PROPOSED DEVELOPMENT OF TWO DWELLINGS TO REAR OF 92 & 94, NORTH STREET, CROWLAND, PETERBOROUGH, PE6 0EF

FLOOD RISK ASSESSMENT

View of site from North Street

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This flood risk assessment has been prepared solely to support the planning application for two new dwellings at the rear of 92 and 94 North Street, Crowland. 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

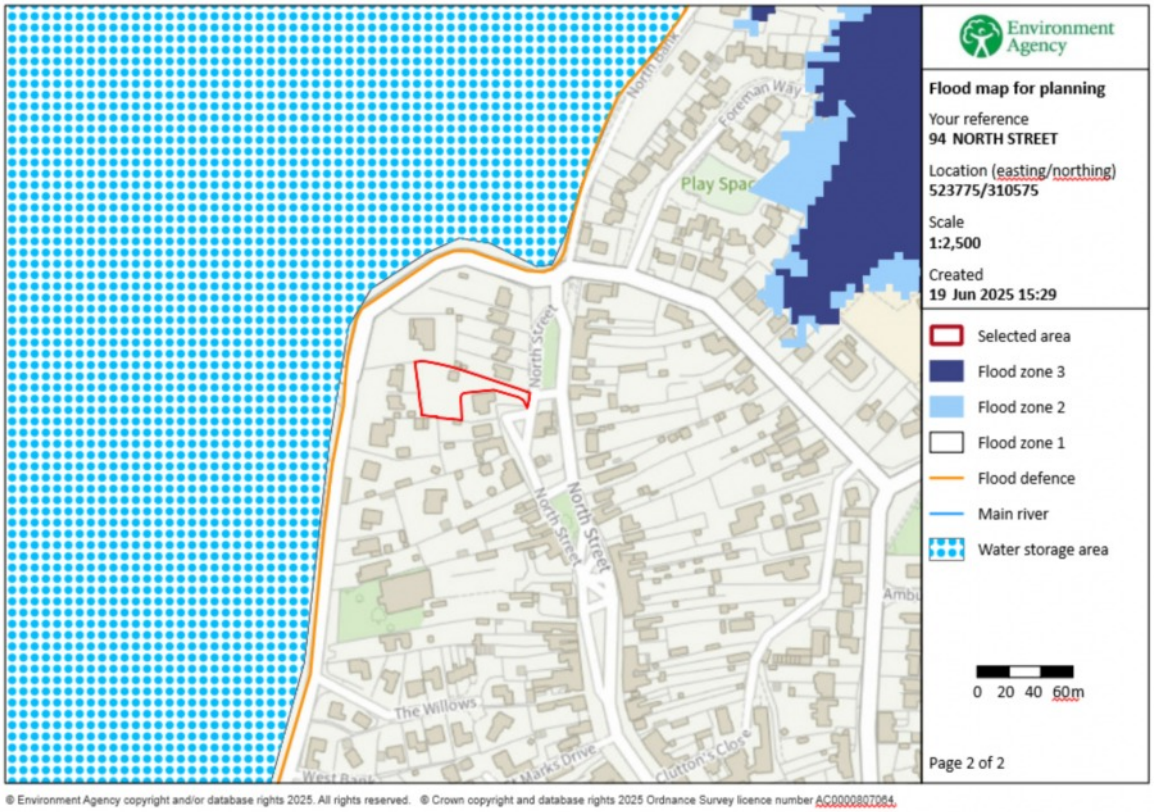
An application is due to be made to South Holland District Council for Planning Permission to construct two dwellings to the rear of the existing bungalows at 92 and 94, North Street, Crowland, PE6 0EF. The site is located approximately 40 metres east of the bank of the Crowland Washes which serve as washlands that can be flooded when the level of the River Welland reaches a very high level.

The site is within Flood Zone 1 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 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 North Level 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 this area of Crowland is shown on the flood map to be within Flood Zone 1.

