PROPOSED RESIDENTIAL DEVELOPMENT AT THE BELL INN, 33 CHURCH STREET, PINCHBECK, SPALDING, PE11 3UB
FLOOD RISK ASSESSMENT



View of development site from the west side of Church Street

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This flood risk assessment has been prepared solely to support the planning application for the proposed development at The Bell Inn, Church 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

A planning application is due to be made to South Holland District Council for permission to carry out a residential development at the Bell Inn, Church Street Pinchbeck Spalding. The proposed development consists of the conversion of the existing building into flats and the construction of bungalows on the land to the south east of the building.

The site is within Flood Zone 3 as shown on the Environment Agency's Flood Zone Map. These 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 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 the whole of this area of Pinchbeck is in Flood Zone 3.

Application Site

The development is located on the western side of the River Welland. The National Grid Reference of the site is 524200 325730.

The location 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 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 †	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 the whole of this area of the village of Pinchbeck is in Flood Zone 3. Therefore it would be difficult to find a similar site for development that is in a lower flood zone.

As part of the development is the conversion of the existing building, it would not be possible for it to be located at an alternative location.

When considering if the proposed development passes the sequential test the following policies in the South East Lincolnshire Local Plan are relevant:

Policy 7: Loss of Employment sites to Non Employment Uses.

It will be demonstrated that in the present climate this is one of a number of public houses that are not now viable due to changing social habits.

Policy 11: Distribution of New Housing

This policy states that 180 additional houses are required by 2036. This development will provide much needed accommodation in Pinchbeck

The safety of the development will be delivered by demonstrating that the proposed floor level of the existing building and the proposed floor levels of the new buildings are above predicted residual flood levels for this area.

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

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…. zero
	Extent of flooding … Low or medium flood probability
	Hazard ……. zero
	Velocity …….. Nil
For the year 2115	Depth of flooding ….0 - 250mm (part of site only)
	Extent of flooding …High
	Hazard …… Less than 0.75
	Velocity ……. 0 – 0.3 m/sec

The hazards for the 0.1% fluvial and tidal event probability are as follows:

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

The extreme tide levels in the section of the River Welland north of Fulney Lock is 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 occurs 200 metres north of Fulney Lock, where a section 300 metres long has a minimum level of 6.98m OD.

The 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 around chainage 6.2km is between 4.74m and 5.15m OD.

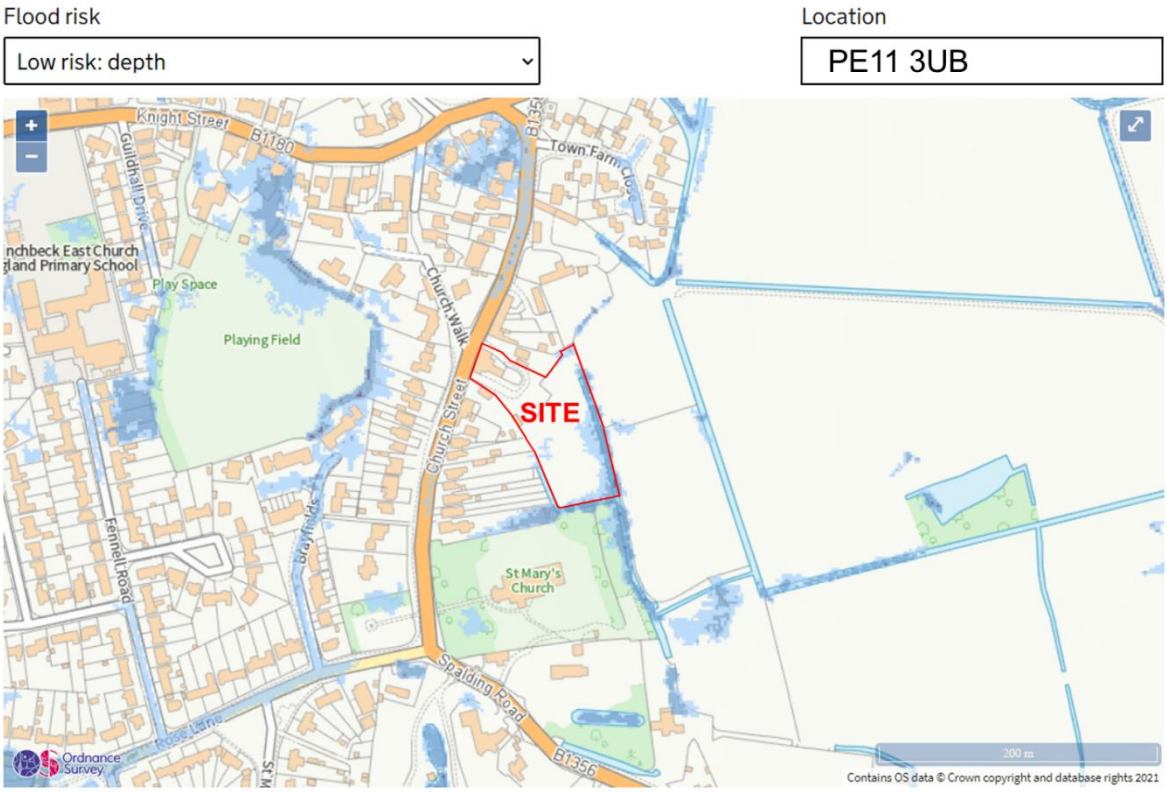
Maximum flood levels in the Vernatt's Drain are shown in the reports as follows:

