

PROPOSED RESIDENTIAL DEVELOPMENT WEST OF
33 KNIGHT STREET, PINCHBECK, SPALDING, PE11 3RA
FLOOD RISK ASSESSMENT



REVISION A: 29th August 2014 Revised recommendation that all floor levels to be at 4.10m OD.

REVISION B: 6th June 2018 Report updated with latest SFRA information

This flood risk assessment has been prepared solely to support the planning application for the proposed 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, or if it is used for any other purposes other than for which it was originally commissioned.

Introduction

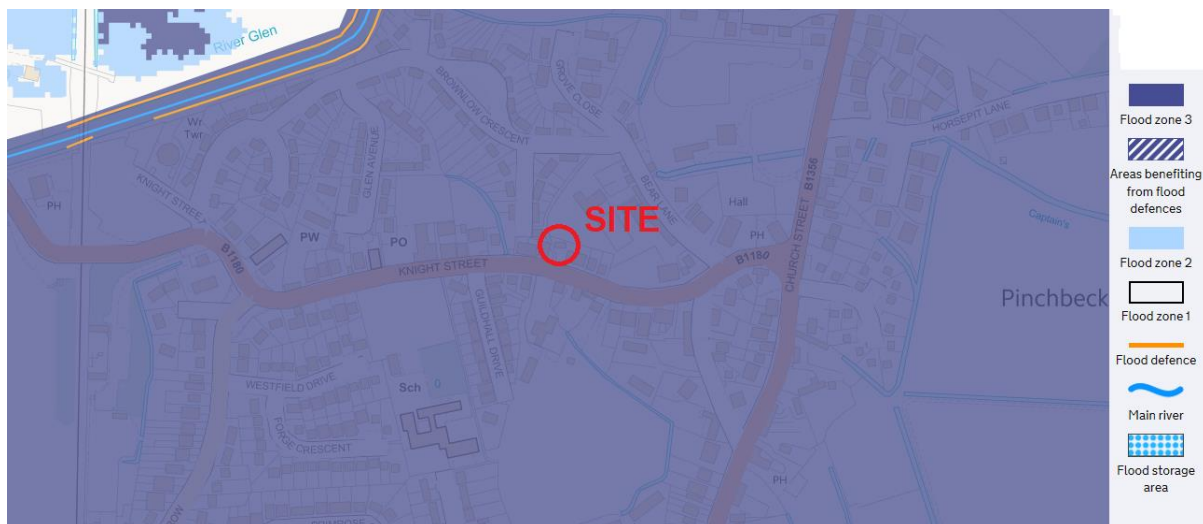
An application is due to be made to South Holland District Council for Planning Permission to demolish four garages and construct a residential building on the land west of 33 Knight Street, Pinchbeck.

The Planning Application requires a Flood Risk Assessment to be carried out as required in the Technical Guidance to the National Planning Policy Framework.

The site is shown 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.



It can be seen that all of this area of Pinchbeck is in Flood Zone 3.

Application Site

The development is located in the centre of Pinchbeck and south of the River Glen. The National Grid Reference of the site is 523990 325940.

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

As the site of the proposed development is within a defended area it can be considered to be within Flood Zone 3(a) "High Probability", as defined in Table 1 of the Technical Guidance.

Applying the flood risk vulnerability classification in Table 2 of the Guidance, a residential development 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 †	X	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	X	X	X	✓*

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 most of this area of Pinchbeck is in Flood Zone 3. Therefore it would be difficult to find an alternative site in this area of Pinchbeck that is in a lower flood zone.

The safety of the development will be delivered by ensuring the floor level of the proposed new dwelling is above the predicted residual flood levels in a 1 in 100 year event in 2115 for this area.

The South Holland District Council Core Strategy states that there is a limited number of sites in the South Holland DC area available for residential development. Some further sites will need to be identified to enable the Council to meet the RSS and Structure Plan requirement for 2021. Therefore there is a requirement for further sites to be brought forward and used for residential development.

Therefore I consider that the sequential test has been passed.

Exception Test

The Sequential Test has demonstrated that it is not possible, consistent with wider sustainability objectives, for the development to be located in zones with a lower probability of flooding. Therefore the Exception Test must be applied and for this to be passed:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risks, informed by the Strategic Flood Risk Assessment; and
- A site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking into account of the vulnerability of its users, without increasing flood risk elsewhere, and where possible will reduce flood risk overall.

