

PROPOSED INDUSTRIAL DEVELOPMENT AT PLATTS CLOSE
SPALDING, PE11 3JG
FLOOD RISK ASSESSMENT



View from south west corner of site

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 a development at Platts Close, 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

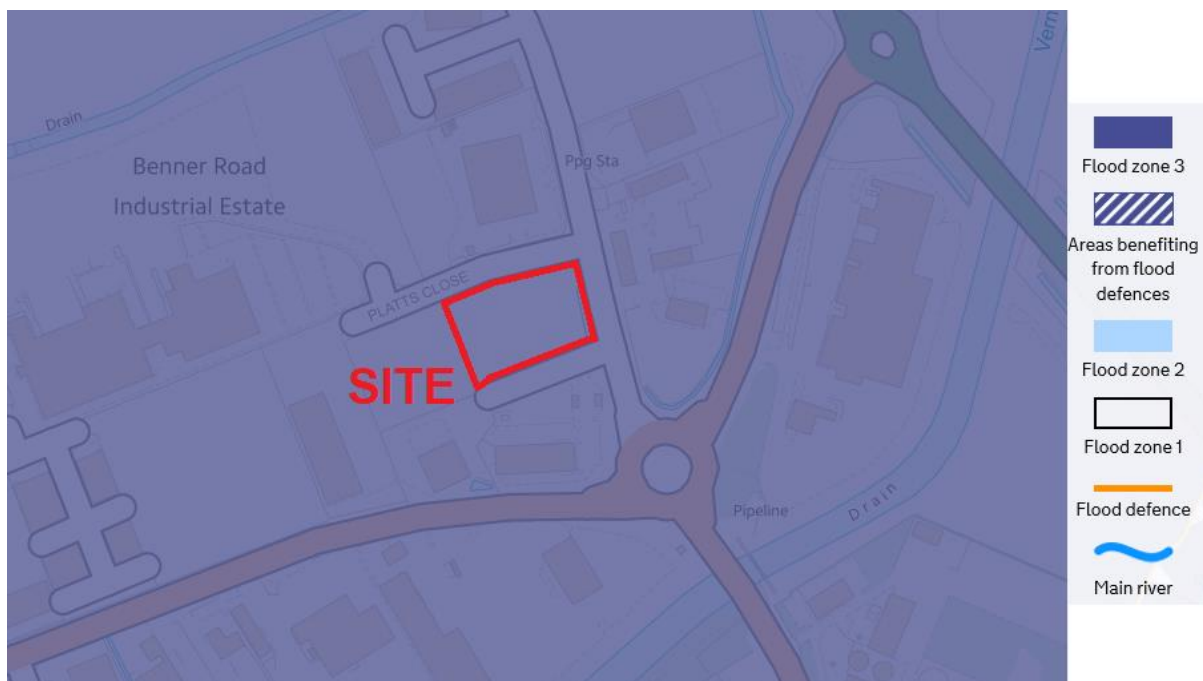
A planning application is due to be submitted to South Holland District Council for permission to construct a new industrial building on a site south of Platts Close, Spalding, PE11 3JG. The site is approximately 2 km north of Spalding, and is on the west side of the roundabout between the A151 and the A16 roads.

All of this site is within Flood Zone 3 as shown on the Environment Agency's Flood Zone map.

The Planning Application requires a flood risk assessment to be carried out as specified in the Practice Guidance to the National Planning Policy Framework Development and Flood Risk. The site is within a defended area as specified on 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 this area.



It can be seen that all of the site is in Flood Zone 3.

Application Site

The National Grid Reference of the site is 525900 325380.

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 proposed development 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, a development consisting of office accommodation and storage is classified as “less vulnerable”.

Table 3 of the Guidance is shown below:

<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 acceptable in flood zone 3(a).

Strategic Flood Risk Assessment

Consultants produced a Strategic Flood Risk Assessment (SFRA) for the South Holland District Council (SHDC) in 2010. This document provides details of the flood risk in the Council’s area. The South East Lincolnshire SFRA gives further guidance on the flood risk. Reference to the maps in this document give the following information for the flood risk and hazard at the site.