	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

Information on Surface Water Flooding on Environment Agency Website

The map below shows areas around the site where there is a low risk of surface water flooding. The light blue areas indicate the low risk of up to 300mm of surface water flooding, and the darker blue areas indicate that between 300mm and 900mm of surface water flooding could occur.



Surface water flood risk: water depth in a low risk scenario
Flood depth (millimetres)

It can be seen there is a predicted risk of up to 300mm of surface water flooding in an area around the eastern boundary of the site.

Site Levels

A topographical study has been carried out and this will be including with other documents to be submitted for the planning application. A plan of the levels taken from the survey is shown on page 14 of this report.

The level of Church Street west of the existing building varies from 3.86m to 3.98m ODN. The existing ground floor level of the Bell Inn is estimated to be 4.10m ODN, which is approximately 200mm above the ground level of 3.90m ODN outside the entrance door on the southern face of the building near to Church Street.

The site roadways either side of the building slope down to a level of approximately 3.40m ODN at the east end of the car parking area at the rear of the building. The remaining part of the site slopes down from approximately 3.00m ODN at the north end to a lowest level of 2.54m ODN at the south end of the site.

Existing Flood Alleviation Measures

The site is within a defended flood plain, as defined in Appendix 1 of the Environment Agency's "Policy and Practice for the Protection of Flood Plains" 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 2.2 km from the tidal section of the River Welland to the east, which is main river and maintained by the Environment Agency.

The site is approximately 540 metres south east of the fluvial section of the River Glen, which is main river and maintained by the Environment Agency.

The site is approximately 1.6km north of Vernatts Drain which is maintained by Welland and Deepings IDB.

There are drainage channels in the Pinchbeck area which are maintained by Welland and Deepings Internal Drainage Board.

Potential Sources of Flooding

The following sources of flooding will be considered:

1. Failure or overtopping of the tidal defences.
2. Overtopping of the River Glen.
3. Flooding from Vernatts Drain
4. From IDB watercourses
5. Surface water flooding

1. Failure or overtopping of tidal defences.

The River Welland is tidal north of Fulney Lock, which is approximately 2.2km east of the site. The SFRA states that the defences are adequate to withstand a 1 in 200 year (0.5%) probability event for present day. In the future in 2115 some of the banks would be overtopped with a 0.5% probability event. However if overtopping or a breach

occurred water would flow westwards from the tidal Welland and would flood into Vernatts Drain which would reduce the impact of this flood and reduce the flood level in this type of event.

It is reasonable to presume that within the next one hundred years works will be undertaken on this section of the bank to ensure that there will be a 1 in 200 year standard of defence continuing into the future, especially considering the value of the industrial and residential properties protected by these defences.

The maps on the South East Lincolnshire Local Plan website show the there could be up to 250mm depth of flooding on the site in a 1 in 200 year event in 2115 and between 500mm and 1.0 metre of flooding in some parts of the site in a 1 in 1000 year event in 2115.

Adequate mitigation will be provided to the proposed development by ensuring the proposed finished ground floor level of the dwellings is above the predicted flood level.

