PROPOSED RESIDENTIAL DEVELOPMENT ON THE SITE OF THE FORMER NEW BRIDGE INN AT SLIPE DROVE, WEST PINCHBECK, SPALDING, PE11 3NH

FLOOD RISK ASSESSMENT



View from the south end of the site looking north east

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 Slipe Drove, West 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 purposes other than for which it was originally commissioned.

Introduction

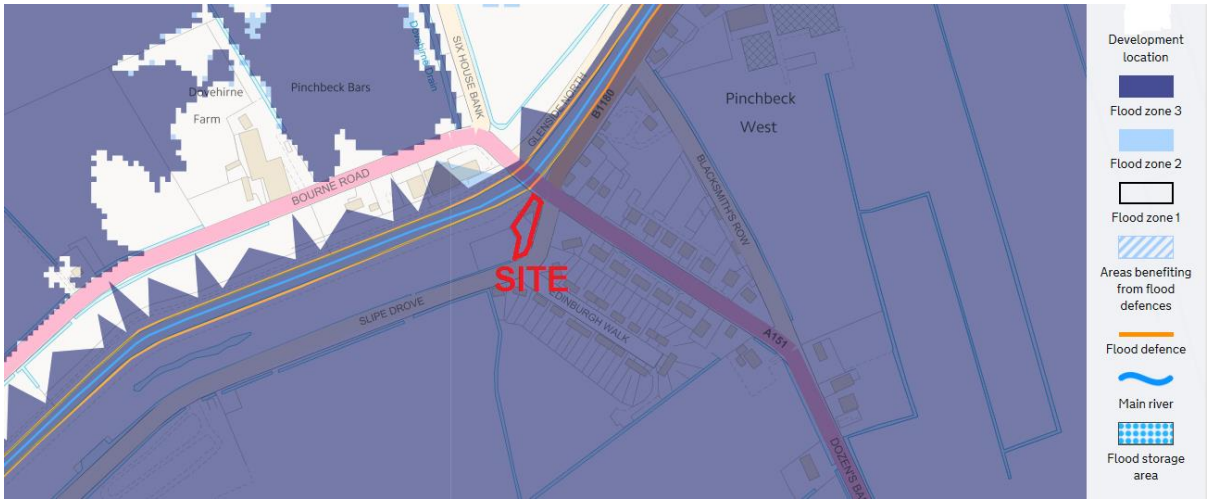
A planning application is due to be submitted to South Holland District Council to construct eight dwellings on the site of the former New Bridge Inn on the junction of Slipe Drove and the A151 at West Pinchbeck, Spalding, PE11 3NF. The site is situated approximately 3.0 km north west of Spalding.

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 approximately 30 metres from the River Glen. The National Grid Reference of the site is 520050 324410.

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.

Refering to the flood risk vulnerability classification in Table 2 of the Guidance, a residential development is categorised 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 in flood zone 3(a) 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 West 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.

The safety of the development will be delivered by ensuring the floor level of the proposed new building is above predicted residual flood levels for this area.

This project complies with all of the policies of the South Holland District Council for village areas such as west Pinchbeck.

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 … zero
	Extent of flooding ... Nil
	Flood Hazard……None
	Peak Velocity ……. None
For year 2115	Depth of flooding … 0 – 500mm
	Extent of flooding …High
	Flood Hazard……Low
	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 …0 – 250mm
	Extent of flooding .. Medium or High

Flood Hazard……Low

Peak Velocity …… 0 – 0.1m/sec

For the year 2115 Depth of flooding …0 – 250mm

Extent of flooding .. High

Flood Hazard……Low

Peak Velocity …… 0.1 – 0.25m/sec

Figure 16 of the general maps show that the site is 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 the River Glen at chainage 10.0 km.

	2007	2115
Peak 1 in 100 year flood level	4.64m OD	4.92m OD
Peak 1 in 1,000 year flood level	4.91m OD	5.14m OD

The table in the SFRA states that the crest level of the stone wall on this section of the southern side of the River Glen is 6.11m OD, and the road level noted on the survey of the site is 5.2m 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.

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	4.63m OD	4.77m OD
Peak 1 in 1,000 year flood level	5.04m OD	5.36m OD

The Environment Agency have also provided a map of modelled flood extents with defences. This is reproduced on page 15 of this report. This map does not predict any flooding to the site in a 1 in 1000 year event in 2115.

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 immediately south of the bank on the south side of the River Glen which is maintained by the Environment Agency.

