EXTENSION TO GLASSHOUSE INCLUDING WATER STORAGE LAGOON AT COOKS ROAD, GOSBERTON, SPALDING, PE11 4PE.

FLOOD RISK ASSESSMENT



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This flood risk assessment has been prepared solely to support the planning application for a proposed glasshouse extension at 7 Cooks Road, Spalding. 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 for permission to construct additional glasshouses at Cooks Road, Gosberton, Spalding, PE11 4PE.

Prior to 2012 there was one glasshouse with an area of 2594 square metres on the site. In 2012 a planning application (reference H08-0460-12) was approved by the Council for a further three glasshouses east of the existing with a total area of 7782 square metres. However only 5,548 square metres were constructed in 2012 and therefore prior to 2025 there was a total area of 8142 square metres of glasshouses.

Recently a further 8901 square metres of glasshouses have been erected east of the existing. The planning application will request retrospective permission for these glasshouses and permission to erect a further 10,833 square metres of glasshouses in the future.

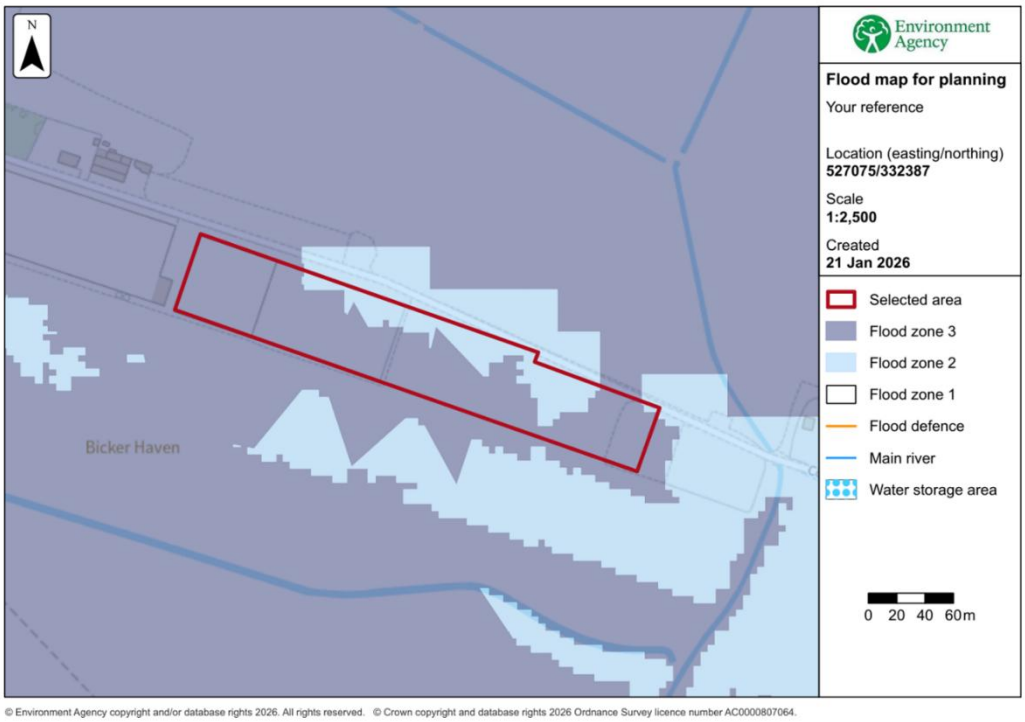
Permission will be also requested for a butyl lined water storage lagoon south of both the existing and proposed glasshouses.

The site is within Flood Zones 2 and 3 as shown on the Environment Agency's Flood Zone Map. These maps do not take into account existing flood defences.

The site is within the defended area of the South Holland District Council's Strategic Flood Risk Assessment (SHDC SFRA) map and is located in the Welland and Deepings 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.



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It can be seen that although the area is level part of the site is in flood zone 2 and part is in flood zone 3.

