD but after heavy rainfall the highland carriers react quickly and the level of the Drain can rise to around 3.00m OD in a significant event. This level reduces after 24 hours to below 2.00m OD. Some flooding can occur in the highland carriers which reduces the risk of flooding from the South Forty Foot Drain.

Following the 2004 studies by the EA Black Sluice IDB undertook a more detailed investigation of bank levels in the southern part of the SFFD and found long lengths with levels of only 3.00m OD. It was concluded from this that the risk of flood levels in the SFFD rising above 3.00m OD were extremely low.

Flows into the SFFD are by gravity from the highland carriers and pumped discharges from fen areas. Black Sluice IDB have an operational plan which states that pumping stations will be switched off when the water level at Black Hole Drove Pumping Station reaches 2.70m OD. This will limit the rate of increase of the water levels in the SFFD and reduce the risk of breaches occurring in the banks in the southern section of the drain.

The water in the SFFD is discharged into the Haven through the two sluices at Black Sluice Pumping Station and a gradient is formed along the drain. As the maximum water level at the upstream end of the SFFD at Black Hole Drove Pumping Station is 3.00m OD then the water level in the SFFD will always be lower than 3.00m OD, and recent studies indicate the maximum level at Black Sluice Pumping Station at Boston would be approximately 2.65m OD.

To conclude the risk of flood water from the SFFD reaching the site and rising to a level of 2.90m OD and causing flooding to the proposed development is extremely low.

Therefore adequate mitigation will be provided by raising ground floor levels of the buildings to a minimum level of 2.90m OD.

2. Flooding from River Glen

The River Glen, which is EA main river, is 950 metres south of the site. The maps in the SFRA predict that if a breach were to occur in the River Glen in a 1 in 100 year event in 2115 the flood depth on the site of the development would be between 250mm and 500mm.

This risk will be mitigated by raising floor levels at least 500mm above the lowest land levels in the area.

3. High Water Levels in IDB Drainage Channels

The area of the proposed development is drained by a dyke on the western side of the access track which discharges through a culvert under Leaveslake Drove into the watercourse on the south side of Leaveslake Drove which is maintained by Black Sluice IDB. This drain is shown in the photograph below.



This drain flows in easterly direction and flows into the South Forty Foot Drain approximately 2.4 km west of the development site. The water level in these drains is controlled by Black Hole Drove Pumping Station. The normal level of the water in the South Forty Foot Drain is -0.3m OD and the 1 in 100 year level is likely to be between 1.5m OD and 2.0m OD.

The Black Sluice IDB drains have been designed to a 1 in 10 year standard with a freeboard of between 800mm and 1.0 metres. This generally provides a standard of at least 1 in 50 years for flooding of the lowest land. Much of the land in the catchment is below 3.00m OD and therefore even if the pumps fail to operate for a considerable time during a rainfall event the site is unlikely to flood.

The flood risk from IDB drains will be adequately mitigated by raising floor levels at least 500mm above the lowest land levels in the area.

4. Flooding from the riparian dyke east of the site.

If a blockage occurred in the culvert under Leaveslake Drove then the water level in the dyke west of the development could be at risk of flooding. It is unlikely that this would occur quickly and the problem would be resolved before levels became so high that they were a danger to the buildings.

The flood risk from this dyke will be adequately mitigated by raising floor levels at least 500mm above the lowest land levels in the area.

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.

In 1999 the west bank of the South Forty Foot Drain breached 100 metres north of Black Hole Drove Pumping Station. An area of farmland was flooded east of the Drain but no properties were flooded. The level of the South Forty Foot Drain was reduced by stopping all of the IDB pumping stations in the area until a temporary repair was carried out, which was less than 12 hours after the breach occurred. In this event no flood water flowed south of Black Hole Drove and all of the flooding was north of Black Hole Drove and south of Star Lode Drove.

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.