The site is located approximately 5.5 km from the tidal section of the River Welland, which is maintained by the Environment Agency.

The site is located 2.7km 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

Levels were taken in 2011 before the building on the site was demolished. This building was situated in the north east corner of the site. Levels were taken on the doorways and these indicated that the floor level in the main part of the building was 4.50m OD and in the rear extension it was 4.00m OD.

The building has now been demolished and levels on the site are approximately 600mm below the levels of the footpath alongside Slipe Drove. The drawings of the proposed development show the levels of the new parking area will be raised to 4.00m ODN on the south end in front of plots 1 - 3 and 4.35m ODN in front of plots 6 - 8.

Levels were taken of the south bank west of the bridge over the River Glen in 2011 and these were found to be a minimum level of 5.80m 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 the River Glen.
3. Failure or overtopping of the banks of the Vernatt's Drain.
4. Flooding from the IDB drainage system.
5. Surface Water Flooding

1. Failure or overtopping of tidal defences

The tidal River Welland is 5.5km 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. The railway line approximately 2.0 km west of the river would then further hold up the water from flowing further westwards and affecting the site of the development.

Therefore it is very unlikely that flood water from this source would flow as far as the development site and as the floor level of the development will be significantly higher than the land to the south of the site the risk of flooding from this source can be considered to be 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. 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 4.63m OD. These predicted levels are lower than the defence levels on this section of the bank of the River Glen which are approximately 5.80m OD.

Predicted water levels with an allowance of 20% for climate change as advised in the SFRA are 4.77m OD for the 1 in 100 year event This is also below the level of the south bank of the River Glen.

The latest advice from the Environment Agency is that the predicted level in a 1 in 100 year event in 2115 will be 5.04m OD, which is again lower than the defence level.

Although the actual risk is extremely low there is still a residual risk if the bank were to fail directly north of the site. It is very unlikely that the bank would fail close to the bridge because there is a length of steel piles reinforcing the bank as can be seen from the photograph below.



The most common first stage for formation of breaches is overtopping of a bank, which then leads to erosion of the back of the bank. This type of failure is more likely to happen at locations where the bank is lower and subject to overtopping.

Although the likelihood of a breach occurring at this location is extremely low, this source of flooding is the greatest risk to the site, and the hazards will be reviewed later in this report.

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 the risk that the banks could fail when water levels are very high and this could cause flooding to land south 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.

With the location of the proposed development near the top of the bank the proposed finished floor levels will be higher than 4.00m OD and therefore this source of flooding can be discounted.

4. Flooding from the IDB Drainage System

Welland and Deepings IDB maintain the Glen Soke Dyke on the south side of the River Glen. This drain flows westwards from the edge of the development site along the north side of Slipe Drove and then flows southwards from Guthram Gowt into the Counter Drain.

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.

As the proposed level of the development is 4.30m OD, compared with the average level of the fields south of the River Glen between 3.00m and 3.50m OD, the possibility of any flooding from the IDB system can be discounted.

5. Surface Water Flooding

As the proposed level of the building is 4.30m OD then there is no risk of flooding from this source.

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

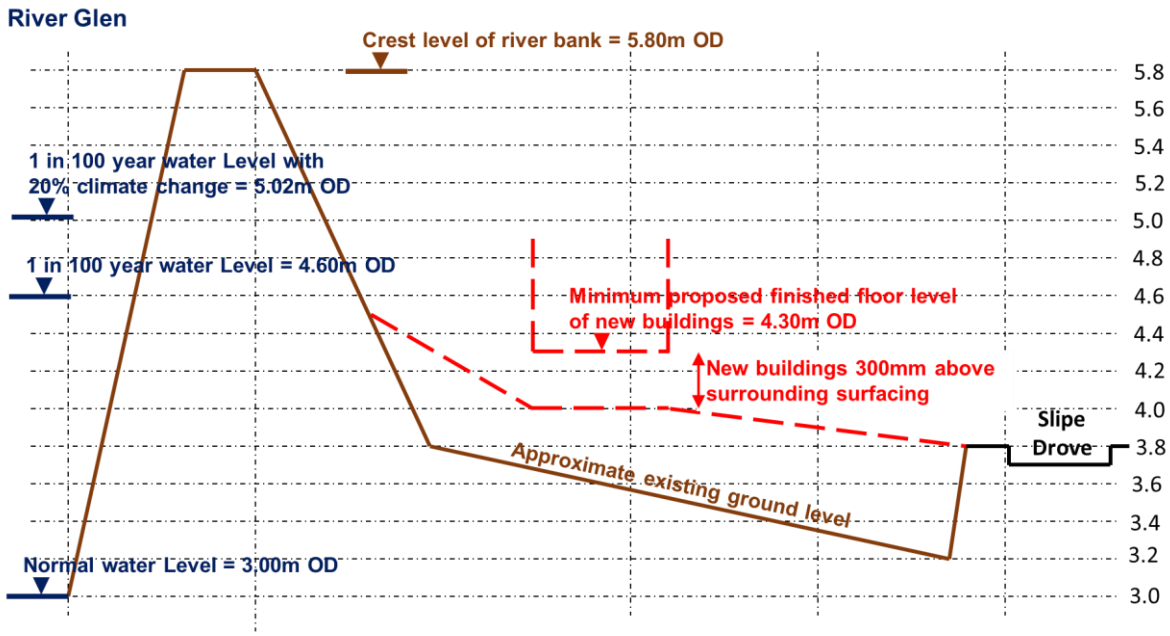
The recommendations for flood depths for this flood risk assessment use information mostly taken from the South Holland DC SFRA which was last updated in 2010. The EA have issued new guidance on recommended contingency allowances for predicted sea rises, fluvial flows and rainfall intensities which from 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.