Application Site

The National Grid Reference of the site is 523770, 310570.

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

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 on the next page:

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 *	✗	✗	✗	✓*

From the above table it can be seen that “More Vulnerable” development is satisfactory within flood zone 1.

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 the site of this development is within flood zone 1. Most available sites in the Crowland area are within flood zone 3 and therefore the proposed site can be considered to be better than most sites in the Crowland area.

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

Therefore I consider that the sequential test has been passed.

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.

The maps illustrate the actual flood hazard for the 1% fluvial event and 0.5% tidal event.

For the present day	Depth of flooding … zero
	Extent of flooding .. Low or medium flood probability
	Peak Velocity ……. Nil
For year 2115	Depth of flooding … zero
	Extent of flooding…. Low or medium flood probability
	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 …0 – 1.0 metre
	Extent of flooding .. High
	Hazard rating…… 0 – 2.0 (Low hazard – danger for most)
	Peak Velocity .. 0 – 0.3 metres/second
For the year 2115	Depth of flooding … 250mm – 2.0 metres
	Extent of flooding .. High
	Hazard rating…… 0 – 2.0 (low hazard – danger for all)
	Peak Velocity .. 0 – 1.0 metres/second

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

For the year 2115	Depth of flooding … 250mm – 2.0metres
	Extent of flooding .. High
	Hazard rating…… 1.25 – 2.0 (Danger for some – all)
	Peak Velocity .. 0 – 1.0 metres/second

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

Maximum flood level and bank levels in the fluvial section of the River Welland

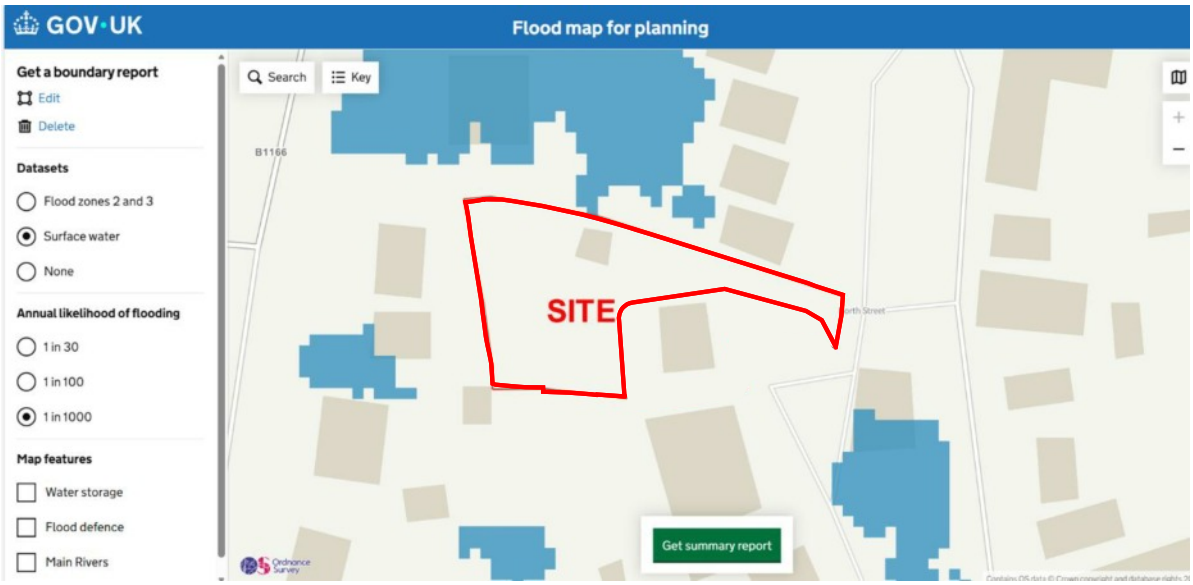
Tables in the SFRA show the following details for the defence bank on the east side of the fluvial section of the River Welland at chainage 13.0 km.