The maps in the 2010 SFRA illustrate the actual flood hazard 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 Nil

For year 2115 Depth of flooding ... 0 – 1.0 metre
 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 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 rating..... Less than 0.75 (Low hazard)

For the year 2115
 Peak Velocity .. 0 – 0.3m/sec
 Depth of flooding ... 0 – 1.0m
 Extent of flooding .. High
 Hazard rating..... 1.25 – 2.0 (Danger for most)
 Peak velocity 0 - 0.3m/sec

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

Maximum flood level and bank levels in the River Welland

Tables in the 2010 SFRA show the following details of the defence bank on the east side of the tidal section of the River Welland north of the A16 road bridge and 2.7km west of the development site, between chainage 19.8km and 20.8km.

	2007	2055	2115
Peak 1 in 200 year extreme tide level	5.98m OD	6.31m OD	7.12m OD
Peak 1 in 1,000 year extreme tide level	6.27m OD	6.60m OD	7.41m OD

With an average defence crest level between 7.80 and 7.90 m OD 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

Tables in the SFRA show the following details for the predicted flood levels in the River Glen at chainage 6.0 km.

	2007	2115
Peak 1 in 100 year flood level	4.36m OD	4.69m OD
Peak 1 in 1,000 year flood level	4.54m OD	4.75m OD

The level of the earth banks on this section of the south eastern side of the River Glen vary between 4.74m OD and 5.38m OD. Further north near Crossgate Bridge at chainage 5.6km the SFRA indicates that bank levels for a short length are as low as 4.30m OD.

The Wash banks are at least 20.0 km north of the site. The tidal defences are earth banks with an average level of 7.80m OD. The maximum predicted 1 in 200 year tide level in 2115 in the SFRA is 7.11m OD.

Tables in the SFRA show the following details for the predicted flood levels in Vernatt's drain at chainage 7.1 km.

	2007	2115
Peak 1 in 100 year flood level	3.86m OD	3.86m OD
Peak 1 in 1,000 year flood level	3.86m OD	3.86m OD

The level of the earth banks on this section of the southern side of Vernatt's Drain vary between 4.25m OD and 4.65m OD.

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 420 metres from the west bank of the tidal section of the River Welland which is maintained by the Environment Agency.

The site is located approximately 2.2 km from the east bank of the River Glen which is maintained by the Environment Agency.

The site is located approximately 200 metres north and west of Vernatts Drain which is maintained by Welland and Deepings IDB.

The major watercourses in the area are maintained by Welland and Deepings IDB.

Existing Ground Levels

The levels on the site are lower than the roads to the north, east and south of the site.

Ground levels on the site vary from around 3.40m OD in the north east corner to the lowest area towards the western boundary which is at 2.92m OD. Platts Close to the north falls from a level of 3.92 m OD at the north east corner of the site to 3.80 m OD further west and Elsom's Way east of the site is between 3.90 and 3.97m OD.

It is planned to locate the building on the north east corner of the site where levels are between approximately 3.40m OD and 3.25m 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.
2. Failure or Overtopping of Vernatts Drain.
3. High water levels in IDB drainage channels.
4. Localised flooding in the area.

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

The nearest section of the east bank of the tidal section of the River Welland is approximately 420 metres west of the site.

The maps of predicted flood depth supplied by the Environment Agency show that most of the site could suffer between 250mm and 500mm in depth following a breach in a 1 in 1000 year event in 2115.

Therefore raising floor levels of the proposed dwelling by approximately 600mm would provide adequate mitigation against this risk which can be considered to be extremely low.

2. Failure or overtopping of the River Glen

The predicted maximum 1 in 100 year water level as advised in the SFRA at the present time is 4.36m OD and the predicted 1 in 1000 year water level at the present time is 4.54m OD. These predicted levels are lower than most of the defence levels on this section of the bank of the River Glen which are all higher than 5.00m OD.

Predicted water levels with an allowance of 20% for climate change as advised in the SFRA are 4.69m OD for the 1 in 100 year event and 4.75 OD for the 1 in 1000 year event. These are still below the defence levels.

The SFRA gives details of top levels of the defences of the River Glen and the following top levels are given for the earth bank on the south east bank between Cricket Bat Willows and Crossgate Bridge, just downstream of Pinchbeck.

Chainage	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0	6.1	6.2
Level	4.96	4.28	4.28	4.74	4.38	5.13	5.09	5.38	4.74	4.74

It can be seen that before any flooding occurs near Pinchbeck water will be overflowing the above section of bank in a 1 in 200 year event in 2115.