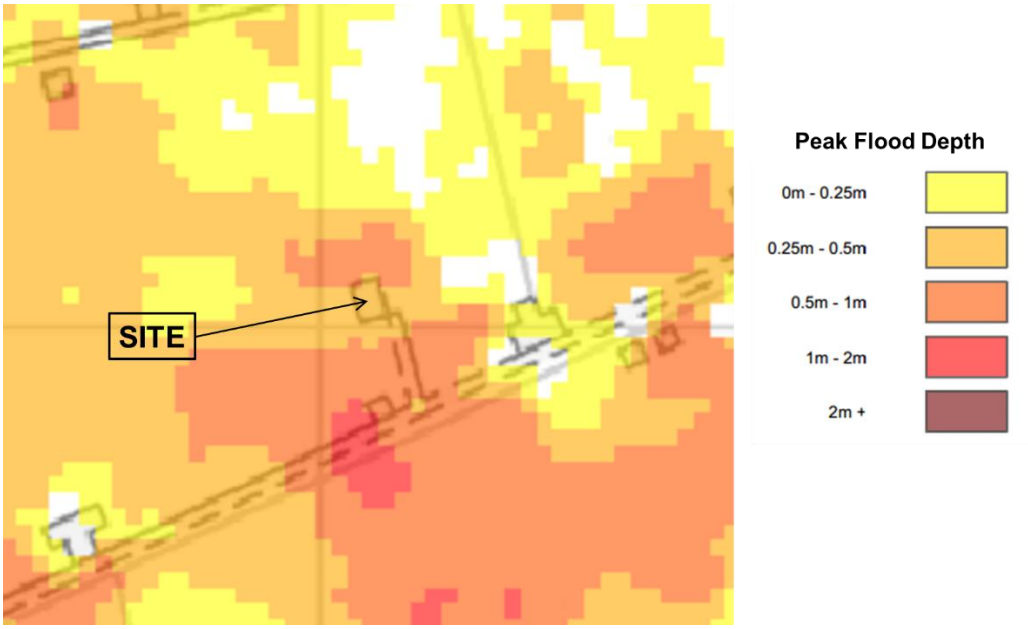
Climate Change

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 13 to 16). It is concluded that no extra mitigation measures are necessary to comply with the new guidance on climate change.

Conclusions

The risk of the level of the downstream section of the South Forty Foot Drain west of the site increasing above a level above 3.00m OD has been shown to be extremely low, and the risk of flood levels in this area north of Leaveslake Drove increasing above 2.80m OD in a 1 in 100 year event in 2115 is remote.

The SFRA indicates that between 250mm and 500mm of flooding could occur at the site in a 1 in 100 year event in 2115. The relevant part of the map is reproduced below.



It is assumed the above flood depths would be caused by a breach in the River Glen and the maximum predicted level of the flood water would be approximately 2.80m OD which is 100mm below the recommended ground floor level.

There is risk of water levels in IDB systems rising to a level above 2.80m OD in a 1 in 100 year event in 2115 can be considered to be unlikely.

Recommendations

In any area at risk of flooding, even though in this case the risk is extremely low, it is preferable that proposed buildings in a defended area should be of two story construction with all bedrooms at first floor level. This will provide a refuge for residents if the building were to become flooded and ensure there is no danger to residents when they are asleep.

All the buildings on the proposed development should have a ground floor level of 2.90m OD, which is at least 600mm above the level of the fields west and north of the site.

If bedrooms are proposed on the ground floor the Environment Agency recommends that the level of these rooms should be raised 300mm above the 1 in 1000 year flood level in 2115. Therefore the level of the proposed master bedroom on the ground floor should be a minimum level of 3.20m OD.

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.

The surface water from the roofs and hardstandings should be discharged into soakaways, these should be designed to conform with BRE Digest 365 and approved under the Building Regulations.