	2007	2115
Peak 1 in 100 year flood level	4.93m OD	4.96m OD
Peak 1 in 1,000 year flood level	4.96m OD	4.97m OD

The bank levels on this section are 6.35m OD. Therefore it can be seen there is a minimum freeboard of 1300mm to the predicted design maximum water levels in 2115.

Information on Surface Water Flooding on Environment Agency Website

The following map, taken from the Environment Agency website, shows areas of the site which are predicted to experience surface water flooding in a 1 in 1000 year event.



It can be seen the map does not predict any flooding would occur on the site in a 1 in 1000 year event. The map does predict flooding to an area north of the site which is presumably lower than the proposed development site.

Existing Flood Alleviation Measures

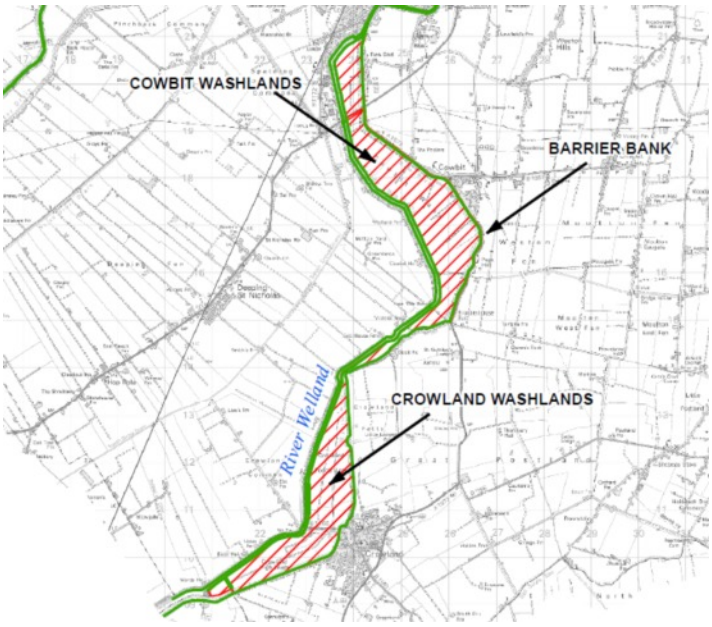
The site is within a defended flood plain, as defined in Appendix 1 of the Environment Agency's "Policy and Practice for the Protection of Flood Plains", which is considered to be passive until such time that a flood greater than the defences can withstand occurs. The likelihood of flooding occurring due to overtopping or failures of the defences is considered to be very low.

The site is located approximately 15.3 km south of the tidal section of the River Welland, which has a tidal defence bank which is maintained by the Environment Agency. The site is not considered to be at risk of tidal flooding.

The rear boundary of the site is located approximately 40 metres east of the bank of the Crowland Washes, which is called the Barrier Bank.

The internal watercourses in the area are maintained by North Level IDB. However there are no watercourses maintained by the Board in the central area of Crowland.

The section of the River Welland from south of Crowland to the southern outskirts of Spalding has two washlands located on the east side of the River, called Crowland Washlands and Cowbit Washlands. A map of the location of these is shown on the next page. These areas are designed to alleviate very high flows in the River Welland. When the water level in the River Welland reaches a level of approximately 5.00m OD large syphons are activated which discharge excess water onto the Washes. The Barrier Bank is located on the east side of the Washes to contain the water in the Washlands and is the main flood defence bank on the east side of the river.



Existing Ground Levels

A survey of the site has been carried out and the levels recorded are shown on the plan on page 15.

The ground level around the existing bungalows is approximately 4.30m OD, and the approximate floor level of the bungalows is 4.45m OD. The rear garden slopes down to a level of 3.21m OD in the north western corner and approximately 3.40m OD in the south western corner.

The gravel drive on the north side of No 94 slopes down from approximately 4.00m OD near the footpath to the level around the existing garage of 3.50m OD.