Application Site

The National Grid Reference of the site is 527075, 332290.

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

As the site is within a defended area the part of the site that is within flood zone 3 can be considered to be within flood zone 3(a), as defined in Table 1 of the Technical Guidance.

Applying the flood risk vulnerability classification in Table 2 of the Guidance, an agricultural glasshouse is classified as “less vulnerable”.

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

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 †	X	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	X	X	X	✓*

The above table indicates that “Less Vulnerable” developments are satisfactory in flood zones 2 and 3.

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 flood probability
	Peak Velocity ……. zero
For year 2115	Depth of flooding … zero
	Extent of flooding…. Low or medium flood probability
	Peak Velocity …… zero

The maps showing the residual flood hazards 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 …zero
	Extent of flooding .. Low or medium flood probability
	Hazard rating…… None
	Peak Velocity .. zero
For the year 2115	Depth of flooding … zero
	Extent of flooding .. Low or medium flood probability
	Hazard rating…… None
	Peak velocity ……. zero

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

Tables in the 2010 SFRA show the following details of the defence bank on the west side of the tidal section of the River Welland north of Surfleet Sluice at chainage 14.0km.

	2007	2055	2115
Peak 1 in 200 year extreme tide level	5.99m OD	6.32m OD	7.13m OD
Peak 1 in 1,000 year extreme tide level	6.32m OD	6.65m OD	7.46m OD

The crest levels of the defences, which are earth banks along this length, vary between 7.50m and 7.60 m OD. With a minimum crest level of 7.50m OD the freeboards are as follows:

	2007	2055	2115
Peak 1 in 200 year freeboard	1500mm	1180mm	370mm
Peak 1 in 1,000 year freeboard	1180mm	850mm	40mm

Tables in the 2010 SFRA show the following details for the predicted flood levels in the River Glen at chainage 2.0 km.

	2007	2115
Peak 1 in 100 year flood level	4.17m OD	4.65m OD
Peak 1 in 1,000 year flood level	4.25m OD	4.68m OD

The lowest levels of the earth banks on this section on the northern side of the River Glen are at a level of approximately 4.60m OD.

Information from the Environment Agency

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

	2007	2115
Peak 1 in 100 year flood level	4.23m OD	5.12m OD
Peak 1 in 1,000 year flood level	4.34m OD	5.26m OD

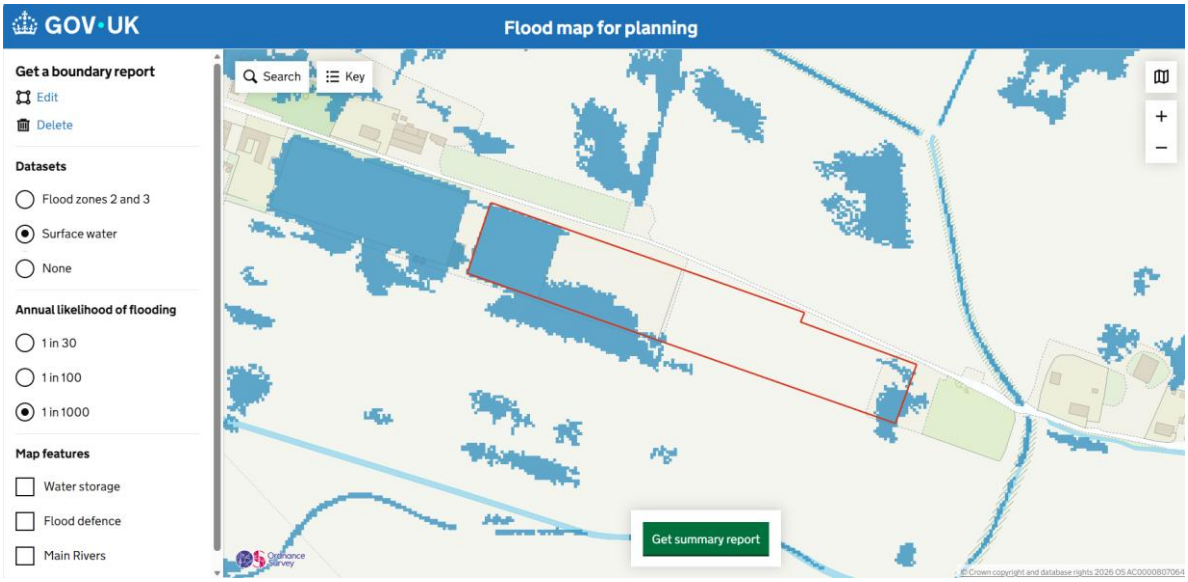
It is difficult to know how levels of above 5.00m OD would be able to occur as there are a number of bank lengths where the crest levels are less than 5.00m OD.