Although the actual risk is extremely low there is still a residual risk if the defences were to fail directly west of the site. The River Glen has a 1 in 100 year standard of service at the present time, which will decrease in the future unless work is carried out by the EA to raise banks. However the most common reason for breaches is overtopping of earth banks. This type of failure is more likely to happen at locations to the east and west of Pinchbeck where the earth banks are lower.

Adequate mitigation will be provided against this source by raising the floor levels of the proposed building and evacuation if flooding is predicted.

3. Failure or overtopping of the banks of Vernatt's Drain

The SFRA states that the maximum predicted flood level in Vernatt's Drain is 3.87m OD for a 1 in 1000 year event in 2115. As the crest level of the banks are at a level of 4.31m OD, the risk of overtopping is extremely low.

There is however the risk that the banks could fail when water levels are very high and this could cause flooding at the location of the proposed development. If a breach were to occur in Vernatt's Drain with water levels at the maximum predicted level of 3.87m OD Welland and Deepings IDB would be able very quickly to reduce water levels in the Drain by switching off a number of the pumps at Pode Hole Pumping Station. This would reduce the consequence of flooding from this source.

Adequate mitigation will be provided against this source by raising the floor levels of the proposed building and evacuation if flooding is predicted.

4. 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. Welland and Deepings IDB maintain a system of sluices, pumping stations, and drainage channels which convey surface water into the River Welland and the Wash to control water levels throughout the Welland and Deepings IDB area.

The site is within of the catchment area of Pinchbeck Marsh Pumping Station in the Welland and Deepings IDB. There is an IDB maintained drain approximately 150 metres north of the site called Blue Gowt No 1 which is the main pump drain leading to the pumping station. It is assumed there is an Anglian Water surface water system that conveys the surface water from this area directly into the IDB drain.

Pinchbeck Marsh Pumping Station is operated and maintained in excellent condition by Welland and Deepings IDB and the likelihood of flooding due to this source is low. 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. Welland and Deepings 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.

The channels maintained by Welland and Deepings 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.

Therefore the risk of flooding from IDB drainage channels can be considered to be extremely low.

5. Localised Flooding in the area

A suitable surface water disposal system will be designed for the development site which will dispose of the water into soakaways or attenuate the flows before they are discharged into the surface water system in this area, subject to the consent from Anglian Water and Welland and Deepings IDB.

The raising of the ground floor levels by at least 300mm above ground level should adequately mitigate the risk 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 from the 2010 South Holland DC SFRA, South East Lincolnshire SFRA (which was issued in March 2017 and the Environment Agency. 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 19 to 22). 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 determine the adequacy of the plan.

As the development is in flood zone 3 and the maximum predicted flood hazard is 1.25 – 2.0 (Danger for some) reference should be made to Category D4 which shows the following advice.

The Environment Agency recommends that the following mitigation is incorporated into the development.

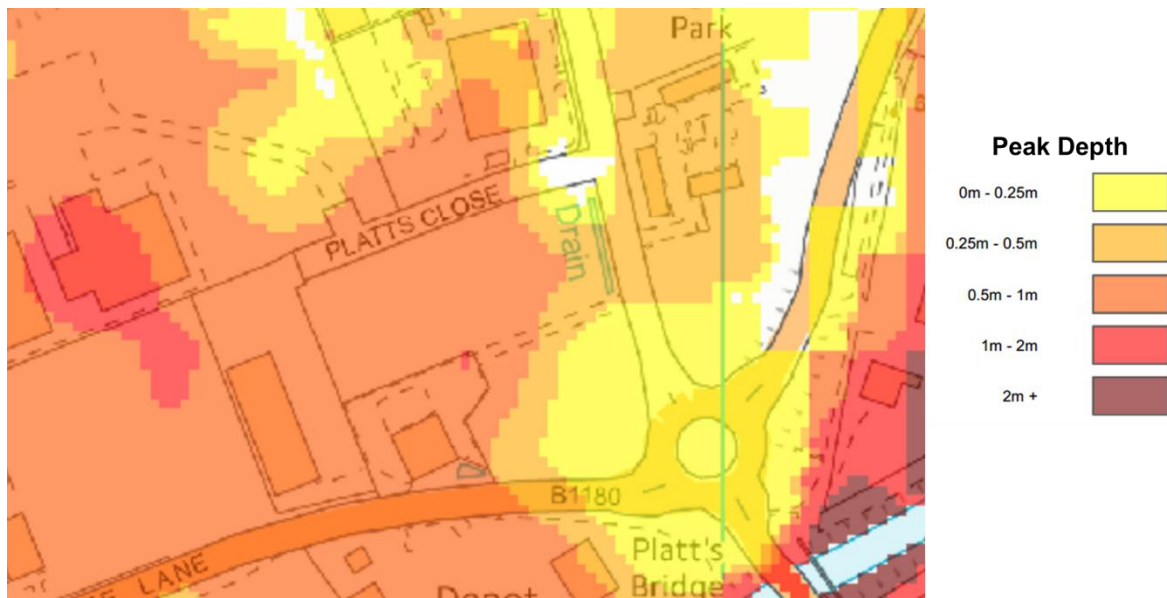
The finished floor levels should be raised as high as practicable (minimum 300mm above ground level). The Environment Agency recommends that appropriate mitigation measures/flood resilience techniques are incorporated into the development. Please refer to the following document for information on flood resilience and resistance techniques to be included: 'Improving Flood Performance of New Buildings - Flood Resilient Construction' (DCLG 2007).

