PROPOSED DEVELOPMENT BEHIND 40 KNIGHT STREET, PINCHBECK, SPALDING, PE11 3RB

FLOOD RISK ASSESSMENT



View from southern corner of the site

S M Hemmings B Sc C Eng MICE MIWEM,

69 Charlotte Way

Peterborough

PE3 9ER

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

Introduction

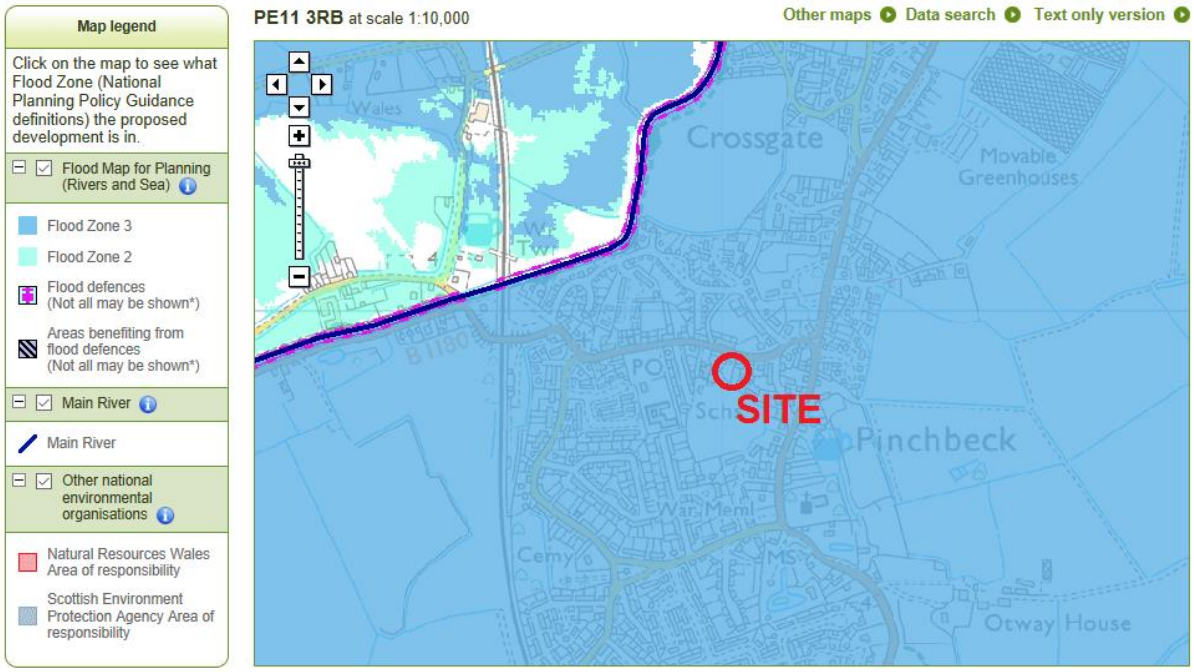
It is proposed to demolish the existing industrial buildings and construct residential housing on a site to the rear of 40 Knight Street, Pinchbeck, Spalding, PE11 3RB. The site is situated approximately 3.0 km north of Spalding.

The site is within 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 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 site is located 340 metres from the River Glen. The National Grid Reference of the site is 524010 325890.

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 dwelling houses 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.

As can be seen from the map on page 2 of this report the whole of this area of Pinchbeck and north Spalding is in Flood Zone 3. Therefore it would be difficult to find a similar site for development 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 of Pinchbeck. The

safety of the development will be delivered by ensuring the floor level of the proposed new dwelling 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. The site of this development can be considered as a windfall site within an existing residential area and as such is more sustainable than developing on greenfield land. There is a requirement for further land to be brought forward and used for residential development to enable the Council to meet the RSS and Structure Plan requirement for 2021.

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 flood risk and hazard at the site for the 1% fluvial event and 0.5% tidal event.