The level of North Street in front of the property is 4.00m OD.

Potential Sources of Flooding

The potential sources of flooding to the site are:

1. Failure or overtopping of the Barrier Bank
2. High water levels in IDB drainage channels.
3. Localised flooding in the area.

1. **Overtopping of the Barrier Bank.**

The Barrier Bank is the eastern bank of the Crowland Washes. The Washes are only flooded in extreme conditions (around 1 in 50 years) and are used the rest of the time as agricultural land. There are two syphons which operate automatically to allow water to flood on to the Washes if the water level rises to a level approaching the top of the bank and prevent flooding from the River Welland. When this occurs the level of water in the washes will quickly rise to approaching 4.95m OD.

If a breach occurred in the Barrier Bank in this scenario then flood water would flow eastwards towards the development site.

The predicted flood levels in the updated SFRA map of the Crowland area are the consequence of a possible breach in the banks of the River Welland or the Barrier Bank.

Mitigation will be provided by raising the ground floor level of the proposed dwellings above the predicted flood level if the Barrier Bank were to breach in a 1 in 100 year event in 2115.

2. **Flooding from IDB Drainage System**

There are no watercourses which are maintained by the North Level IDB in the central area of Crowland. The nearest watercourse to the development is the upstream length of Brickfield Drain (drain 916), which is maintained by North Level IDB. This drain is approximately 100 metres north east of the site.

The greater part of the surface water drainage systems in Crowland flow into IDB drainage channels on the eastern side of the town which flow eastwards to the North Level Main Drain and the levels of all these watercourses are controlled by the Pumping Station at Tydd which is approximately 24 km east of Crowland.

IDB drains were designed to provide at least a 1 in 10 year standard of service with a freeboard of at least 900mm. This normally provides at least a 1 in 50 year standard of service against overtopping and in many cases a 1 in 100 year standard at the present time.

North Level IDB have a policy of monitoring standards of protection in all their catchments and will carry out improvements to pumping stations, sluices and drainage channels to ensure they do not fall due to higher runoffs predicted with climate change.

It is unlikely that any failure of assets such as pumping stations, sluices or drainage channels would lead to overtopping of the watercourse because North Level IDB have an excellent maintenance regime and monitor all assets with a modern telemetry system.

As the banks of the IDB drains are below the proposed ground floor levels recommended to be above the risk from a breach in the Barrier Bank this will provide adequate mitigation against the risk of flooding from the IDB drainage system.

3. Localised Flooding in the area

Although there is an adequate surface water drainage system in North Street there is still a risk of accumulations of surface water flowing onto the site. The raising of the ground floor levels by approximately 800mm – 900mm above the existing ground level will provide adequate mitigation against surface water flooding to the proposed dwellings.

Extent of known Flooding

A combination of heavy snow, a sudden thaw, high tides, rain and wind, all caused the River Welland to break its banks in March 1947. The map on page 14 of this report shows the extent of the flooding which completely cut off Crowland for a few days. The map shows the proposed site was not affected by the flooding. Following this event banks have been raised and many other improvements have been carried out by the Environment Agency and its predecessors and the North Level IDB which significantly reduces the risk of an event such as this reoccurring.

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 Barrier Bank.

The risk of this happening in this case is low but the hazard if the bank breached would be high.

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 17 to 20). 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. The only designated advice in the Matrix for this type of development in flood zone 1 is “No Comment”.

The relevant part of the EA map showing predicted flood hazard for Crowland in a 1 in 200 year event in 2115 is reproduced on the next page. The locations of the proposed dwellings on the western (rear) part of the site are shown dotted.

It can be seen that the proposed northern dwelling is 50% within the “danger for most” and 50% within the “danger for all”. The proposed southern dwelling is within the “danger for most” area.

If the development were to be considered to be in flood zone 3 a flood hazard of “danger to Most” (1.25 to 2.0) reference would be made to Category D8 of the matrix. Alternately with a flood hazard of “danger for all” (greater than 2.0) then Category C8 should be considered. Both categories C8 and D8 state the following advice.