Both parts of this test must be satisfied in order for the development to be considered appropriate in terms of flood risk. There must be robust evidence in support of every part of the test.

The first section will be demonstrated by the Supporting Planning Statement and compliance with South Holland District Council's planning policies.

This flood risk assessment will demonstrate that the development will be safe for its lifetime and it will not increase flood risk elsewhere.

Strategic Flood Risk Assessment

The following information about the flood risk at the location of the proposed development has been gained from the maps produced for the South Holland District Council Strategic Flood Risk Assessment:

1. Report Maps

Map 16 indicates the site is not within the present day or the year 2115 rapid inundation zone.

2. Flood Maps Table D1

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

For the present day	Depth of flooding ... zero
	Extent of flooding .. high
	Hazard low
	Velocity ... zero
For year 2115	Depth of flooding ...0 - 0.5m
	Extent of flooding ...High flood probability,
	Hazard ... Significant
	Velocity .. 0 to 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 – 0.3 m/sec
For the year 2115	Depth of flooding 250mm – 500mm
	Extent of flooding ...High
	Hazard at rear..... 0.75 – 1.25 (Danger for some)
	Hazard at front..... 1.25 - 2.0 (Danger for most)
	Velocity at rear 0 – 0.3 m/sec
	Velocity at front ... 0.3 – 1.0 m/sec

3. Maximum flood levels:

Maximum flood levels in the River Glen are shown in the reports as follows:

	Present	Present + Climate Change
1 in 100 year	4.32	4.91
1 in 1,000 year	4.47	4.98

The bank level at this location is 4.39m OD, but there is a flood wall 900mm high along this length of the River which raises the defence height to 5.29m OD.

Maximum flood levels in the Vernatt's Drain are shown in the reports as follows:

	Present	Present + Climate Change
1 in 100 year	3.79	3.79
1 in 1,000 year	3.79	3.79

The bank level at this location is 4.25m OD

4. Extreme tide levels

The extreme tide levels in the River Welland between are shown in the report as follows:

	2007	2055	2115
1 in 100 year	5.98	6.31	7.12
1 in 1,000 year	6.32	6.65	7.46

The lowest bank level on the left bank of the tidal River Welland is 7.57m 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" and is considered to be passive until such time that a flood greater than the defences can withstand occurs. The likelihood of flooding due to overtopping or failures of the defences is considered to be very low.

The site is approximately 280 metres south of the River Glen, which is main river and maintained by the Environment Agency.

The site is approximately 2.5 km from the tidal defences of the River Welland.

The area is drained by watercourses maintained by the Welland and Deepings IDB.

Proposed Levels of Buildings

The road level in Knight Street outside the existing property is 3.70m and the ground floor level of the existing house (No 33) on the site is approximately 3.68m OD. The floor level of the adjoining property to the west is 3.96m OD. It is recommended that the floor level of the proposed bungalow should be 520mm above the existing ground level of 3.58m OD at a level of 4.10m OD.

Potential Sources of Flooding

The following sources of flooding have been identified:

1. Failure or overtopping of the tidal defences of the River Welland
2. Flooding due to high water levels in Vernatt's Drain
3. Overtopping or breaching of the River Glen.
4. Failures of Pinchbeck Pumping Station (IDB).
5. Flooding from the IDB drainage system.
6. Blockages in local surface water and foul sewers (highway or Anglian Water).

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

The tidal River Welland is 2.5km east of the site. The predicted levels in this watercourse show that the defences will not be overtopped in a 1 in 1000 year event in 2115. However there is still the risk that the earth bank could breach when the water levels are high. 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.

2. Flooding due to high water levels in Vernatt's Drain

The SFRA states that the maximum water level in Vernatt's Drain is 3.79m OD. This is 450mm below the bank levels on the east side of 4.25m OD. These levels are lower than the proposed finished ground floor level of the new building and therefore this source of flooding can be discounted.

3. Overtopping or breaching of the River Glen.

The predicted maximum 1 in 100 year water level 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 climate change 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.

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

4. Failures of Pinchbeck Pumping Station (IDB)

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 this pumping station provides a good standard of service for the catchment area, and the risk of flooding from this source can be considered to be extremely low.