The maps illustrate the actual flood hazard which is as follows:

For the present day Depth of flooding … 0 – 500mm

Extent of flooding ... High

Flood Hazard……Significant

Peak Velocity ……. 0 – 0.1m/sec

For year 2115 Depth of flooding … 500mm – 1.0m

Extent of flooding …High (starting ½ hour after event)

Flood Hazard……Significant

Peak Velocity …… 0 – 0.1m/sec

The maps also illustrate the residual flood hazard which is as follows:-

For the present day Depth of flooding …500mm – 1.0m

Extent of flooding .. High

Flood Hazard……Significant

Peak Velocity …… 0 – 0.1m/sec

For the year 2115 Depth of flooding …500mm – 1.0m

Extent of flooding .. High

Flood Hazard……Significant

Peak Velocity …… 0.1 – 0.25m/sec

Reference to the maps in the SFRA give the following information for the residual flood risk and hazard at the site for the 0.1% fluvial event and tidal event.

For the year 2115 Depth of flooding …500 – 1.0m

Extent of flooding .. High

Flood Hazard……Significant

Peak Velocity …… 0.1 – 0.25m/sec

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

Tables in the SFRA show the following details of the defence bank on the west side of the tidal section of the River Welland north of Fulney Lock at chainage 22.0km.

	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	6.32m OD	6.65m OD	7.46m OD

The crest levels of the defences, which are earth banks along this length, vary between 6.97 and 7.30 m OD. With a minimum crest level of 7.00m OD the freeboards are as follows:

	2007	2055	2115
Peak 1 in 200 year freeboard	1020mm	690mm	-120mm
Peak 1 in 1,000 year freeboard	680mm	350mm	-460mm

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.

Tables in the SFRA show the following details for the predicted flood levels in the River Glen at chainage 6.3 km.

	2007	2115
Peak 1 in 100 year flood level	4.38m OD	4.70m OD
Peak 1 in 1,000 year flood level	4.56m OD	4.77m 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 west towards the railway bridge the SFRA indicates that there is no raised defence and bank levels vary between 4.74m OD and 5.04m 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.

	2007	2115
Peak 1 in 100 year flood level	4.33m OD	5.12m OD
Peak 1 in 1,000 year flood level	4.50m OD	5.30m OD

The flows in the River Glen in the same events in cubic metres / second are as follows.

	2007	2115
Peak 1 in 100 year fluvial flood flows	32.08	40.21
Peak 1 in 1,000 year fluvial flood flows	39.59	49.37

The predicted flood levels for 2115 seem to have been computed ignoring any effect of overtopping that will occur between Bourne and the outfall once the river levels rise above 4.80m 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 340m south of the River Glen which is maintained by the Environment Agency.

The site is located approximately 2.4 km from the tidal section of the River Welland, which is maintained by the Environment Agency.

The site is located 2.0km north of Vernatt's Drain which is maintained by Welland and Deepings IDB.

There are additional smaller watercourses in the area that are maintained by Welland and Deepings IDB.

Existing Ground Levels

The levels on the site generally are between 3.10m and 3.30m OD, with a low level of 2.99m OD in one location. The floor level of the existing house (No 40 Knight Street) is approximately 3.4m OD, and the level of Knight Street north of the site is 3.61m OD. The floor level of the existing buildings on the site is 3.19m OD.

A topographical survey has been carried out and the plan with all the levels will be submitted with the planning application. A plan showing a summary of these ground levels on the site is shown on page 14 of this report.

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 the River Glen.
3. Failure or overtopping of the banks of the Vernatt's Drain.
4. Failure of Pinchbeck Pumping Station (IDB).
5. Blockages in IDB drains or culverts
6. Surface Water Flooding

1. Failure or overtopping of tidal defences

The tidal River Welland is 2.4km east of the site. The predicted levels in this watercourse show that the defences will be overtopped in a 1 in 200 year event in 2115. There is a section of the western bank of the tidal River Welland 500 metres in length between Marsh Road Sluice and the power station where the SFRA advises that the bank levels are only 7.00m OD. North of this section the bank levels are all higher than 7.50m OD. If a breach occurred in the west bank of the tidal Welland water would flow westwards and would flow into Vernatt's Drain. This will hold up the flow until the water level reaches 4.25m OD then water would flow out of Vernatt's Drain and start to flow westwards towards the development site.