2. Overtopping 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 4.75m 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. Therefore some flooding is possible in a 1 in 100 year event in 2115.

Although the actual risk is extremely low there is a residual risk if the defences were to fail. The River Glen does not have a 1 in 100 year standard of service at the present time, and the flood risk will increase in the future unless work is carried out by the EA to raise banks. 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.

3. 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 ground floor level of the existing building and approximately 500mm below the proposed finished floor levels of the proposed new buildings.

Therefore it is considered that this source is adequately mitigated.

4. Flooding from IDB watercourses

Maximum predicted water levels in the IDB catchment controlled by Pode Hole Pumping Station in a 1 in 100 year event in 2115 are below 1.00m OD and therefore this source of flooding can be considered to be adequately mitigated.

5. Surface Water Flooding

The site slopes from a level of 3.90m ODN in Church Street to a level of 2.54m ODN at the southern end of the site. Surface water could flow southwards and accumulate at the southern end of the site. The map of predicted surface water flooding predicts some flooding could occur on the eastern boundary of the site at the southern end of the site.

The risk of flooding to dwellings will be mitigated by constructing a satisfactory surface water drainage system and as the floor levels of the proposed properties at the southern end of the site will be raised by at least 500mm.

Extent of known Flooding

During the preparation of this assessment, no evidence was discovered of any surface water flooding having occurred in this area of Spalding.

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.

Although this site is within Flood Zone 3 according to the initial classification because of the current standards of drainage and flood risk in this part of Spalding there is a very low risk of flooding to this site.

Climate Change

The recommendations for flood depths for this flood risk assessment use information mostly taken from the South Holland DC SFRA which was last updated in 2010. The EA have issued new guidance on recommended contingency allowances for predicted sea rises, fluvial flows and rainfall intensities which from 19th February 2016 needs to be considered in the FRA. The effects of these new recommendations are considered in Appendix A of this report (pages 16 to 19). 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 most of the new part of the development is in flood zone 3 and the flood hazard is 0.75 - 1.25 (Danger for some)

reference should be made to Category E8 which states that the following standing advice is:

The NPPF requires that the proposal is accompanied by a Flood Risk Assessment which contains evidence that appropriate mitigation measures/flood resilience techniques have been incorporated into the development.

The applicant is advised to refer to the document "Improving Flood Performance of New Buildings Flood Resilient Construction (DCLG2007).

Finished floor levels (FFL) should be informed by the predicted flood depth maps (refer to the relevant 2115 1% fluvial or 0.5% tidal maximum depth maps) and set as required below (single storey proposals must use the 0.1% event, 2115 scenario for setting FFL's).

Depth 0.25 – 0.5m: FFL must be set 500mm above ground level, with flood resilient construction to a height of 300mm above the predicted flood depth.

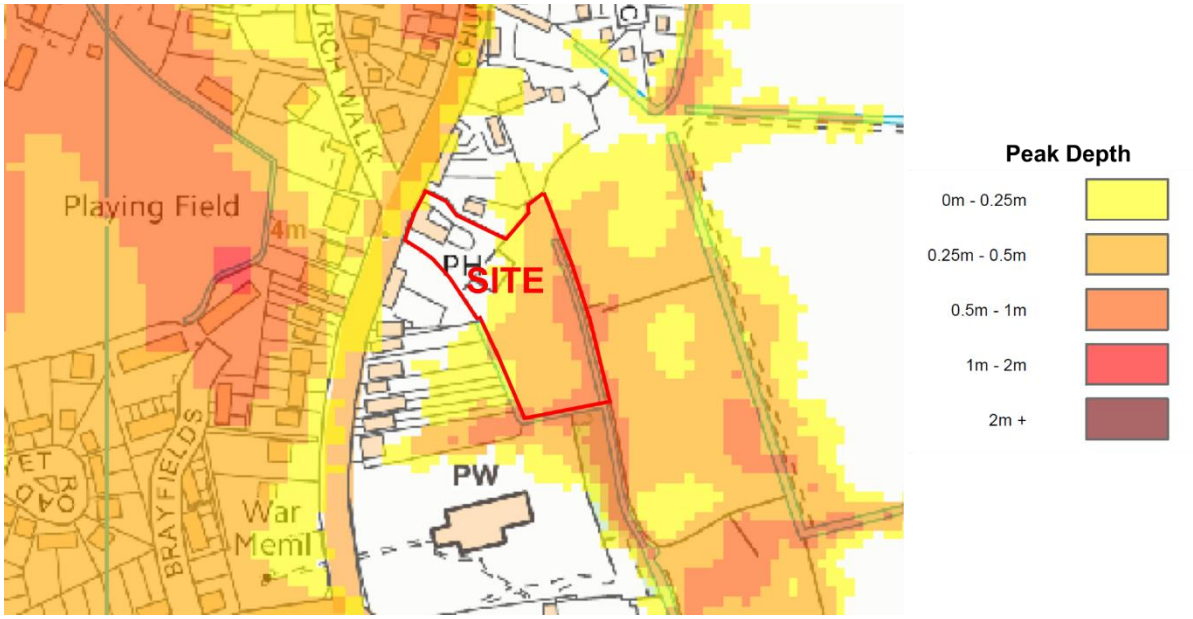
Depth 0. – 0.25m: FFL must be set 300mm above ground level.