Conclusions

The map in the SFRA showing the residual 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 the site would not exceed 250mm. It is assumed this is for the 1 in 100 year fluvial event with climate change. This map is shown on the next page:



It is assumed that this flooding will result from overtopping of the River Glen. The predicted maximum levels in River Glen are shown on a cross section north west to south east through the centre line of the building which is shown below.



Using this cross section it can be concluded that the finished ground floor levels of the proposed properties should be a minimum of 4.30m OD, which is 300mm above the proposed ground level around the buildings.

It should be noted that the the predicted 1 in 100 year level in the River Glen in 2115 with 20% allowance for climate change is 5.02m OD. Therefore the River Glen is not predicted to overtop at this location. The EA have increased the allowance for flows to be considered for climate change. However in the River Glen any increase in flow will lead to more overtopping at numerous locations and will not lead to an increase in the peak water level in the River.

Therefore it can be concluded that the proposed floor level of 4.30m OD will provide adequate mitigation against flooding to the proposed new buildings.

The risk of flood water from the tidal River Welland reaching the site if a breach occurred in these banks can be considered remote. Flood water would need to be at least 1.8 metres in depth across the whole fen before the proposed development would be affected.

The risk of flooding from Vernatt's Drain can be discounted because the recommended floor level is above the maximum predicted level in this watercourse.

The risk of any flood water from any IDB sources increasing above 4.30m 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 any new buildings should be of two storey construction designed with all sleeping accommodation located on the first floor.

The ground floor level of the proposed two storey buildings should be at a minimum level of 4.30m OD.

In an extreme fluvial event water levels in the River Glen would rise slowly and would only reach their peak after a minimum of 24 hours. The Environment Agency would issue warnings hours before the event, and all occupiers would be aware of the situation.

On site surface water drainage will be discharged into a storage facility, possibly plastic water storage cells, and will be discharged at a low rate into the IDB drain on the west side of the site, subject to the agreement of the Welland and Deepings IDB.

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 buildings. 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.