5. Flooding from the IDB Drainage System

The area of Pinchbeck village is drained by a piped IDB surface water drain which runs westwards under Church Street and discharges into Captains Drain. If any part of this system becomes blocked this could cause some minor flooding of lower areas of Pinchbeck, but the flooding would not rise as high as the finished ground floor level of the proposed building. Welland and Deepings have a regular maintenance programme on all of their open and piped drains which reduces the risk of this happening.

Therefore this source of flooding can be considered to be adequately mitigated.

6. Blockages in local surface water sewers and highway drains

Any flooding due to blockages in surface water sewers or highway drains could cause low level flooding in Knight Street but the flood water would flow away from the site northwards onto lower land and would not accumulate on the site.

Therefore this source of flooding can be considered to be 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 having been flooded in the last 50 years.

Probabilities and Trends of Flooding

The probability of this development flooding from Environment Agency main river is very low. In an extreme tidal event the 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

There is a residual risk from extreme events on this site. The major risk to the site is from high water levels in the River Glen. The defences on the south side of the river seem to provide a satisfactory defence, being 300mm higher than the 1 in 1000 predicted level including climate change.

If a breach occurred in the bank, or the stone flood wall collapsed, flood water would flow southwards flooding many of the properties behind the defences. The maps of the predicted residual depths for the 1% probability event show maximum flood depths of between 500mm and 1.0 metres for properties and land along Glen Avenue to the north west of the site and then 250mm to 500mm for this area of Knight Street.

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 13 to 16). 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 spreadsheet on the South East Lincolnshire website.

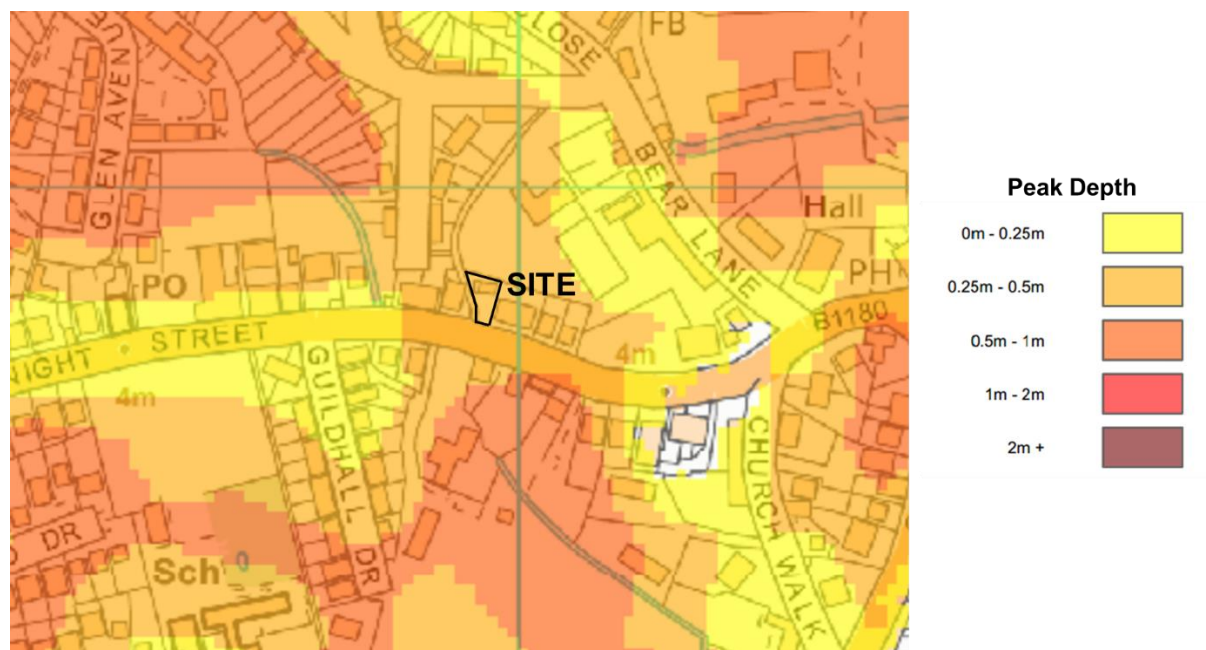
As the development is in flood zone 3 and the hazard where the new building will be located to the rear of the site is 0.75 – 1.25 (danger for some) reference should be made to Category E8 which gives the following standing advice:

FFL must be set 500mm above ground level, with flood resilient construction to a height of 300mm above the predicted flood depth.