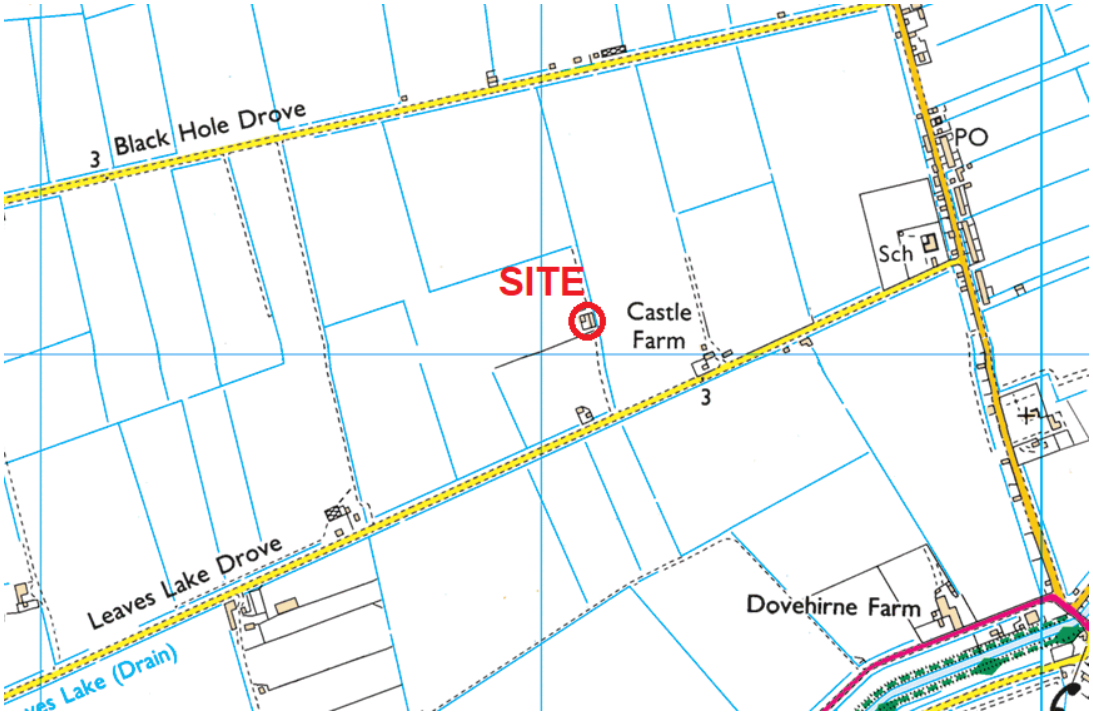
Occupiers of the property should register to receive automatic telephone flood warnings from the Environment Agency's Floodline Warnings Direct Service.

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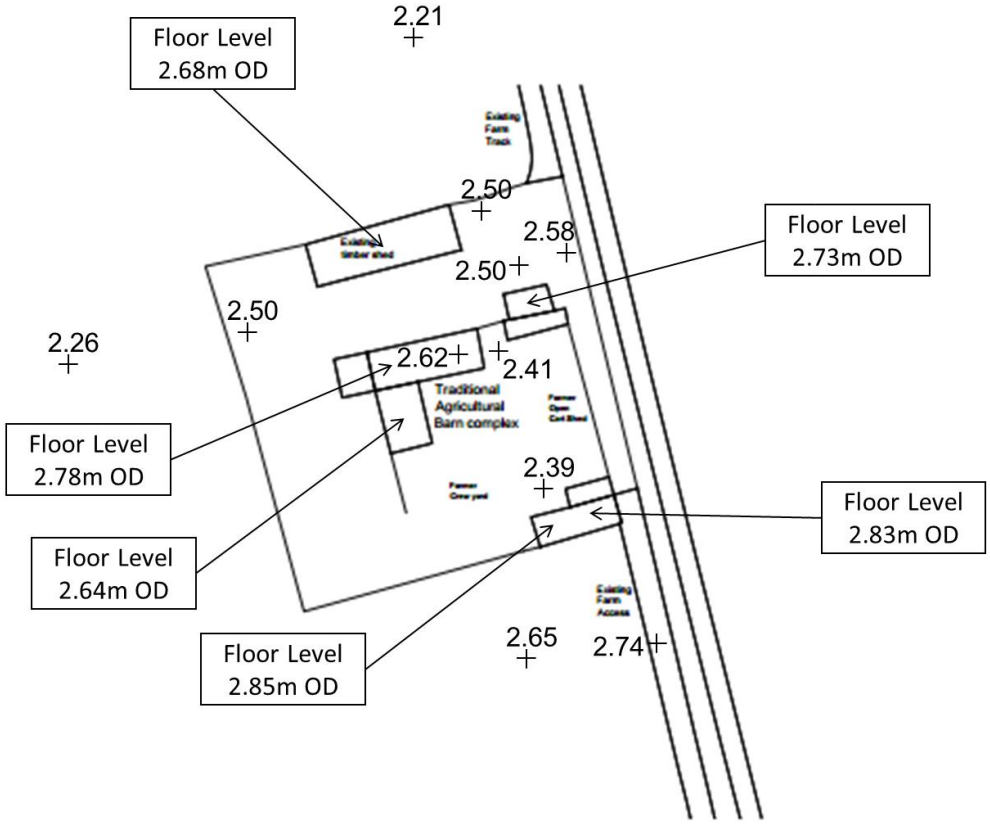
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30th November 2017