Therefore it is very unlikely that flood water from this source would reach and cross Church Street and cause flooding to Pinchbeck and the risk of flooding from this source is extremely low.

It is considered that the precaution of significantly raising floor levels will adequately mitigate the risk of flooding to the building from this source.

2. <u>Failure or overtopping of the River Glen</u>

The predicted maximum 1 in 100 year water level as advised in the SFRA at the present time is 4.32m OD and the predicted 1 in 1000 year water level at the present time is 4.47m OD. These predicted levels are lower than 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 4.91m OD for the 1 in 100 year event and 4.98 OD for the 1 in 1000 year event. These are still below the defence levels.

The latest advice from the Environment Agency is that the predicted level in a 1 in 100 year event in 2115 will be 5.12m OD.

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	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5
Level	4.42	4.59	4.43	4.35	4.37	4.39	4.96	4.28	4.28

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 in 2115.

Although the actual risk is extremely low there is still a residual risk if the defences were to fail directly north 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.

This source of flooding is the greatest risk to the site, and the hazards will be reviewed later in this report.

3. <u>Failure or overtopping of the banks of Vernatt's Drain</u>

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.

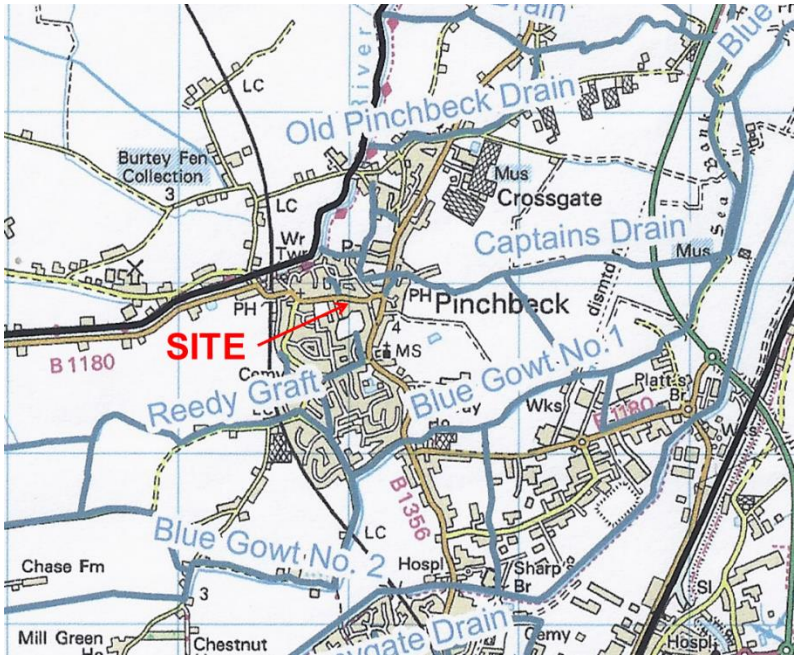
There is however the risk that the banks could fail when water levels are very high and this could cause flooding at the location of the proposed development. However the Welland and Deepings IDB would monitor the situation and reduce the flow in the

Drain by switching off the pumps at Pode Hole Pumping Station which will reduce the risk of very high levels of flood water from occurring.

It is considered that the precaution of significantly raising floor levels will adequately mitigate the risk of flooding to the building.

4. Flooding from the IDB Drainage System

The site is drained by dykes and IDB drains flowing southwards which discharge into the Blue Gowt No 1 Drain which is located on the south side of Market Way. This is maintained by Welland and Deepings IDB who have stated that the design 1 in 100 year water level in this watercourse south of the development site is predicted to be 1.25m OD. The drain at this location flows either eastwards to Pinchbeck Pumping Station or westwards towards Pode Hole Pumping Station. W & D IDB have stated that although all of this system operates well at the present time if more development is approved in the area further improvements will be carried out to ensure that the standard of drainage is maintained in the future. A plan of the IDB drains around Pinchbeck is shown below.