Summary of Risk of Flooding to the Site

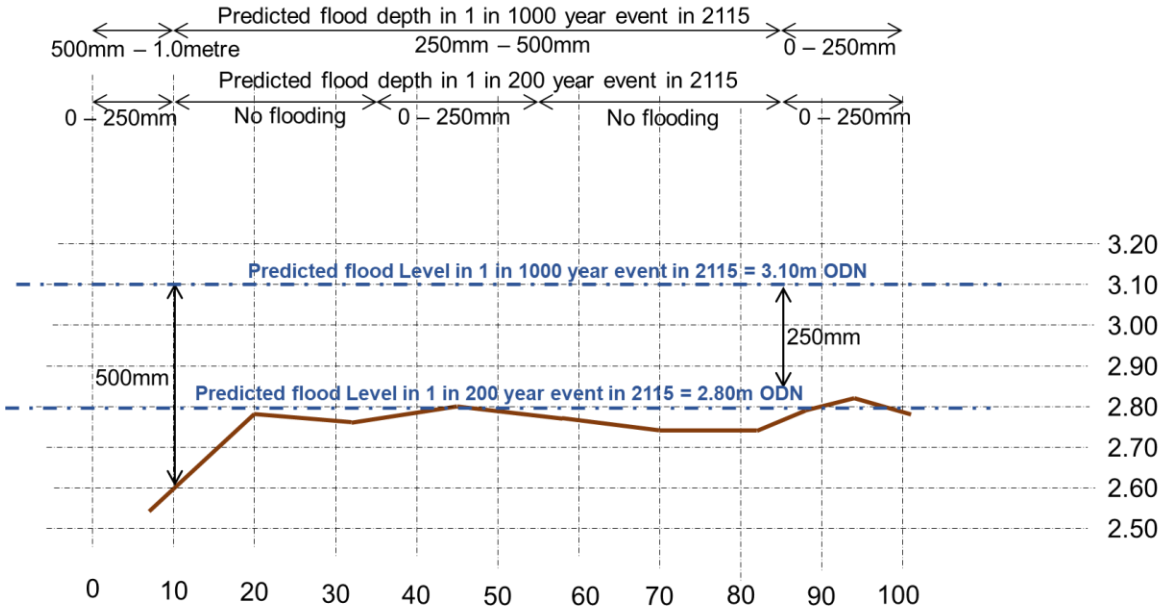
Part of the map in the SFRA of the residual peak depth in 2115 for the 0.5% (1 in 200 year) tidal and the 1% (1 in 100 year) fluvial event probability in 2115 is shown below and this predicts up to 250mm of flooding on the south eastern side of the site.



Part of the map in the SFRA of the residual peak depth in 2115 for the 0.1% (1 in 1000 year) tidal fluvial event probability in 2115 is shown on the next page and this predicts a flood depth of between 250mm and 500mm on the central area of the southern part of the site and a smaller area near the eastern boundary where flood depths are predicted to between 500mm and 1.0 metre.



A section has been drawn south to north for the lower part of the site and this is shown below.



As can be seen from the above section it can be deduced that the estimated maximum flood level in a 0.1% (1 in 1000 year) tidal and fluvial event in 2115 is 3.10m OD and the estimated maximum flood level in a 0.5% (1 in 200 year) tidal and a 0.1% (1 in 100 year) fluvial event in 2115 is 2.80m OD

Conclusions

The proposed development is not in a functional flood plain as defined by the Technical Guidance.