Single storey buildings should be built with FFL's above the predicted flood depth (refer to the relevant 2115 1% fluvial or 0.5% tidal Max Depth Map). If this is not practicable an area of safe refuge will need to be provided or an appropriate flood

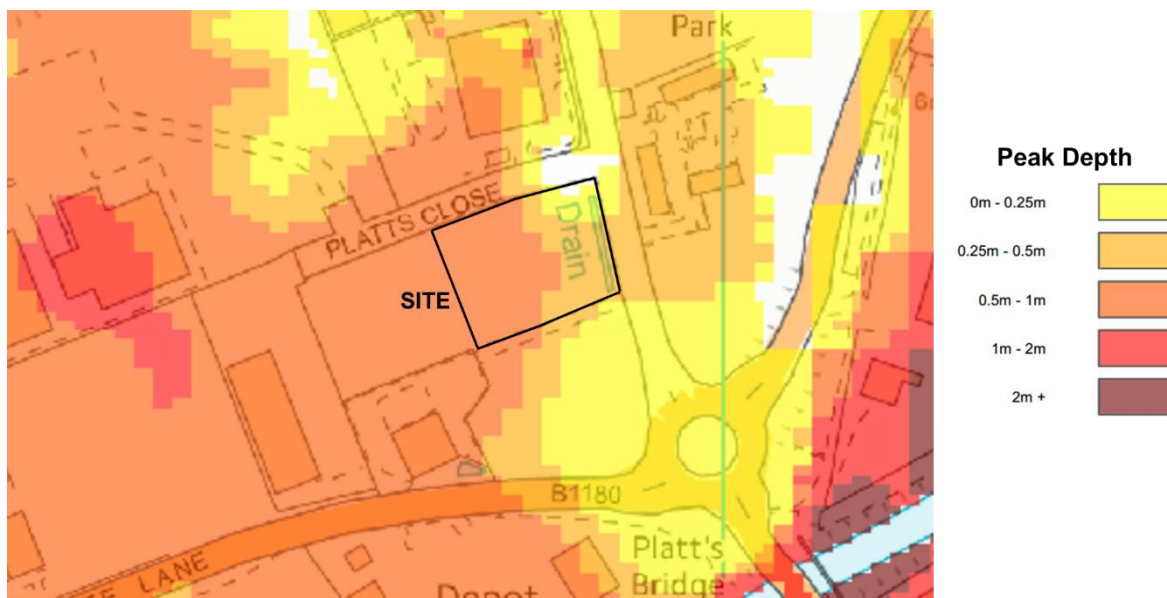
warning and evacuation plan will need to demonstrate how this risk will be managed. It is the responsibility of the Local Planning authority to determine the adequacy of the plan.

Summary of Predicted Flood Risk to the Site

The plan (shown below) of predicted depths of flooding in a 1 in 100 year fluvial or 1 in 200 year tidal event in 2115 shows flood depths of between zero and 1.0 metre on the site of the proposed development.