The Environment Agency state:-

- The predicted water levels are in channel levels and therefore may not represent the flood level on the flood plain, particularly where the channel is embanked or has raised defences.
- The allowance for climate change in the 2007 model was 20%.

Information on Surface Water Flooding on Environment Agency Website

The map below shows the predicted extent of surface water flooding in this area of Boston in a 1 in 1000 year event.



The above map predicts the areas coloured blue to be at risk from surface water flooding in a 1 in 1000 year event.

It can be seen that the mapping predicts that there may be surface water flooding on the eastern end of the glasshouses mainly where the existing glasshouses are located.

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 2.8 km north west of the tidal section of the River Welland, which has a tidal defence bank which is maintained by the Environment Agency.

The site is located 3.5 km north of the River Glen, which has a fluvial defence bank which is maintained by the Environment Agency.

The site is located 800 metres north of the Risegate Eau which is maintained by the Welland and Deepings IDB.

Existing Ground Levels

The existing ground levels in this area are approximately 4.0m OD.

Potential Sources of Flooding

The potential sources of flooding to the site are:-

1. Failure or overtopping of the tidal defences of the River Welland.
2. Failure or overtopping of the defences of the River Glen.
3. High water levels in IDB Drains
4. Blockages or problems in local surface water systems

1. Failure or overtopping of tidal defences of River Welland

The embanked tidal section of the River Welland is approximately 2.8km east of the development site. At this location the left bank of the River Welland is at a level of between 7.38m OD and 7.65m OD. Therefore in a 1 in 200 year event in 2115 there could be a small amount of overtopping during the few hours of high tide. However this flooding is unlikely to reach the site of the development.

There is extensive land north and south of Cooks Road which is approximately 1.0 metre lower than the level of Cooks Road which will flood before the development site is affected.

The maps of the predicted flooding in a 1 in 200 year tidal event in 2115 do not indicate any flooding will occur on the site. Therefore the risk of flooding from the tidal River Welland can be considered to be adequately mitigated.

2. Failure or overtopping of the defences of the River Glen

The SFRA gives predicted levels for the River Glen of 4.65m OD and 4.68m OD for the 1 in 100 year and 1 in 1000 year events in 2115. However the Environment Agency advise that the levels will be much higher at 5.12 and 5.26m OD for the 1 in 100 year and 1 in 1000 year events in 2115.

The levels of the earth bank on the north side of the River Glen are all approximately between 5.00m and 5.20m OD, with some lengths with much lower levels. Therefore it would seem very unlikely that maximum levels in the River Glen could actually rise to the levels above 5.00m OD predicted by the EA.

Peak water levels occur in the River Glen when the outfall into the tidal River Welland is tide locked. During this time the levels in the River Welland are higher than levels in the River Glen, even when the latter levels are very high. This closes the large timber doors at the sluices and prevents discharge from the River Glen into the River Welland for approximately 3 to 4 hours. Immediately upstream of the sluices is an area called Surfleet Reservoir where the area between the banks is much wider where excess water is stored.