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

The above cross section shows that the predicted maximum flood level in a 0.1% event in 2115 is 3.10m OD.

Therefore the minimum finished floor level of proposed bungalows on this site should be 3.20m ODN. Where ground levels are higher than 2.90m ODN the bungalows should be raised 300mm above ground level.

The risk of flooding if there is a breach in the tidal defences has been shown to be extremely low.

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 the proposed buildings should be of at least two storey 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 flood bank, and ensure there is no danger to residents when they are asleep.

However bungalows with bedrooms on the ground floor are proposed on this site and the finished ground floor levels of these will be considered satisfactory as long as the floor level is raised above the predicted flood level in a 1 in 1000 year event in 2115. The ground floor level of the proposed bungalows should therefore be raised to a minimum level of 3.20m OD, and where ground levels are higher than 2.90m ODN the ground floor level should be a minimum of 300mm above the existing ground level.

As the finished ground floor level of the existing building is approximately 200mm above the road levels it is considered that this is not predicted to be flooded in a 1 in 1000 year event in 2115.

All future occupiers of the proposed house should register with the Environment Agency's Floodline Warnings Direct Service to receive telephone flood warnings.

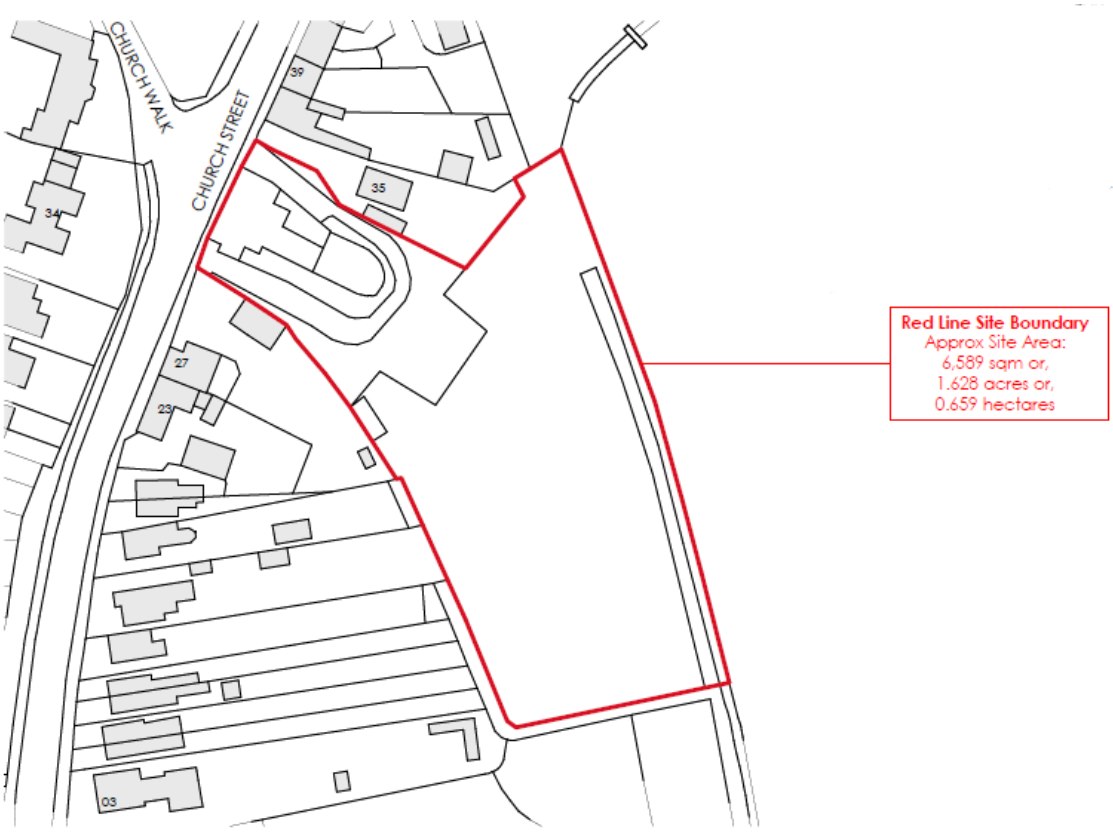
The surface water from the roofs of the proposed buildings should if possible be discharged into soakaways. These should be designed to comply with the recommendations of BRE 365 and approved under the Building Regulations. A satisfactory surface water system should be designed and constructed for the proposed access road to prevent any surface water flooding to the properties on the southern part of the development.