The Environment Agency requires direct consultation on proposals in this hazard zone. 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 and set as required below (single storey proposals must use the 0.1% event, 2115 scenario, for setting FFLs).

Flood depths of greater than 1.6 metres

It is unlikely that mitigation measures would prevent flood water from entering the building at ground floor level. Therefore proposals should have a minimum of 2 storeys with no ground floor habitable accommodation. The first floor living accommodation must be above the highest predicted flood depth.

Flood depths of 1.0 – 1.6 metres

Proposals must have a minimum of 2 storeys, with FFL set a minimum of 1.0 metre above existing ground level, flood resilient construction to a height of 300mm above the predicted flood depth, and demountable defences to 600mm above FFL.

Flood depths of 500mm – 1.0 metre

FFL set a minimum of 1.0 metre above ground level with flood resilient construction to a height of 300mm above the predicted flood depth.

However the conclusions set out below will consider the ground levels on the site and this will enable a more accurate assessment of the flood level to be made, and a recommended level for the finished floor level of the building.

Summary of Risk of Flooding to the Site

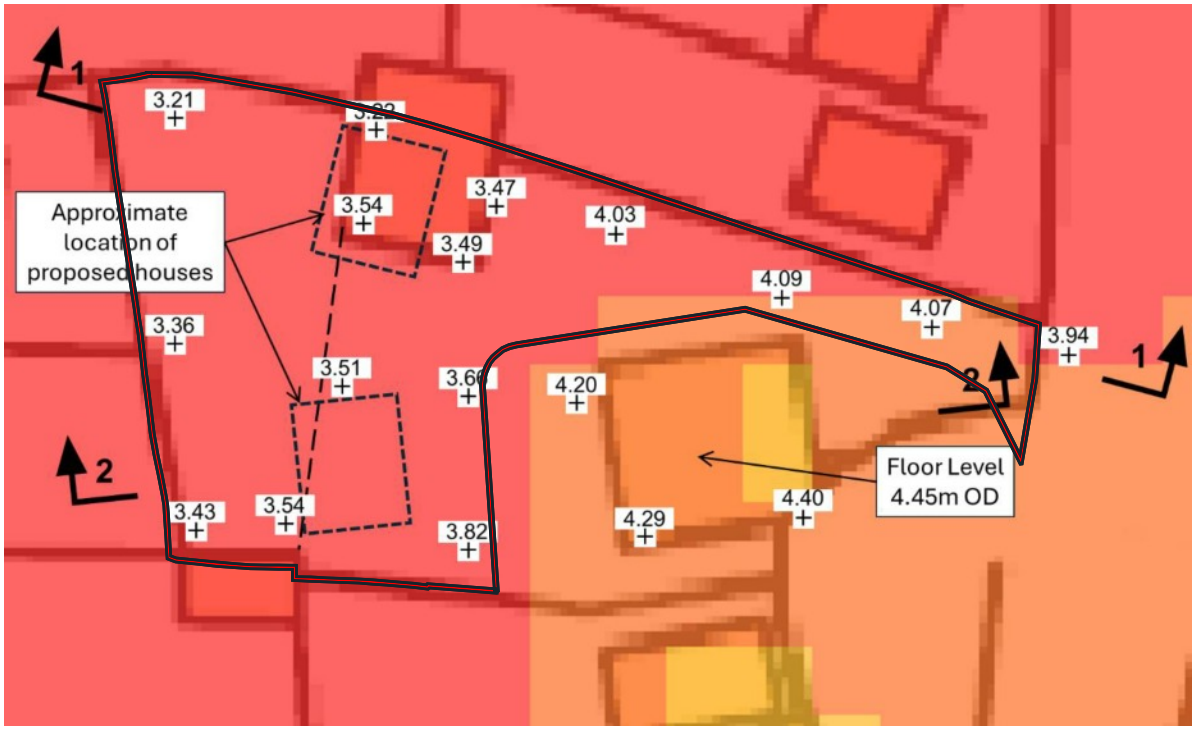
The site is within flood zone 1, as shown on the Environment Agency flood zone maps, which initially indicates the risk of flooding is within the lowest risk zone, with an annual probability of less than 1 in 1000 annual probability of flooding.