In a 1 in 100 year event in 2115, assuming no bank raising is carried out along this section of the River Glen in the next 100 years, water would overtop the earth banks in numerous places between Surfleet and Bourne which would prevent river levels rising much above the levels predicted in the SFRA.

The SFRA does not predict any flooding at the development site in a 1 in 100 year event in 2115. There is extensive land north and south of Cooks Road which is approximately 1.0 metre lower than the level of the site of the proposed extension which will flood before the development site is affected.

Therefore the risk of flooding from the River Glen can be considered to be adequately mitigated.

3. High water levels in IDB Drains

The surface water from the existing glasshouses discharges into a dyke 200 metres south of the development and it is proposed that the surface water from both the existing and proposed glasshouses will discharge into the new storage lagoon immediately south of all of the glasshouses. When the storage lagoon is full the surface water will overflow into pipes which will discharge the excess into the storage dyke 200 metres south of the glasshouses. The flow from the dyke will be attenuated and discharge into the IDB Bicker Haven Drain, which flows west to east approximately 200 metres north of Cooks Road and then flows south to discharge into the Risegate Eau.

The water level in the Risegate Eau is controlled by Risegate Eau Pumping Station which is 3.5 km west of the development site. The pumps and motors are maintained in excellent condition by Welland and Deepings IDB, who have emergency plans arranged if there is a failure of the plant.

The Welland and Deeping 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 proposed development site would be unlikely to flood. The normal water level in the Risegate Eau is 0.00m OD at the outfall. The maximum design level in the Risegate Eau at Wargate Bridge, which is 1.5km south west of the centre of Gosberton, is 1.05m OD.

Therefore the risk of flooding from the main IDB system can be considered to be adequately mitigated.

4. Blockages or problems in local surface water systems.

The surface water from both the existing and proposed glasshouses will discharge into the proposed butyl storage lagoon south of the glasshouses. This water will be reused for irrigation in the glasshouses. Any additional rainwater will flow into pipes which will discharge into the dyke 200 metres south of lagoon. This will discharge into the IDB Bicker Haven Drain at a controlled rate. The proposed drainage system for the glasshouses will be detailed in a separate report entitled "Surface Water Drainage Strategy"

Extent of known Flooding

During the preparation of this assessment, no evidence was discovered of the site or any of the adjoining properties being flooded. This has been confirmed by a local resident who has lived in this area all her life.

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

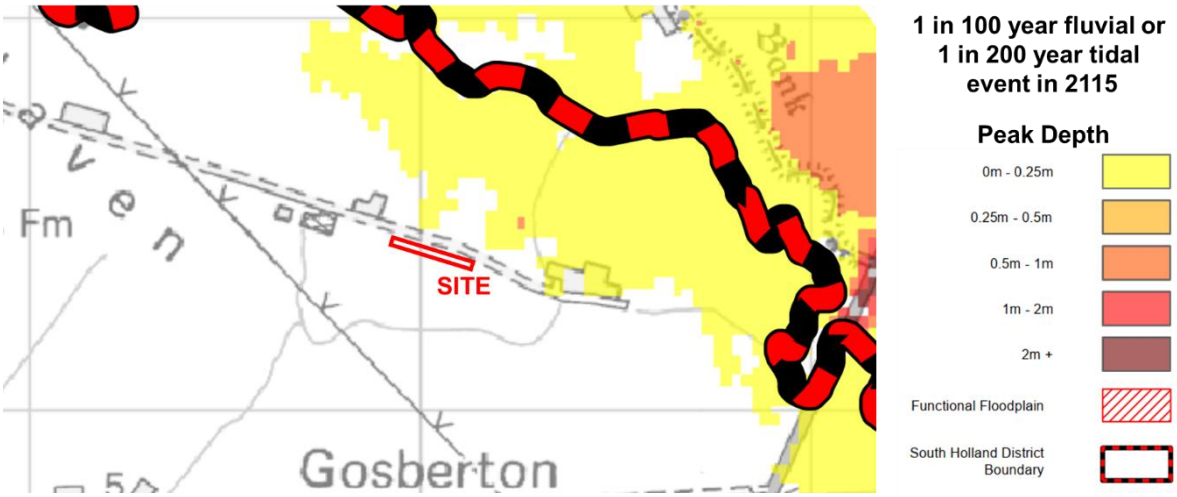
The risk of this happening in this case is low and the hazard from any flooding is also low.