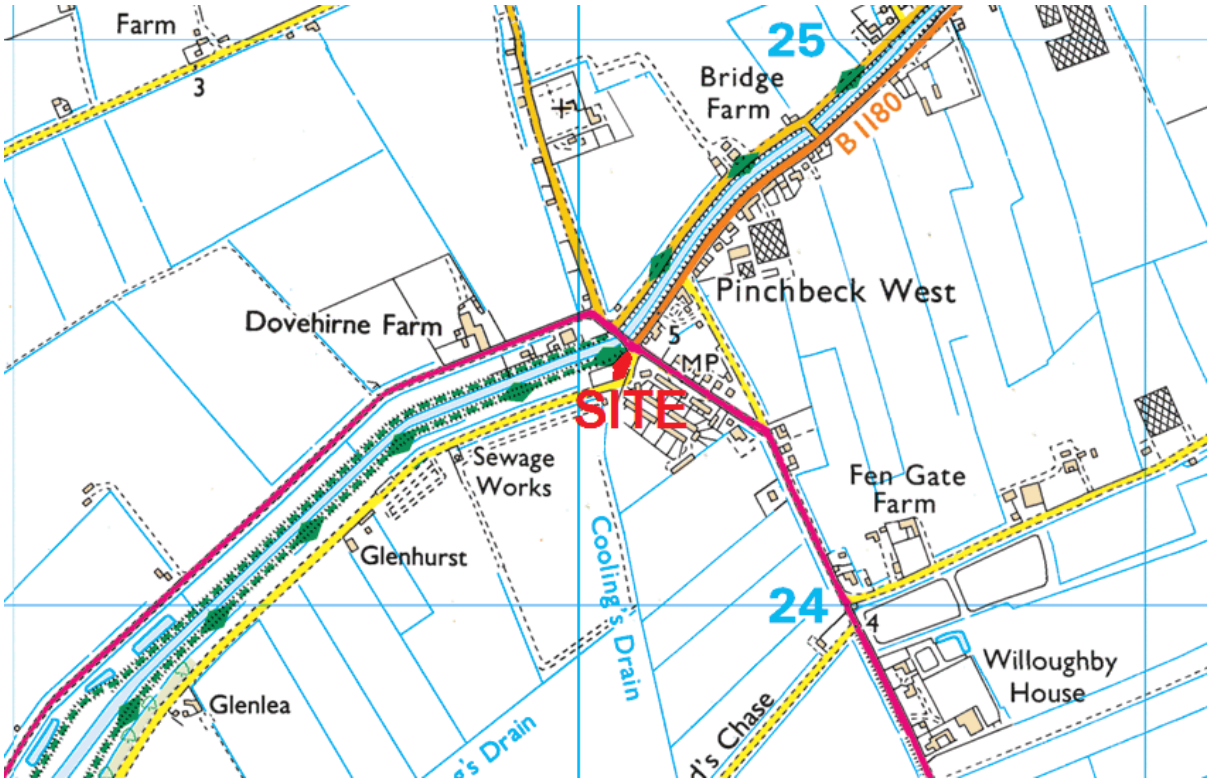
All future occupiers of the properties should register with the Environment Agency's Floodline Warnings Direct Service.

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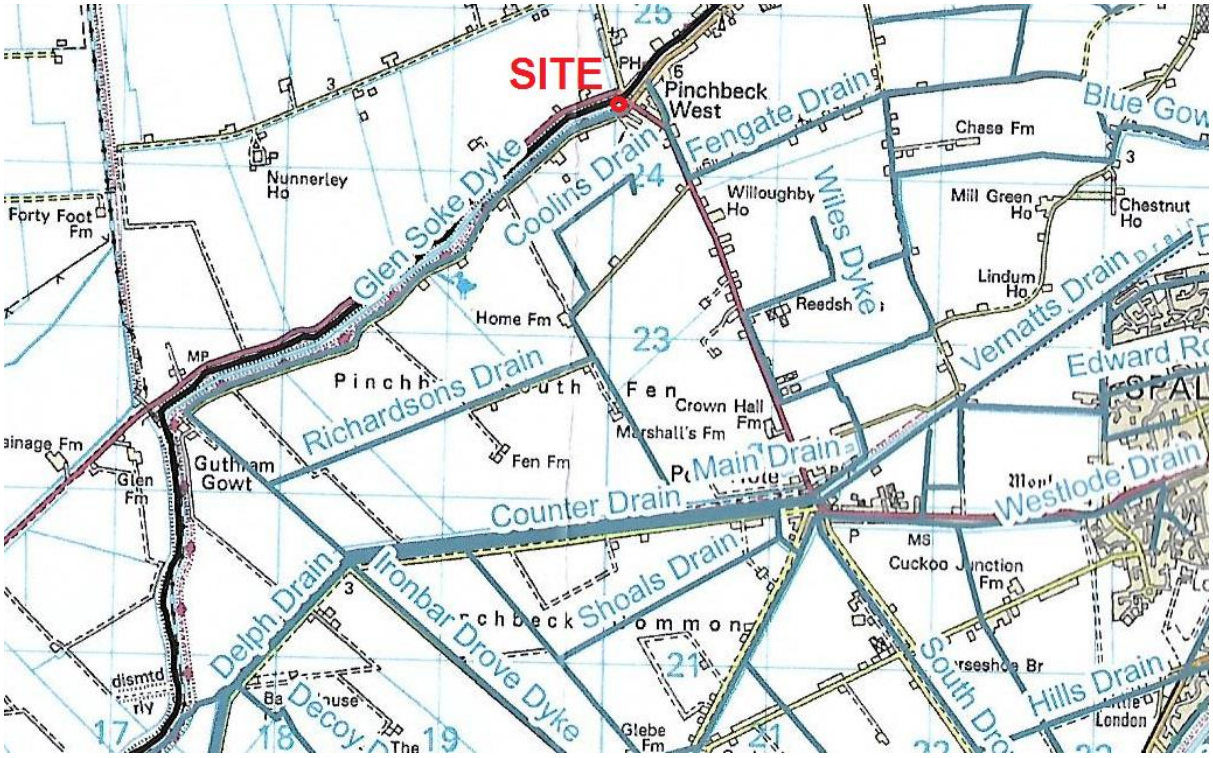
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14th October 2020