The main risk of flooding to the site is if a breach were to occur in the east bank of the Crowland Washes. The risk of this happening along this section of bank can be considered to be extremely low. The bank has a wide top with a tarmac road on the top and bank slopes are not steep.

The relevant part of the map showing the predicted peak depths in this area if a breach occurred in the Barrier Bank of the River Welland in a 1% fluvial and 0.5% tidal event in 2115 probability is shown below.

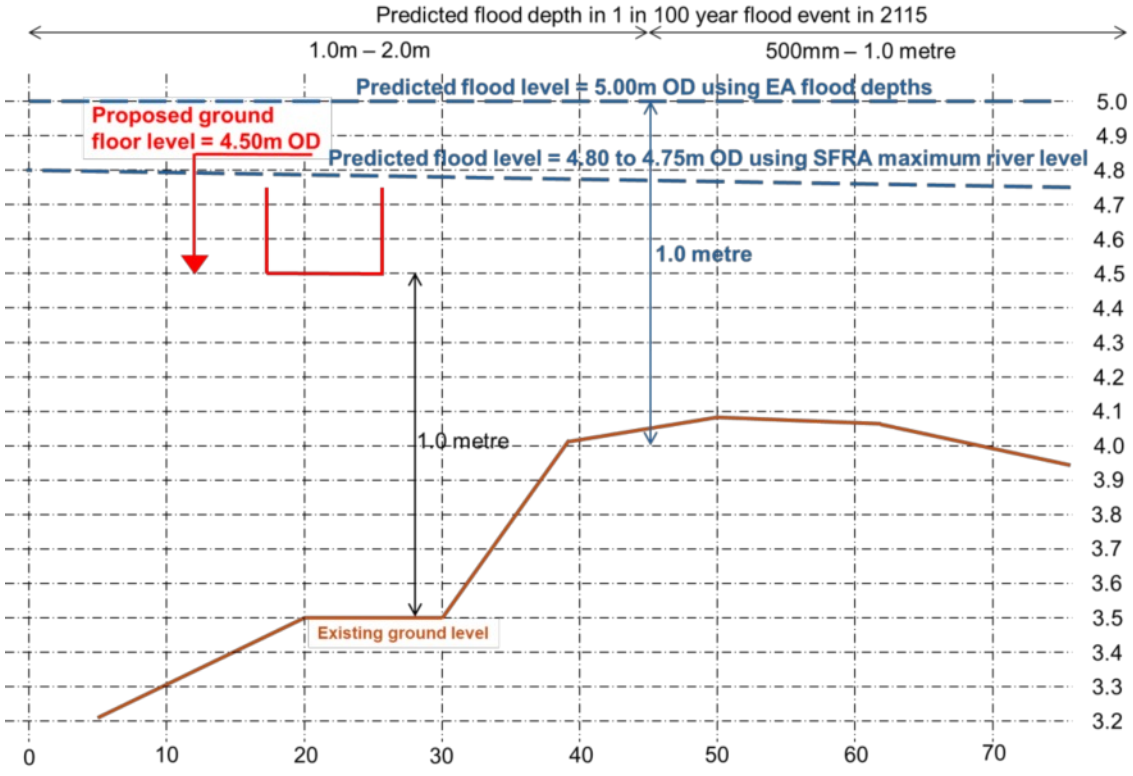
It can be seen that the predicted flood depth in the 1 in 200 year event in 2115 at the locations of the two proposed properties is between 1.0 metre and 2.0 metres.

Levels have been taken on the site and these have been superimposed on the above map. This is shown on the next page.