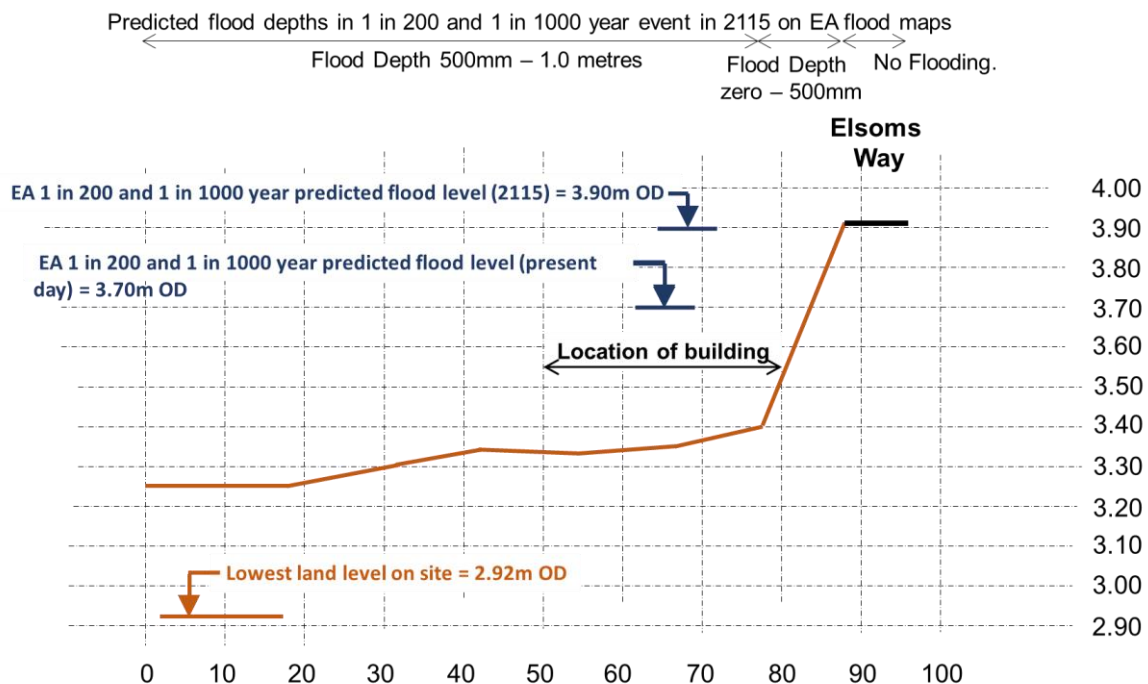


The plan (shown below) of predicted depths of flooding in a 1 in 1000 year fluvial or tidal event in 2115 shows flood depths of between zero and 1.0 metre on the site of the proposed development.



It can be seen that both maps indicate identical predicted flood depths on the site.

Using the topographical study a cross section can be drawn across the site, which is shown on the next page.



The South East Lincolnshire Advice Matrix recommends that the ground floor level of the proposed building should be a minimum of 300mm above the existing ground level on the site. If this ground level is taken to be 3.40m OD then the minimum level would be 3.70m OD. This level is the maximum predicted flood level for the present day.

If we assume that the life of this industrial building would be 50 years, and the developer wanted to ensure that the floor level would be above the maximum predicted flood level in fifty years time, then the ground floor level should be raised to 3.85m OD, which is 50mm above the predicted flood level, and approximately 450mm above the existing ground level.

The raising of floor levels to a level of 3.85m OD would provide greater mitigation against surface water flooding on the site.

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

Recommendations

In any area at risk of flooding it is preferable that the offices in new industrial buildings should have two storeys. This is to provide a refuge for workers if the buildings were to become flooded after a major breach of the tidal bank.

The matrix used by the planning authority advises that it would be acceptable for the ground floor of the building to be raised by 300mm above ground level. As the existing ground level is around 3.40m OD then the finished ground floor level would be 3.70m OD.

The developer may wish to consider raising the finished ground floor level to 3.85m OD, which would be approximately 450 mm above the ground level in this area of the

site, so that it is above the predicted flood level in a 1 in 1000 year event in fifty years time, which is assumed to be the predicted life of this building.

The owner and the operator of the new building should register with the Environment Agency's Floodline Warnings Direct service. They should also draw up a flood plan for the site which should include arrangements to evacuate the site if a flood alert or a flood warning is received.