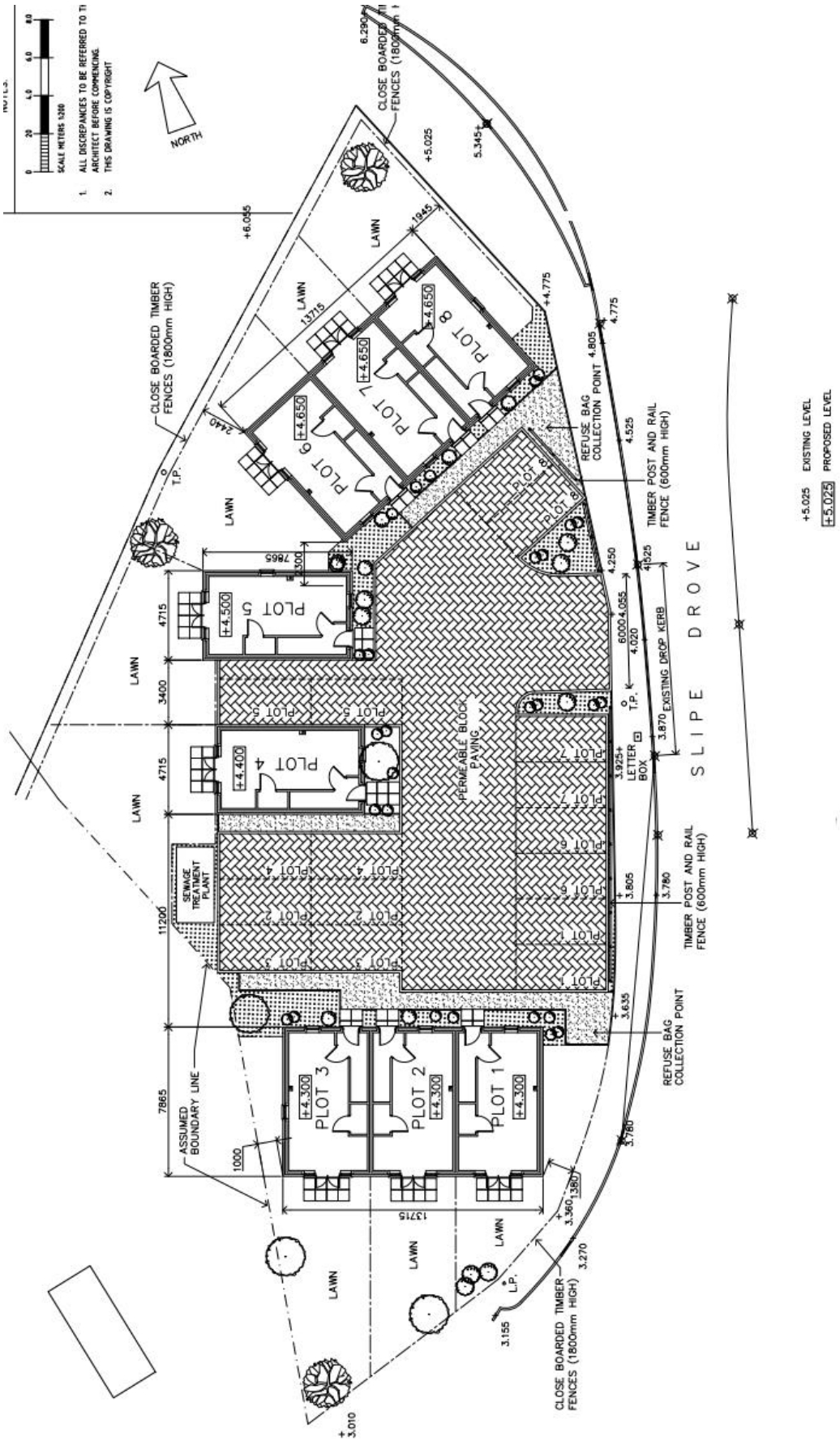
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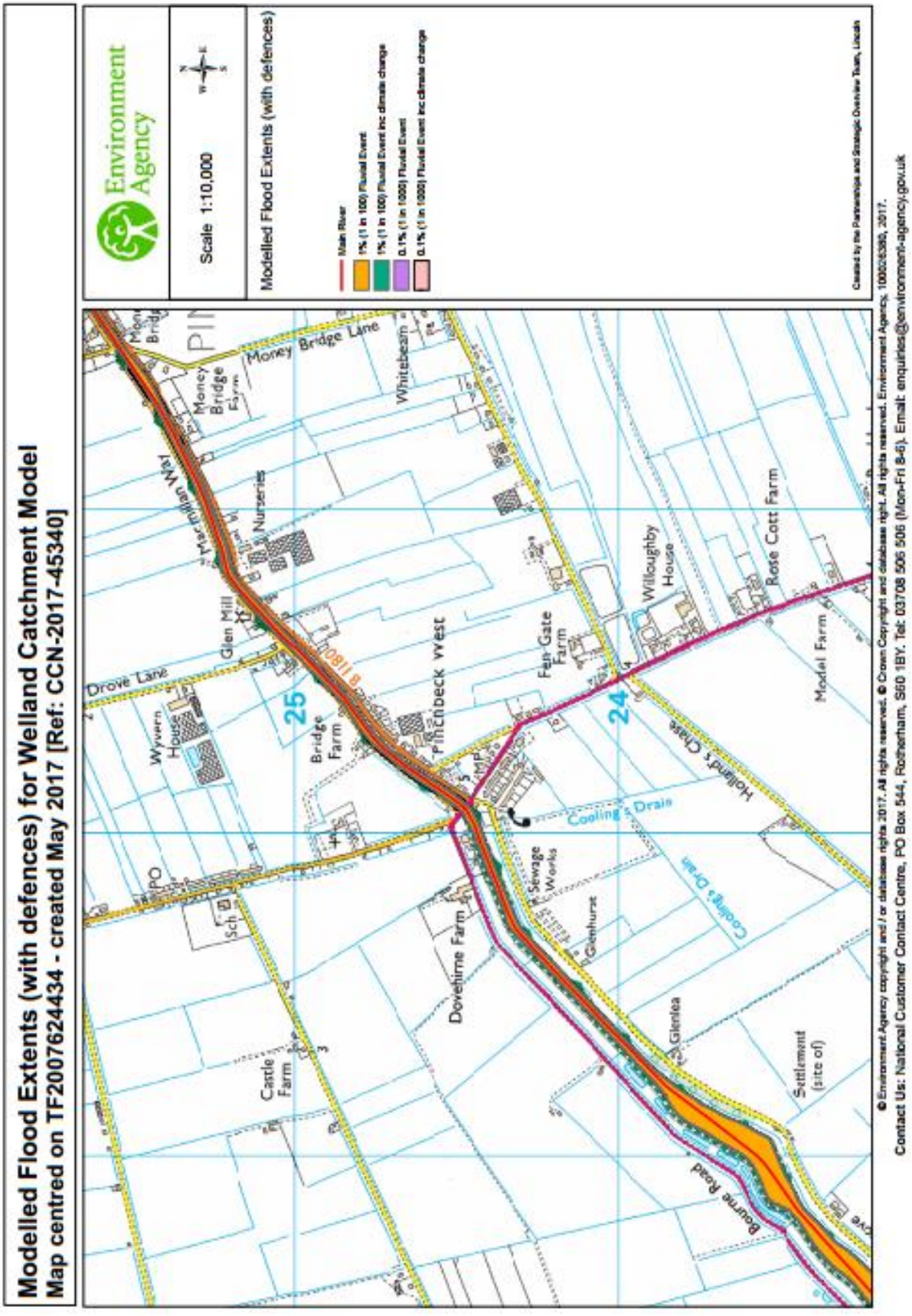
PLAN OF IDB DRAINS



PLAN OF PROPOSED DEVELOPMENT



ENVIRONMENT AGENCY PLAN SHOWING MODELLED FLOOD EXTENTS WITH FLOOD DEFENCES



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 SFRA predicts that there will be flooding to the proposed development site up to a depth of 500mm 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 building should have a ground floor level of 4.70m 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 it is considered that the mitigation proposed for the development, with the recommendation that the ground floor levels should be a minimum of 300mm above the proposed site levels at a minimum level of 4.30m OD is considered satisfactory.