Climate Change

The predictions of flood depths for this flood risk assessment use information in the SHDC SFRA which was produced in 2010, the South East Lincolnshire SFRA (March 2017) 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 12 to 15). It is concluded that no extra mitigation measures are necessary to comply with the new guidance on climate change.

Conclusions

There is a risk of flooding if there is a breach in the west bank of the tidal part of the River Welland or the north bank of the fluvial River Glen. However the map of the predicted depths of flooding in a 1 in 200 year tidal or a 1 in 100 year fluvial event shown on the next page indicates that the flooding will not extend as far as the site of the glasshouses south of Cooks Road in these events.



The risk of flooding from IDB drains can be considered low. If the pumping stations were to fail then the IDB have adequate arrangements to operate pumps with alternative motive power, or to bring in mobile pumps. If drains become full any flooding that occurs would happen very slowly and be unlikely to reach the floor level of the proposed building because there are large areas of land below 3.0m OD which will flood before any of the land adjacent to Cooks Road is affected.

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

Recommendations

Peter C Thorold should register with the Environment Agency's Floodline Warnings Direct Service. The company is likely to be already registered for this service.

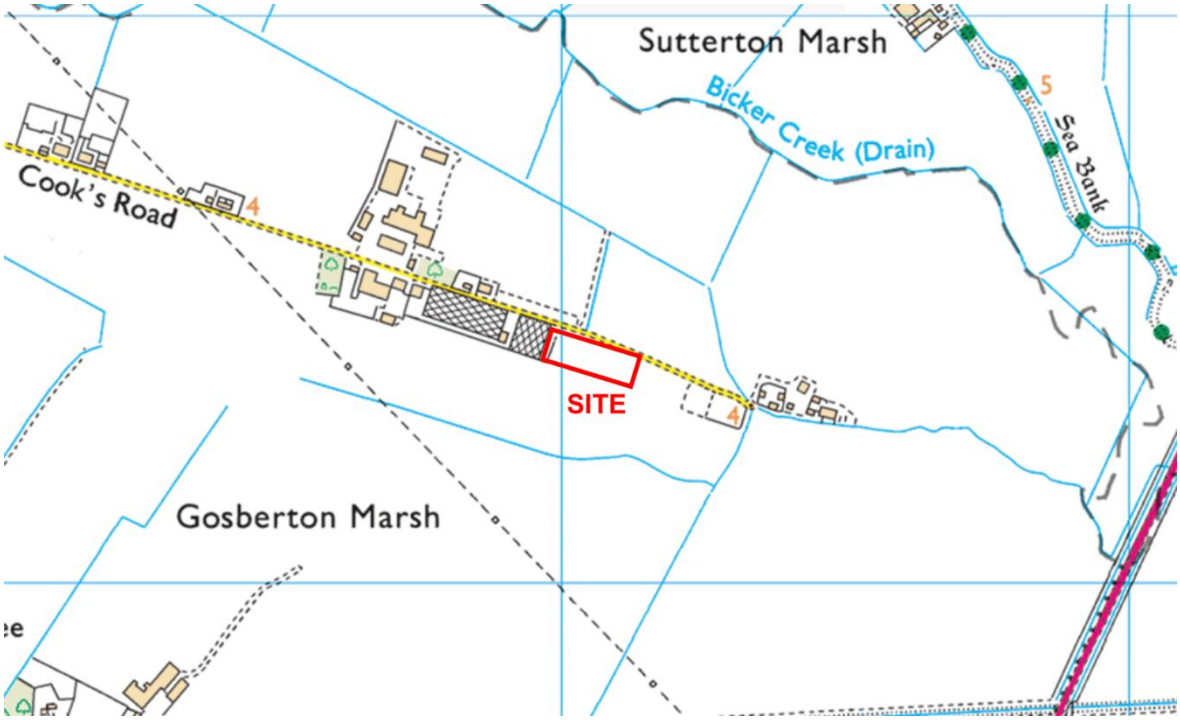
On site surface water drainage should be discharged into the new storage lagoon and as much as possible will be used for irrigation of plants in the glasshouses. Any excess rainwater will overflow into pipes which will direct the water into the storage dyke on the southern boundary of the field south of the glasshouses. A surface water drainage strategy has been written for this project which will be included with the planning application.