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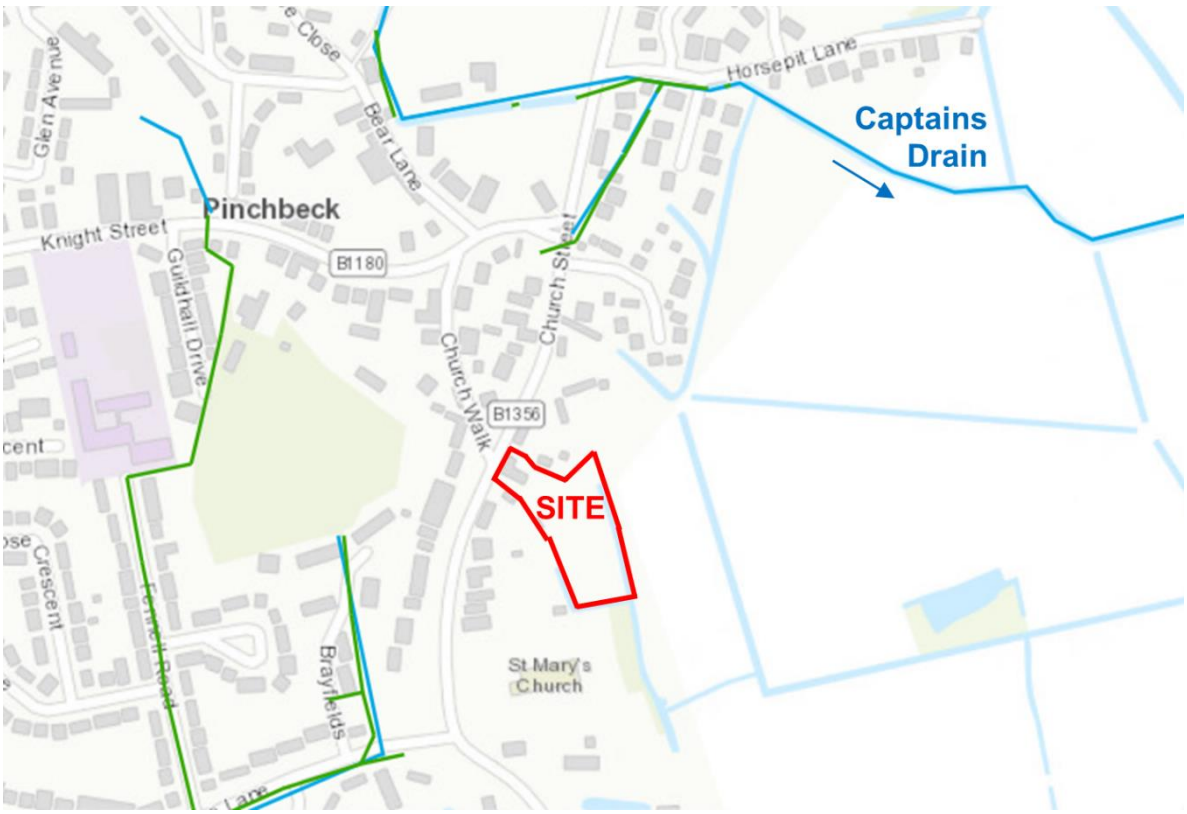
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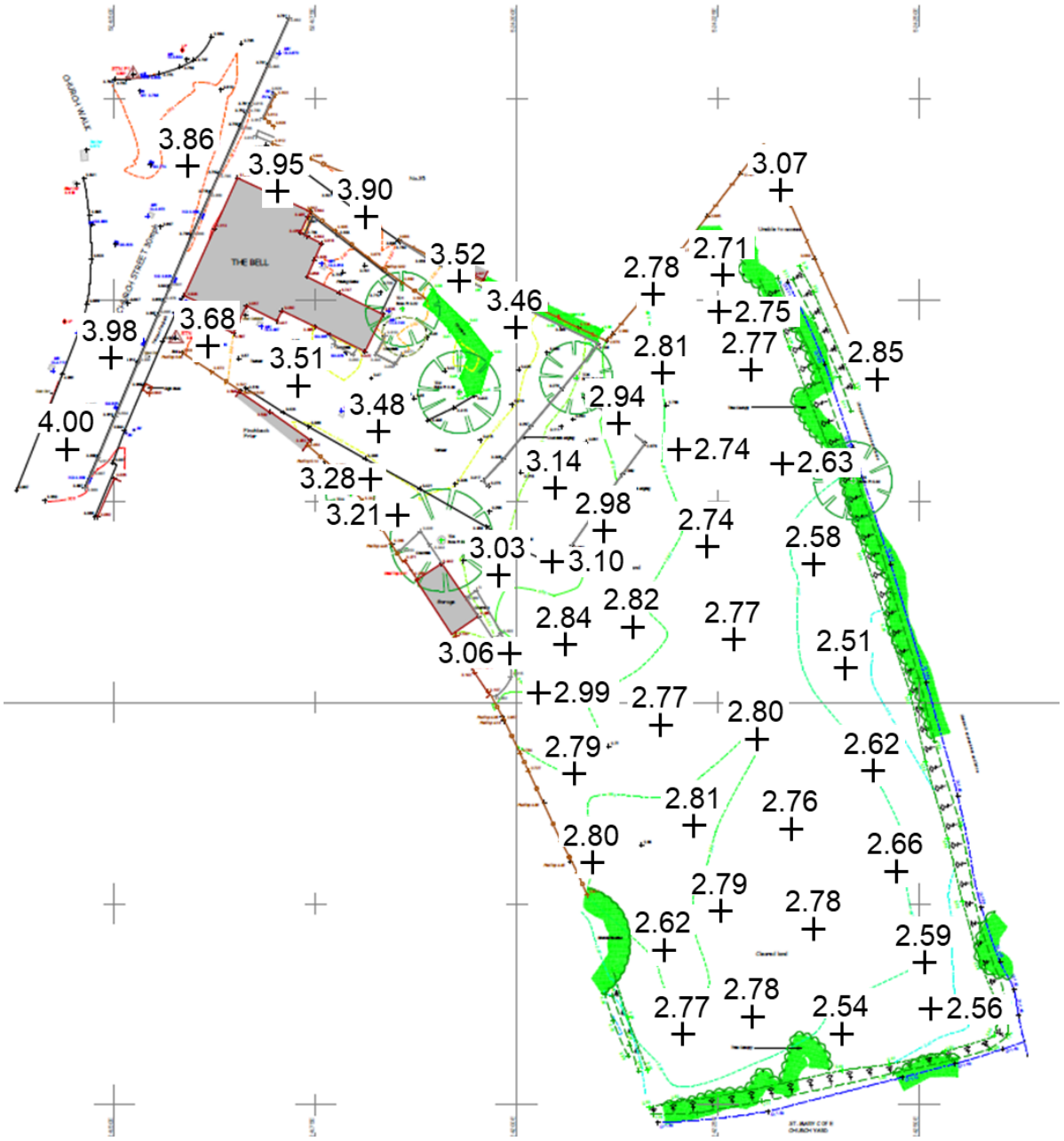
LOCATION PLAN



PLAN SHOWING IDB DRAINAGE CHANNELS



PLAN SHOWING SITE LEVELS



PROPOSED BLOCK 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

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

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

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

s been withdrawn (19

Revised 2016 EA Guidance

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

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

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

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

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

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

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

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

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

Effects on Predictions of Flood Risk in FRA

The FRA has identified two 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 fluvial section of the River Glen or the IDB drainage system

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

Therefore it can be seen that the revised guidance increases the maximum allowance for sea rise in 2115 by 100mm. This may slightly increase the risk of a breach occurring in the tidal bank north of the site. It may also slightly increase the flow of water into the area west of the tidal River Welland. However it will not change the conclusions and recommendations in this report.

Fluvial Flooding.

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 65% in these systems it will have the effect of flooding over the long sections of bank between Bourne and Surfleet and the maximum levels will not increase significantly.

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 ground floor levels of proposed dwellings (either bungalows or houses) should be a minimum level of 3.20m OD is satisfactory.