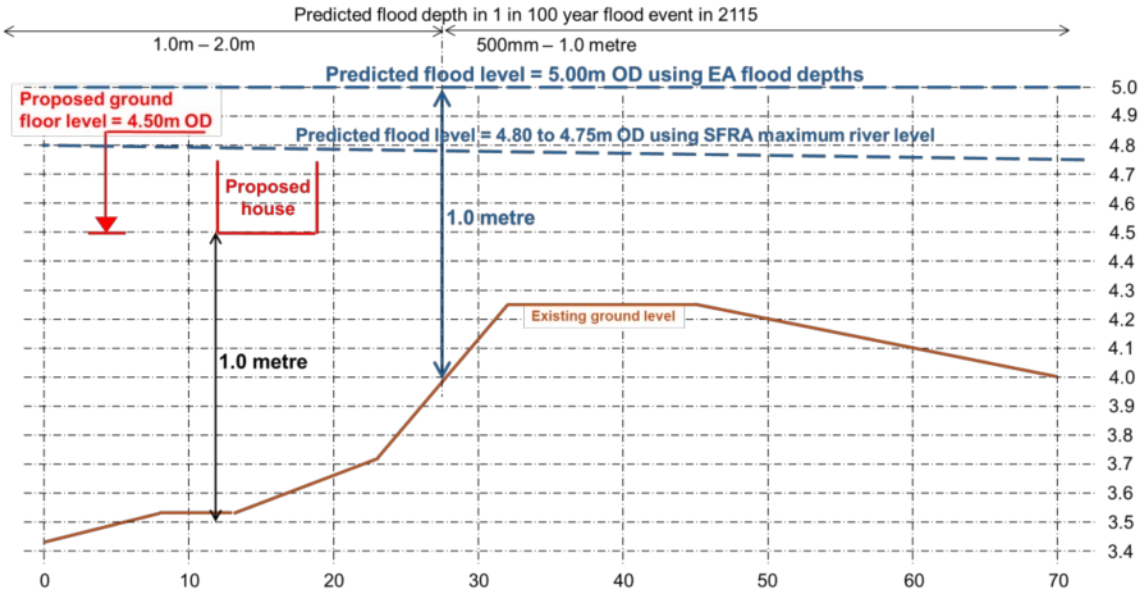


The above map indicates that the boundary line between the red zone (flood depth between 1.0 metre and 2.0 metres) and the orange zone (flood depth between 500mm and 1.0 metre) is approximately 4.0m OD and as the predicted flood depth along this boundary is 1.0 metre then this map indicates the maximum flood level would be 5.00m OD. This is shown on the following cross sections west to east across each of the proposed houses.

<u>Cross Section Through Proposed Northern House.</u>



Cross Section Through Proposed Southern House.



The proposed ground floor level for the houses is approximately 1.0 metre above ground level. This follows the recommendation in the south east Lincolnshire Matrix that for flood depths of 1.0 – 1.6 metres proposals must have a minimum of 2 storeys, with FFL set a minimum of 1.0 metre above existing ground level, flood resilient construction to a height of 300mm above the predicted flood depth, and demountable defences to 600mm above FFL.

By referring to the 2010 SFRA the maximum 1 in 1000 year level in the River Welland at Crowland Bridge is 4.95m OD. If a breach were to occur in the Barrier Bank, the west side of which is approximately 40 metres from the western (rear) boundary of the site it can be shown that the level of the flood water would be approximately 4.80m OD at the rear of the site and 4.75m OD at North Street. These approximate levels have been estimated by assuming a 40 metre wide breach forms in the Barrier Bank and water flows through this breach onto the site. This maximum water level is 200mm lower than the maximum water level indicated by the ground levels and the flood maps.

Recommendations

In any area at risk of flooding it is preferable that new dwellings should be of two storey construction with all bedrooms at first floor level. This is to provide a refuge for residents if the buildings were to become flooded after a major breach of the tidal bank, and ensure there is no danger to residents when they are asleep.