Summary of Risk of Flooding to the Site

The relevant part of the map in the updated SFRA issued in March 2017 on the South East Lincolnshire Joint Strategic Planning Committee Website showing the residual

peak depths for Spalding in 2115 in a 1% fluvial and tidal event probability is shown below.



It can be seen that flood depths of between 250mm and 500mm are predicted on the site if a breach occurred in a 1 in 100 year event in 2115.

Conclusions

The following conclusions can be made:

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

Although the site is in flood zone 3, the actual risk of the site flooding from any Environment Agency water course is low.

With the predicted maximum level in the River Glen with climate change of 4.98m OD, this will be 880mm above the proposed level of the proposed building. As the water flows through any breach that may occur then initially there will be a head loss of at least 500mm as the water flows out of the river. After some time this may reduce, but so will the maximum level in the river as water escapes out of the river. This provides further evidence that any flood water will only reach a level of 4.10m OD at the proposed site.

Any flooding from the IDB drain or local sewers or drains will occur very slowly and it is extremely unlikely that flooding from this source would reach a level of 4.10m OD and flood the proposed dwelling.

In a flood risk area there is always a risk of an event occurring of greater magnitude than has been considered in this flood risk assessment.

Recommendations

In any area at risk of flooding it is preferable that a proposed building should be of two story construction with all bedrooms at first floor level. This will provide a refuge for

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

It is recommended that the floor level of the proposed building should be no lower than 4.10m OD which will be greater than 500mm above the existing ground level on the site. The map showing the depths of residual flooding for the year 2115 in the SFRA indicates that the flood depth in the area of this property would be between 250mm and 500mm.

The Occupiers of the property should register with the Environment Agency's Floodline Warnings Direct Service. If a Flood Alert is received residents should stay vigilant and be prepared to relocate for the period when water levels are very high to a location east of the old A16. If a Flood Warning is received then residents should consider evacuating the area and only returning when the danger is over.

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

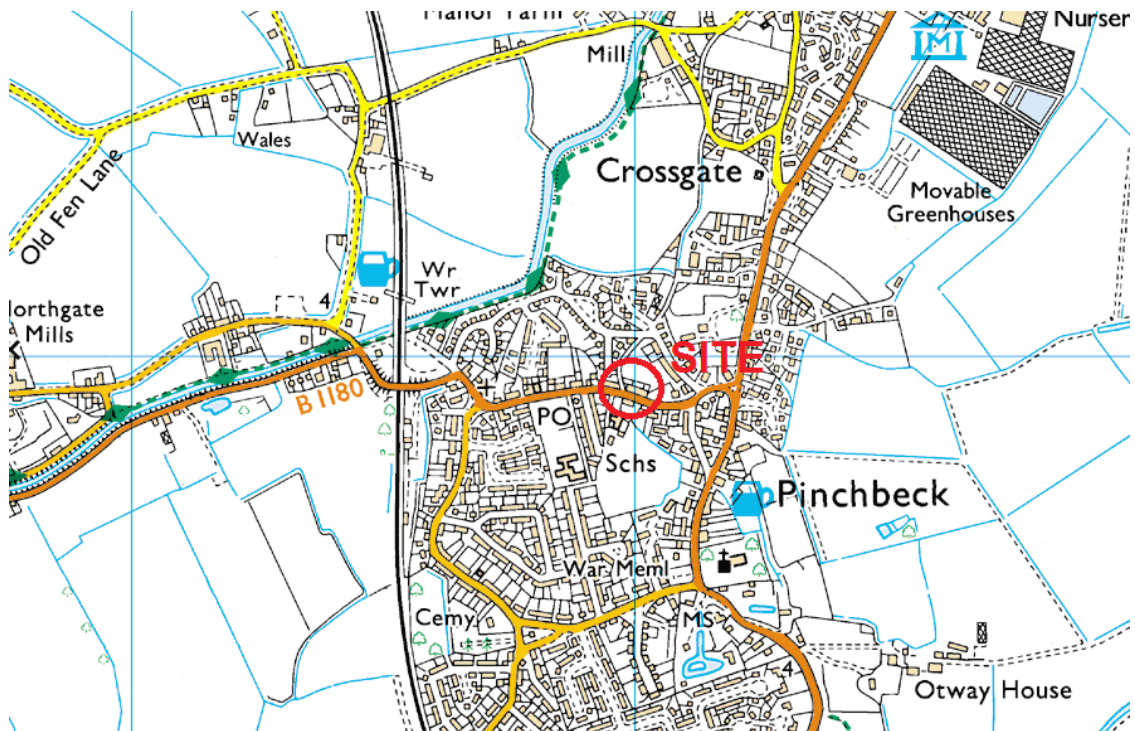
The buildings should be designed incorporating flood resistant and resilient techniques to allow it to be refurbished after being flooding to a depth of approximately 300mm above the finished ground floor level of the new building.