If a failure occurred in any part of the IDB system levels would rise in the drainage channels and eventually lower agricultural land outside Pinchbeck would start to flood. If the situation continued, which is unlikely, some flooding of lower areas in Pinchbeck could start to take place. However this would happen over a period of at least 24 hours and residents in the area would have adequate time to assess the situation and take appropriate action.

Drainage channels maintained by the Welland and Deeping IDB generally have a 1 in 10 year standard with up to 1.0 metre of freeboard, which generally provides between 1 in 50 and 1 in 100 year standard against flooding.

The risk of water levels rising to above 3.00m OD in the IDB drain are remote but as the average land levels in the area are lower than 3.00m OD a large area of land would be flooded before the proposed development was affected.

Therefore this source of flooding can be considered to be extremely low.

5. Failures of IDB Pumping Stations

As stated above the water in the Blue Gowt Drain can either flow to Pode Hole Pumping Station to the west or to Pinchbeck Marsh Pumping station to the east.

Pode Hole Pumping Station is the main pumping station operated by W & D IDB, and there are both diesel and electrically powered pumps available in the pumping station. All of these pumps are kept in very good order by the IDB and the scenario of no pumping capacity being available at Pode Hole is remote.

The original pumps at Pinchbeck Marsh had a capacity of 1.5 cumecs, and the new part of the pumping station built approximately five years ago added a further 1.5 cumecs of capacity. The catchment area that the pumps serve is 850 hectares.

Therefore the risk of very high water levels occuring in IDB drains due to the failure at pumping stations can be considered to be remote.

6. Surface Water Flooding

There is a risk that surface water that has been discharged from roofs, roads or hardstandings on the site could accumulate and flood some of the dwellings on the site.

There is also a risk of the dyke immediately south of the site becoming blocked and causing flooding on the site. However any flooding from this source is unlikely to be high as flood water will also flow onto the field behind which is at the same level as the site.

The raising of floor levels above the level of Knight Street will ensure that the risk of flooding from this source is adequately mitigated.

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.

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 River Glen.

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 this FRA. The effects of these new recommendations are considered in Appendix A of this report (pages 15 to 18). It is concluded that no extra mitigation measures are necessary to comply with the new guidance on climate change.

EA Recommendations

For two story developments:

- *In area where the SFRA hazard mapping shows 500mm – 1.0m:*
  FFL should be set 1150mm above ground level, with flood resilient construction measures incorporated to a minimum height of 300mm above FFL.

Conclusions

The map in the SFRA showing the flood depths in a 1 in 200 year coastal or a 1 in 100 year fluvial event in 2115 predicts that the maximum depth of flooding on most of the site will be between 500mm and 1.0m. However the northern part of the site as it slopes up to the road, and the road itself is shown to only be subject to flood depths of up to 500mm. This map is shown below.



By referring to the above plan and the plan showing site levels it can be concluded that the predicted level of flood water following a breach of the banks of the River Glen in a 1 in 100 year fluvial event in 2115 is 3.80m OD. By adding another 200mm to take account of the accuracy of the prediction and possible very small increases due

to revised climate change guidance it is recommended that the proposed ground floor levels of the residential development should be 4.00m OD. It is presumed that the major flood risk to the site is from a breach in the banks of the River Glen immediately north of the site.

The risk of flood water from the tidal River Welland reaching the site if a breach occurred in these banks and the depth of flooding being 1.0 metres can be considered extremely low.

The risk of flooding from Vernatt's Drain can also be considered to be extremely low.

The risk of any flood water from any IDB sources increasing above 3.50m OD can be considered remote.

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

Although the all of the site is in flood zone 3, the actual risk of the site flooding from any Environment Agency or IDB watercourse is very low.

Recommendations

In an area where there is a flood risk, however small, it is preferable that new dwellings should be of two story construction designed with all sleeping accommodation located on the first floor.

The ground floor level of a proposed two story building should be at a minimum level of 4.00m OD, which is 1.0 metre above the lowest existing ground level on the site.