Rainwater from the roofs of the buildings should be discharged if possible into soakaways and these should be designed to BRE Digest 365 and approved under Building regulations. Hardstandings around the buildings and access roads should be constructed with permeable paving. If soakaways and permeable paving are found to be unadvisable in this area then the surface water should be discharged into the Anglian Water surface water drainage system in this area, subject to the agreement of Anglian Water.

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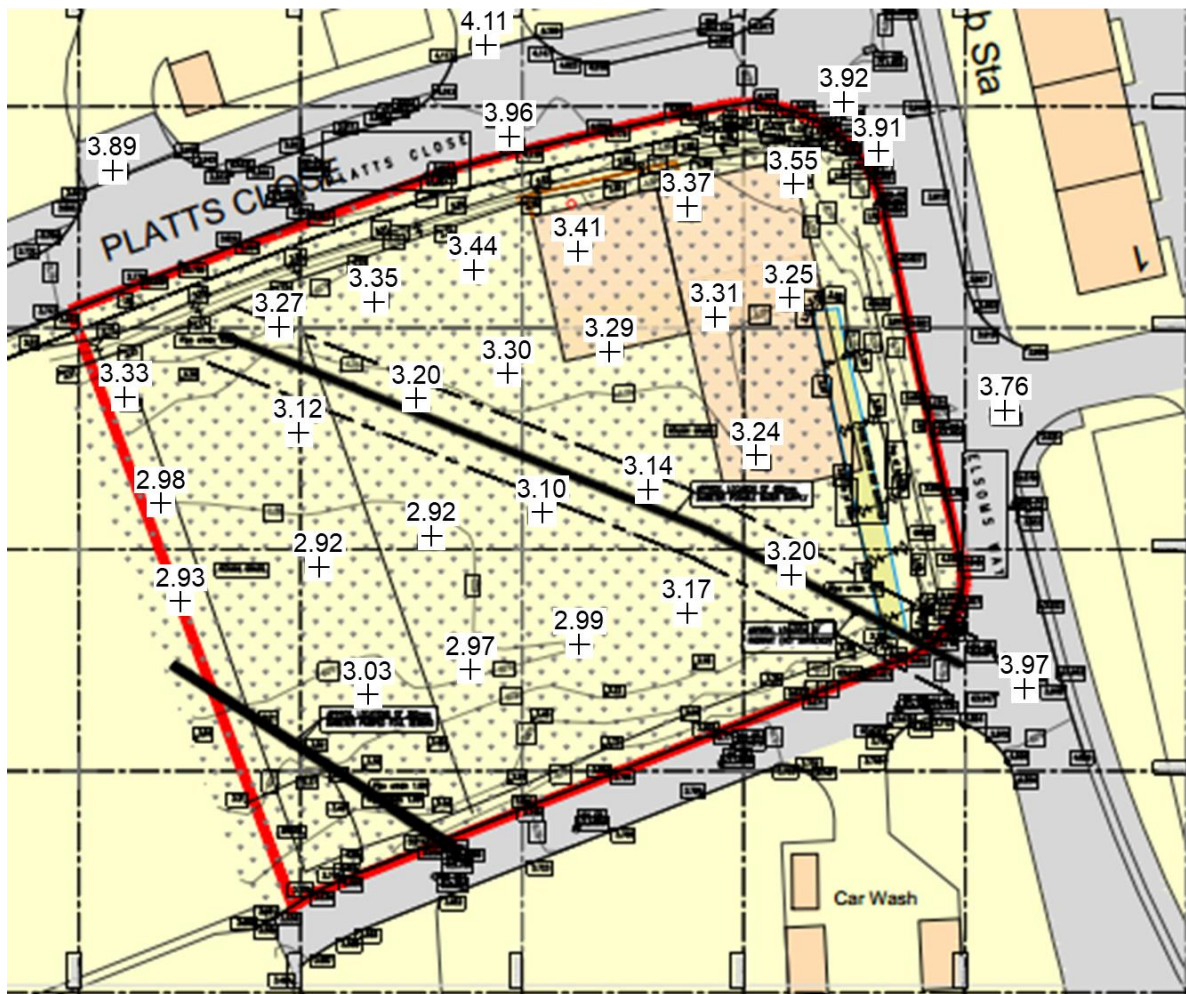
stuart.hemmings@btinternet.com