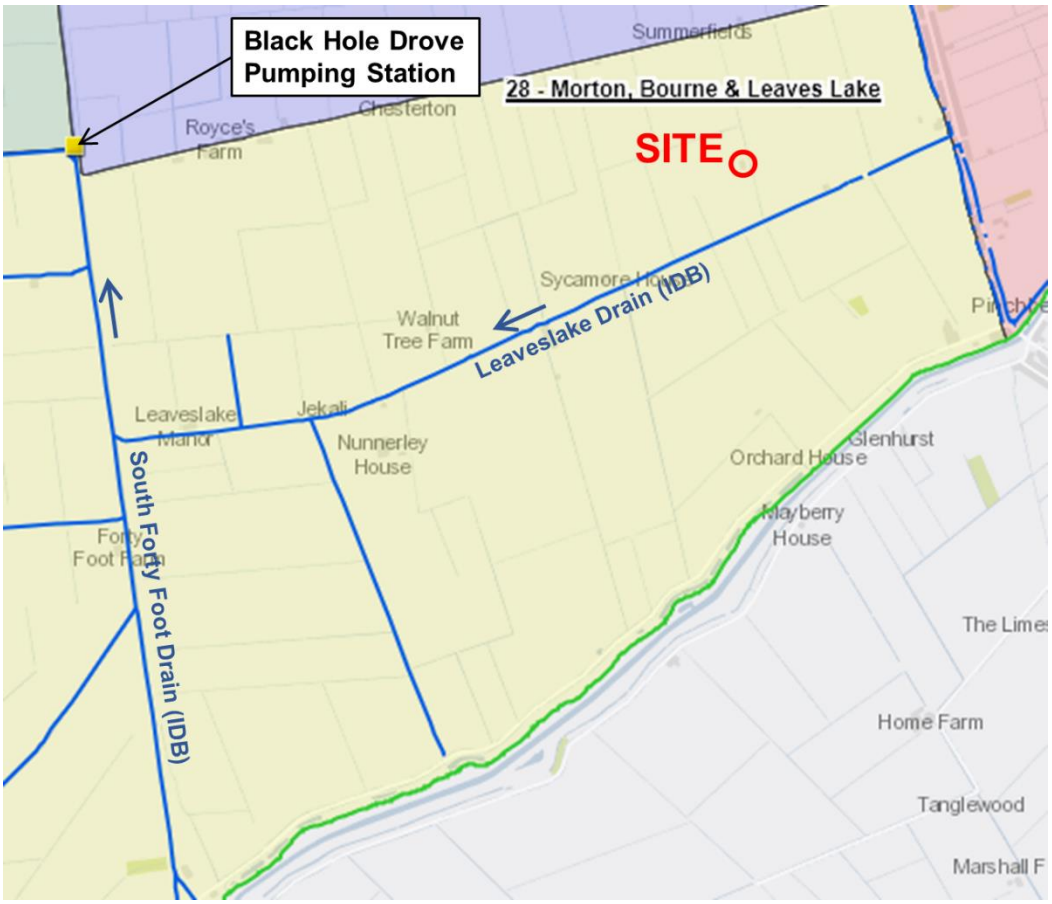
PLAN OF AREA



LOCATION PLAN WITH SITE LEVELS



PLAN OF 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 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'a

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

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

s been withdrawn (19

Revised 2016 EA Guidance

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

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

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

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

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

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

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

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

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

Effects on Predictions of Flood Risk in FRA

The FRA has identified the three sources of flooding where the new climate change recommendations could affect the predictions of flood levels in 2115 at the development site. These are flooding from the River Glen, from the South Forty Foot Drain, and from IDB drainage systems.

Fluvial Flooding from River Glen.

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 SHDC SFRA also has used this figure of 20%. The increase to 35% will not significantly change the conclusion in the SFRA of what might happen if a breach occurred in the bank of the River Glen. If there are additional flows along this part of the River Glen it will lead to

additional flooding in the upper reaches of the River system rather than significantly increasing water levels in the River Glen.

The upper end allowance predicting a 65% increase in flows above the 1 in 100 year predicted flows now needs to be considered. The River Glen is an embanked watercourse along the section between Pinchbeck and Bourne. The increases in rainfall leading to this would lead to significant flooding in the upper part of the River Glen Catchment. It is unlikely that there will be any significant increase in the water level in the River. Therefore the consequence will not be significantly different to the maps produced in the SFRA.

Fluvial Flooding from 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 SHDC SFRA also has used this figure of 20%. The increases to 35% and 65% will not significantly change the conclusion in this report. Any increase in flows in the Black Sluice Catchment would not lead to the water level in the South Forty Foot Drain rising significantly. It would lead to significant flooding in the catchment west of the South Forty Foot Drain.

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.

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 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 2.90m OD, is satisfactory.