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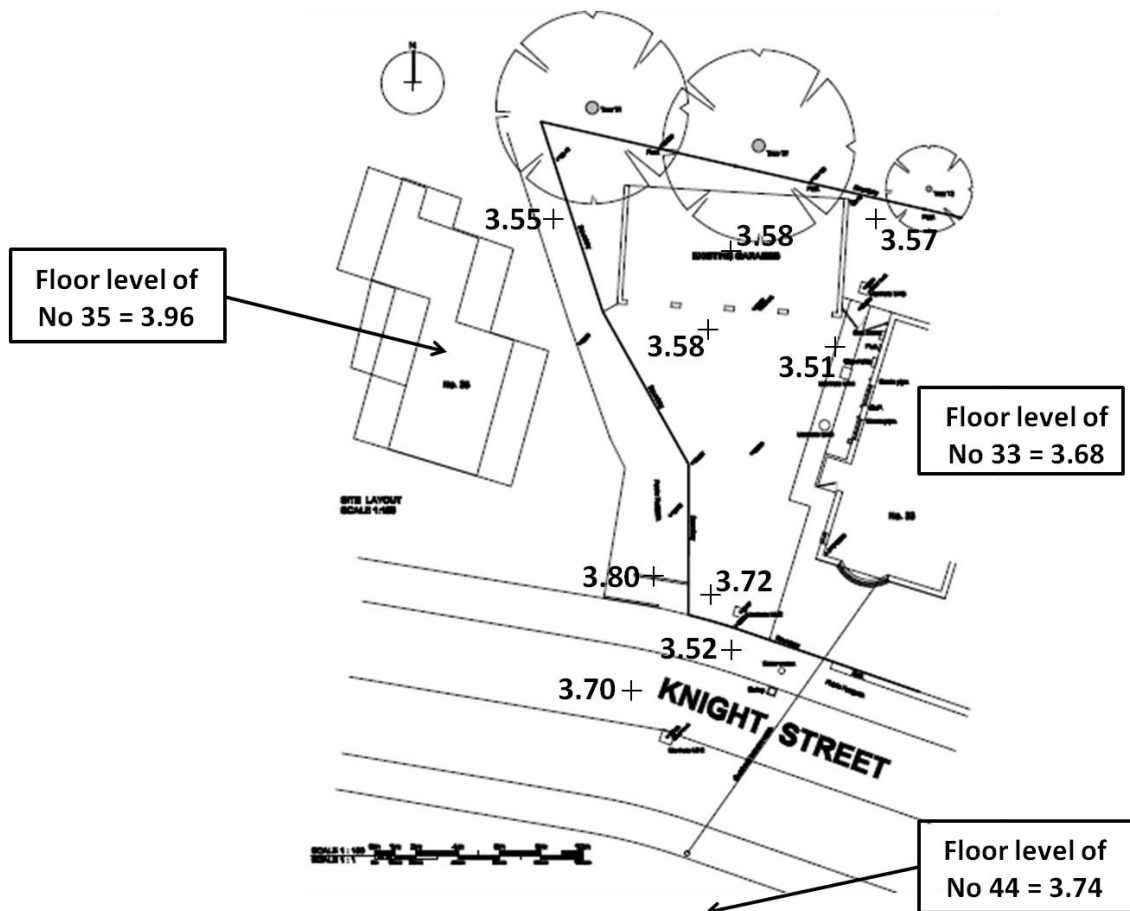
Stuart.hemmings@btinternet.com