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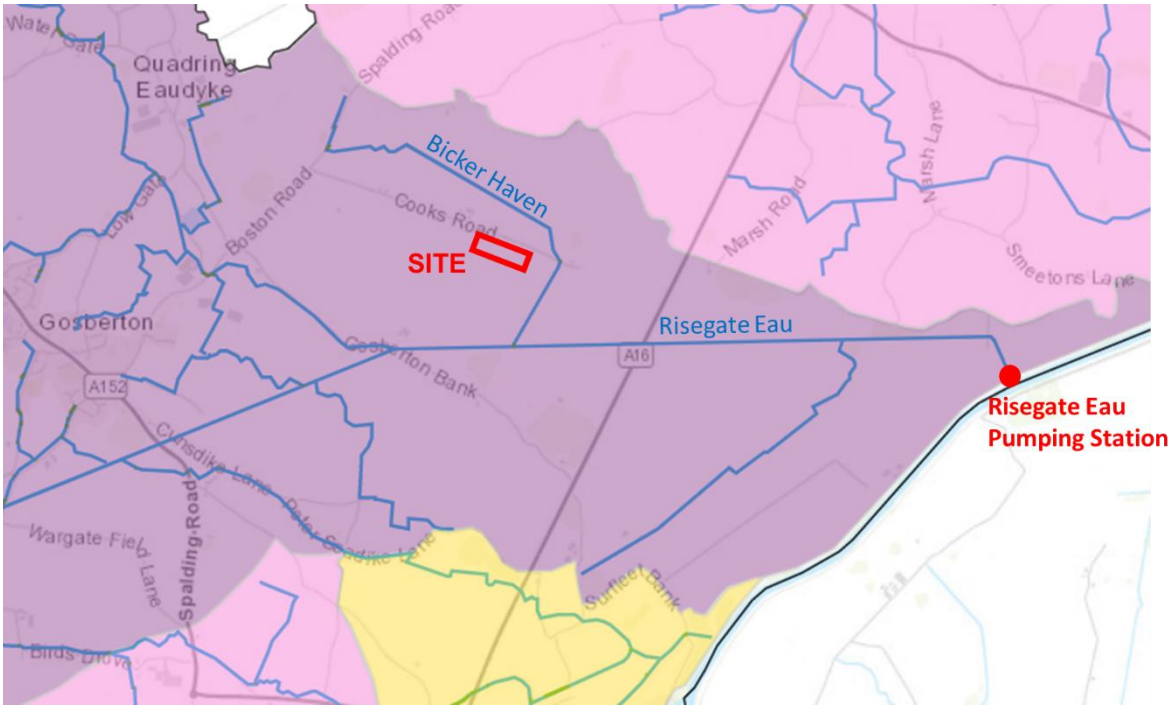
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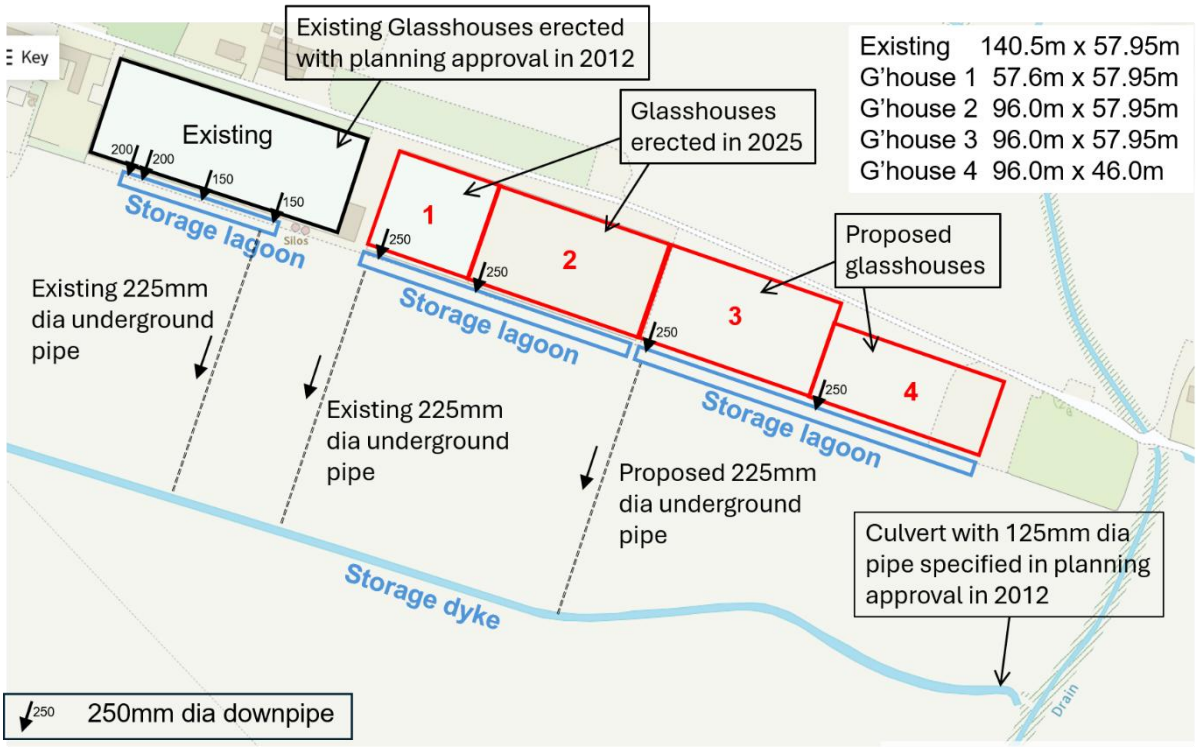
LOCATION PLAN