If any flooding did occur it would happen extremely slowly over many hours and the Local Authorities and emergency services would have adequate time to warn residents that flooding might occur, and residents would have adequate time to prepare themselves for the event.

The buildings 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 the floor level of the new building. Consideration should be given to the electrics and heating pipes being distributed at ceiling level rather than at floor level. Materials used for the floor and walls should be able to withstand flooding for a period of a few days. Further details are given in Appendix B on page 18.

On site surface water drainage will be discharged into soakaways and these should be designed to BRE Digest 365 and approved under Building regulations.

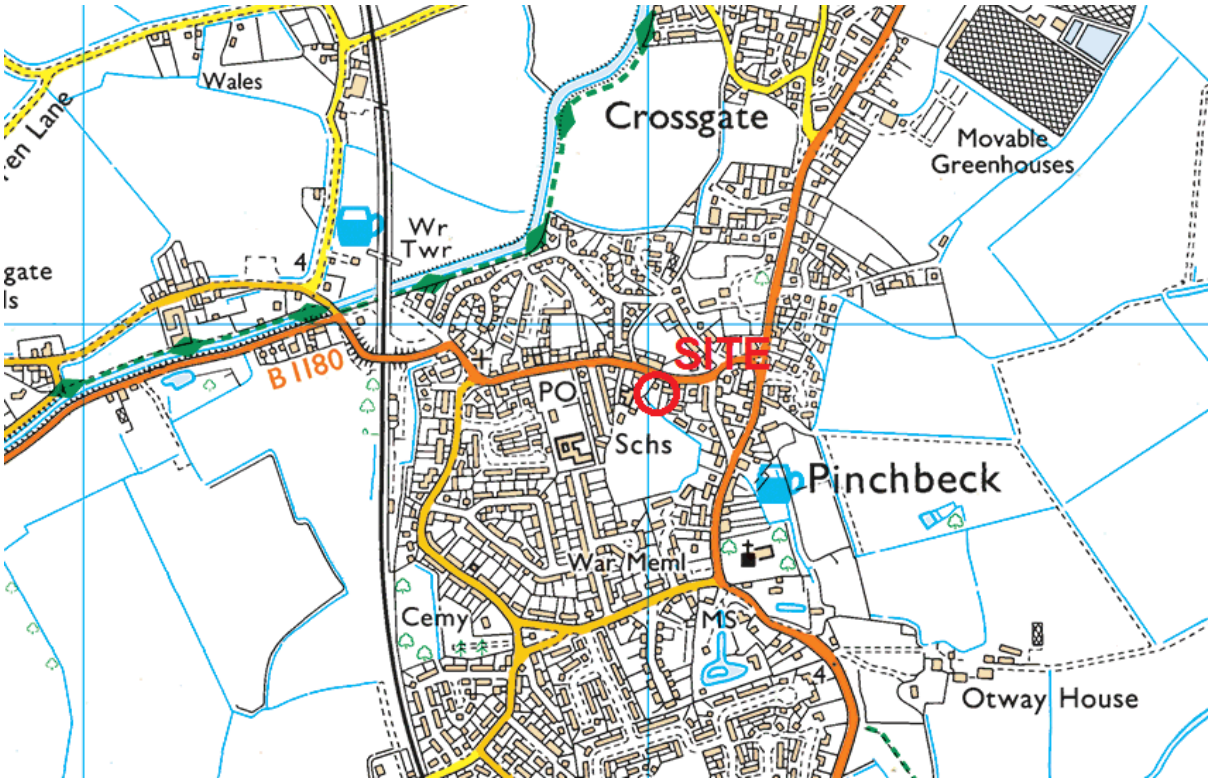
All future occupiers of the properties should register with the Environment Agency's Floodline Warnings Direct Service.