REVISION B: 6th June 2018

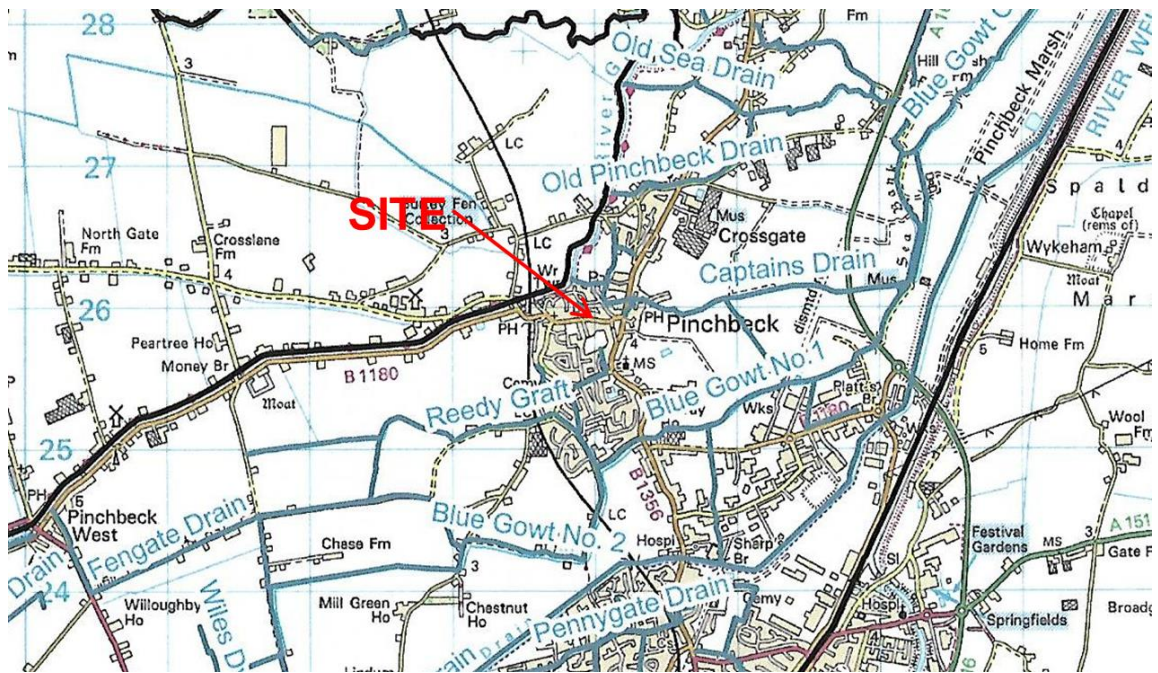
LOCATION PLAN



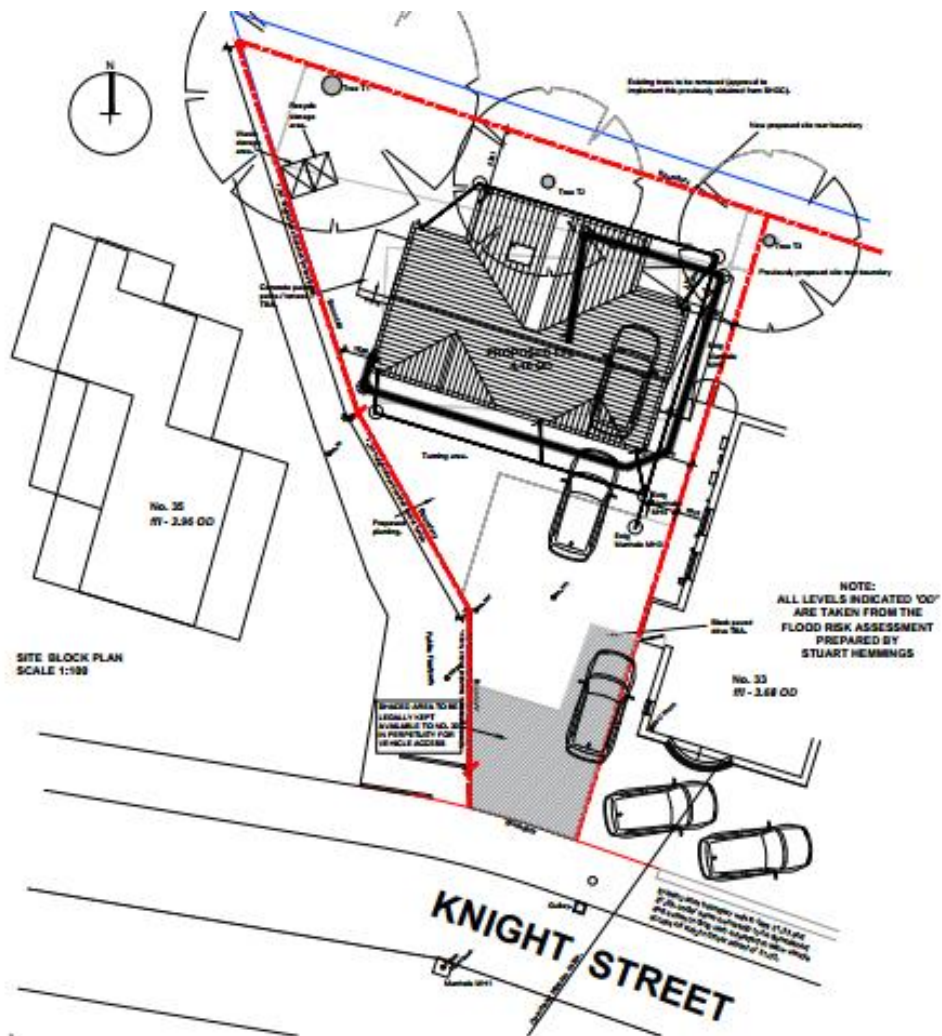
SITE PLAN WITH GROUND LEVELS



PLAN OF IDB DRAINAGE CHANNELS



PLAN OF PROPOSED DEVELOPMENT



APPENDIX A CLIMATE CHANGE

The Environment Agency has issued revised guidance on climate change and have now stated that the new predictions should be considered and incorporated into all flood risk assessments produced after 19th February 2016.

Listed below are the climate change allowances in three documents:

- South Holland SFRA
- EA guidance (2013)
- Revised EA guidance

The recommendations in each document are shown below.

2010 South Holland DC SFRA

The SHDC SFRA states that the the following allowances have been made for climate change:

4.4 Climate Change

Scenarios for the years 2055 and 2115 include for climate change contingency allowances to the amount suggested by PPS25¹. These allowances are expressed in Table 2. Percentage increases are relative to the present-day.

Table 2 – Adopted Climate change contingency allowances

Parameter	Year 2055	Year 2115
Sea level rise (m)	+ 0.33	+ 1.14
Extreme wave height	+ 10%	+ 10%
Peak river flow and volume	+ 20%	+ 20%
Peak rainfall intensity	+ 20%	+30%

Where flows arise from pumping rather than natural run-off, notably in the Vernatt's Drain and for the Fenland subcatchments of the South Forty Foot Drain, peak flow rates for future eras have been taken as equal to current rates since this SFRA assumes all flood risk management measures will remain in their current state.

2013 Guidance to Planners

Guidance to planners was issued by EA in September 2013

Table 1: Recommended contingency allowances for net sea level rises (Net sea level rise (mm per year) relative to 1990)

	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
East of England, east midlands, London, south-east England (south of Flamborough Head)	4.0	8.5	12.0	15.0
South-west England	3.5	8.0	11.5	14.5
North-west England, north-east England (north of Flamborough Head)	2.5	7.0	10.0	13.0

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

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

Revised 2016 EA Guidance

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

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

For more vulnerable development in flood zone 3 the upper end and the higher central 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

Fluvial Flooding from River Welland.

As the development is in flood zone 3 and is classed as more vulnerable, the higher central climate change allowance, which is 35%, should first be considered. After considering the effects of this increase the higher central 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 overtopping over lower banks west of Pinchbeck rather than any significant increase in levels in the river.

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 between north of Bourne and Pinchbeck. Long lengths of these banks west of Pinchbeck are lower than the banks through Pinchbeck village. Therefore

there would be significant overtopping of the banks in an event with a 65% increase in flows but the maximum level would not be greater than the levels predicted in the SFRA. Therefore the consequence will not be significantly different to the maps produced in the SFRA.

Effect on IDB Systems

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 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 level of the proposed development should be raised by 500mm above existing ground level is satisfactory.