3rd January 2020

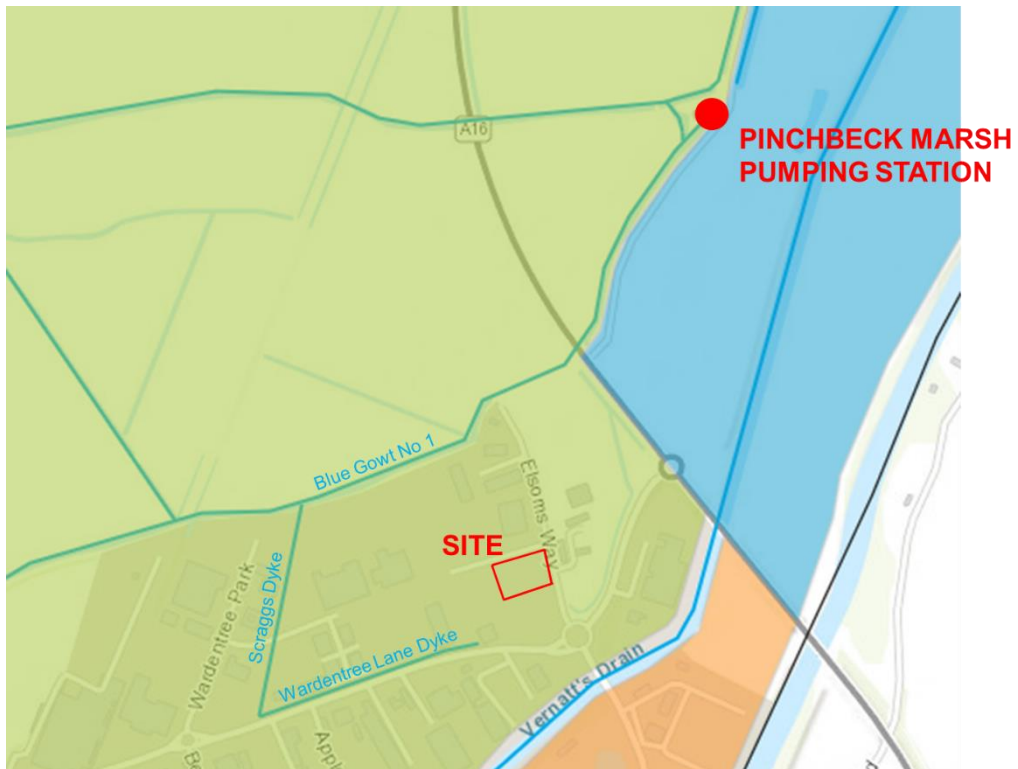
LOCATION PLAN



PLAN OF SITE LEVELS



PLAN OF IDB DRAINS



PROPOSED 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
- South East Lincolnshire SFRA (March 2017)

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 and 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%

South East Lincolnshire SFRA (March 2017)

The SE Lincs SFRA States that all FRA's should refer to the revised guidance issued by the EA in 2016.

Effects on Predictions of Flood Risk in FRA

1) Flooding from Tidal River Welland

The FRA has identified tidal flooding as one source where the new climate change recommendations could affect the predictions of flood levels in 2055 and 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

As the likely life of the building is fifty years it can be seen that the revised guidance increases the maximum allowance for sea rise in 2115 by 13mm for the maps in the SFRA and 40mm for maps issued by the Environment Agency. The small increase shown above will not change the EA map showing predicted flood depth significantly and the mitigation recommended of raising floor levels by 300mm is considered satisfactory.

2) Fluvial Flooding from the River Glen.

Fluvial flooding from the River Glen is considered to be the major flood risk to the site. 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.

Maximum flood levels in the River Glen will not be increased by the increase in flows projected in the new climate change allowances. If flows increase by between 35% and 65% in this river system it will have the effect of increased flooding over the long sections of bank between Bourne and Surfleet Reservoir and the maximum levels will not increase significantly. Therefore the residual peak flood depths predicted in the SFRA will not be increased by a significant amount.

3) Flooding from the IDB drainage system

As the development is in flood zone 3 and is classed as less vulnerable, the central climate change allowance, which is 35%, should firstly be considered. After considering the effects of this increase the higher central, 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.

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, with the recommendation that the floor levels should be raised a minimum of 300mm above the existing ground level, is satisfactory.