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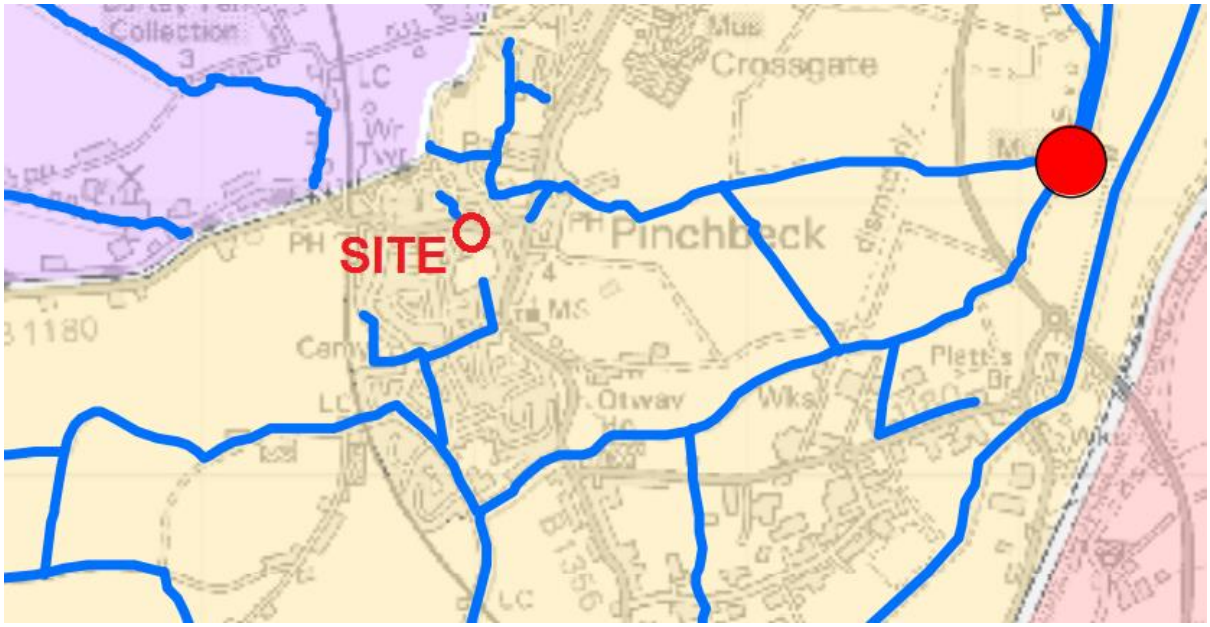
stuart.hemmings@btinternet.com