PLAN OF IDB DRAINAGE CHANNELS



PLAN OF GLASSHOUSES



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

The current peak river flow allowances for the Welland Management Catchment are as follows:

	2020's (2015 – 39)	2050's (2040 – 69)	2080's (2070 – 2115)
Upper End	22%	26%	53%
Higher central	10%	10%	28%
Central	5%	4%	17%

For less vulnerable development in flood zone 3(a) the central and higher central figures 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 possibilities of both tidal and fluvial flooding at this site. These will be addressed separately below.

Flooding due to failure of the Tidal defences

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 may have the effect of slightly 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 in the SHDC SFRA, the maps supplied by the Environment Agency or the conclusions in this FRA.

Flooding from the River Glen

Table 1 shown in the EA guidance gives peak river flow allowances for the upper end, higher central and central categories. As the development is in flood zone 3 and is classed as less vulnerable, the central allowance, which is 25%, should first 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.

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 higher central allowance predicting a 28% increase in flows above the 1 in 100 year predicted flows now needs to be considered. The River Glen is an embanked watercourse between Spalding and Bourne. 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.

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 central climate change allowance, which is 25%, should be considered. After considering the effects of this increase the higher central allowance, which is 28%, 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.

Welland and Deepings 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 Welland and Deepings 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, and the precautions recommended, will ensure that the proposed building will be safe in the future.