29th December 2016

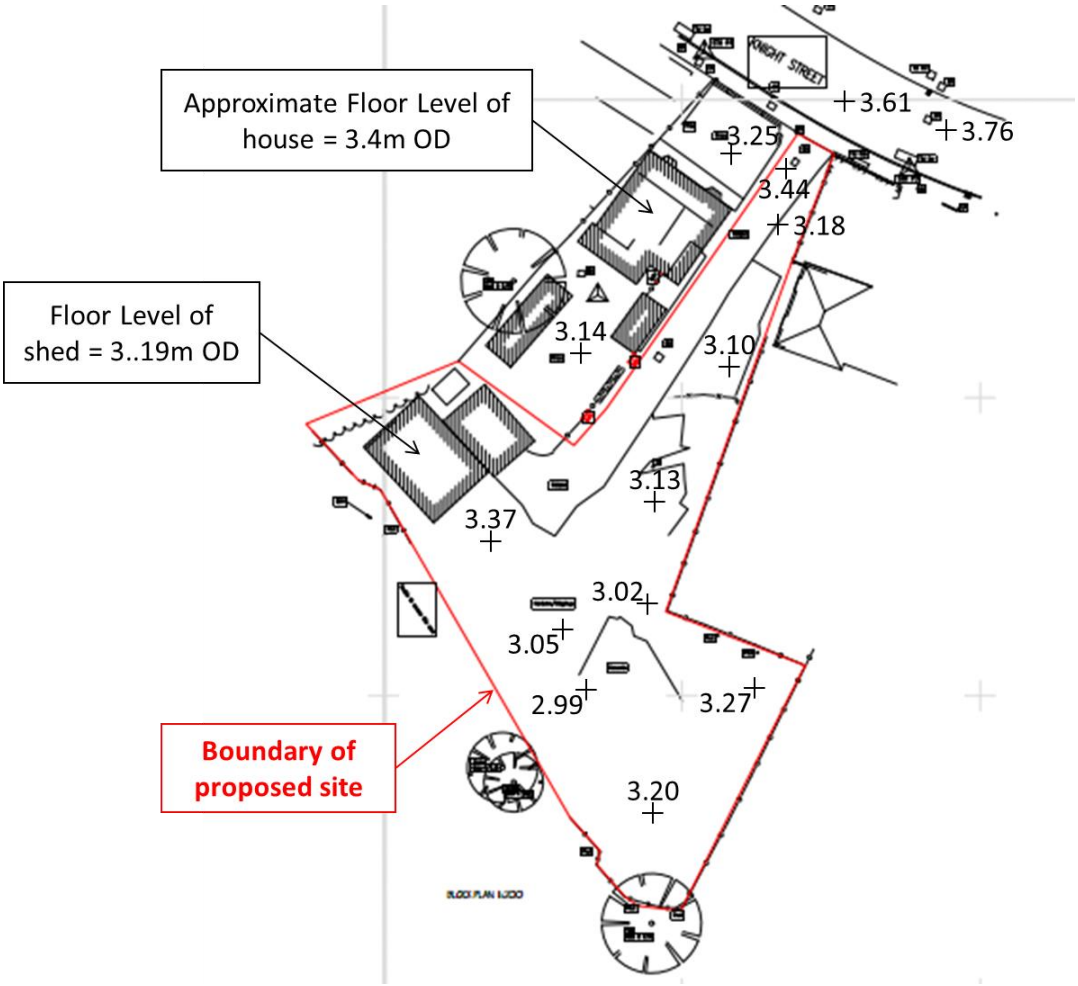
LOCATION PLAN



PLAN OF IDB DRAINS



PLAN SHOWING SITE LEVELS



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 SFRA predicts that there will be flooding in this area of Pinchbeck up to a depth of 1000mm in a 1 in 100 year fluvial or 1 in 200 year tidal event in 2115. It has been concluded that the major flood risk to the site is most likely to be fluvial flooding from the River Glen to the north of the site.

The FRA has identified three 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
2) Flooding from the River Glen
3) Flooding from the Vernatts Drain and other IDB drains

1) Flooding from the tidal River Welland

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 can be seen that the revised guidance increases the maximum allowance for sea rise in 2115 by 100mm. This will only have the effect of increasing flood levels by between 10mm and 20mm at the most. This may slightly increase the risk of a breach occurring in the tidal bank north of the site.

Therefore with the precaution of recommending that the new buildings should have a ground floor level of 4.00m OD for two story buildings the small increase in the maximum level of tidal flooding will not change this conclusion.

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 systems it will have the effect of flooding over the long sections of bank between Bourne and Surfleet Reservoir and the maximum levels will not increase significantly.

3) Flooding from the Vernatts Drain and other IDB drains

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 as the major flood risk to the site in Knight Street is from tidal flooding then any increases in flow from fluvial sources do not need to be considered further.

Therefore it is considered that the mitigation proposed for the development, with the recommendation that the ground floor levels should be a minimum level of 4.00m OD for two story buildings is satisfactory.

APPENDIX B

RECOMMENDATIONS ON LIMITING FLOOD DAMAGE TO BUILDING

Walls:	Construction to first floor level should be carried out with good quality brickwork. Specification for blockwork should be checked and only blockwork that does not absorb water should be used. If possible brickwork should be used instead of blockwork to first floor level. Construction below DPC should be carried out with engineering brickwork.
Ground Floor:	Either precast concrete beams with concrete infill, or concrete above made up ground should be used. Dense concrete screeds should be used.
Doors:	Doors should be solid construction, or plastic should be considered. Butt hinges should be fitted to allow doors to be removed and placed in a dry area prior to any flooding.
Kitchens:	Install plastic base feet and if possible other plastic items to reduce damage from low level flooding. Raise fitted ovens as high as possible.
Electrical Services:	Place all of electrical wiring at first floor level and drop wiring down to sockets at least 1.0 metre above ground level.