As the maximum predicted flood depths are greater than 1.0 metre then the building should have two storeys with all bedrooms located on the first floor.

The finished ground floor level of the proposed houses should be set a minimum of 1.0 metre above existing ground level, with flood resilient construction to a height of 300mm above the predicted flood depth, and demountable defences to 600mm above finished floor level. The finished ground floor level of the houses will be approximately 4.50m OD.

The developer should advise owners and occupiers of the properties to register with the Environment Agency's Floodline Warnings Direct Service.

Rainwater from the roofs of the buildings should be discharged if possible into soakaways and these should be designed to BRE Digest 365 and approved under Building regulations. New hardstandings around the proposed buildings should be constructed with permeable paving.

S M HEMMINGS B Sc C Eng MICE MIWEM

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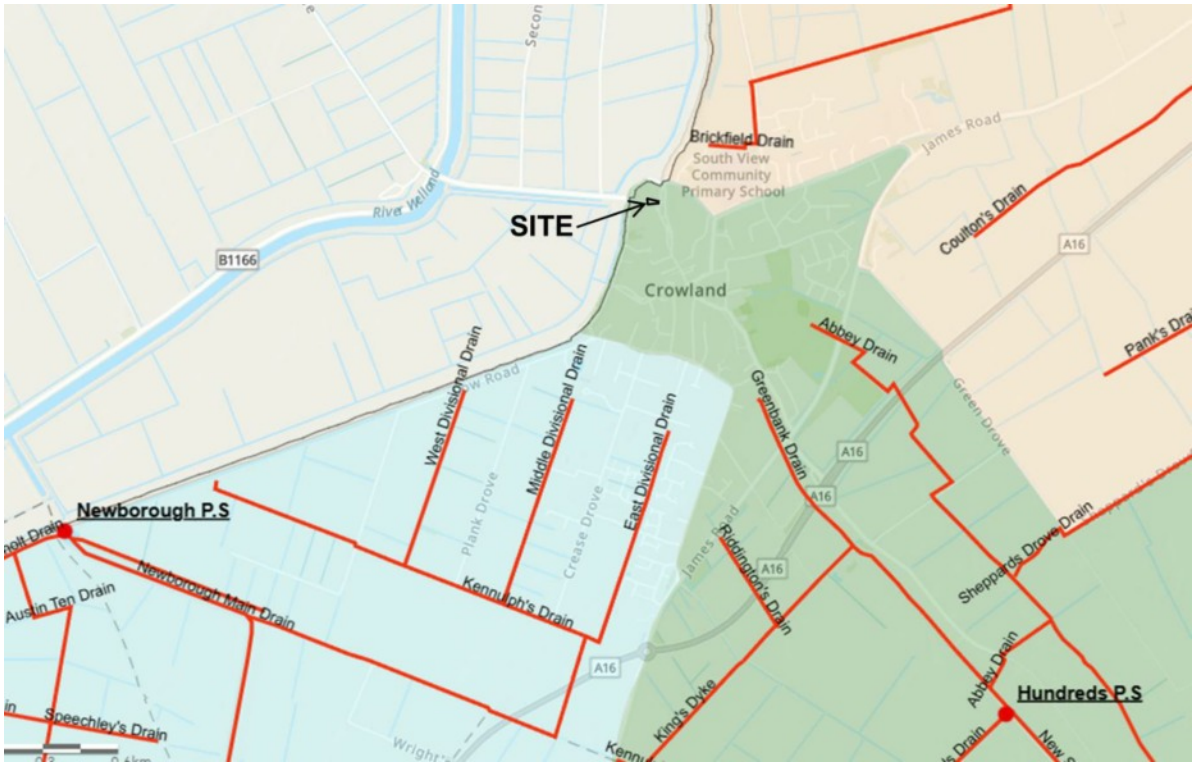
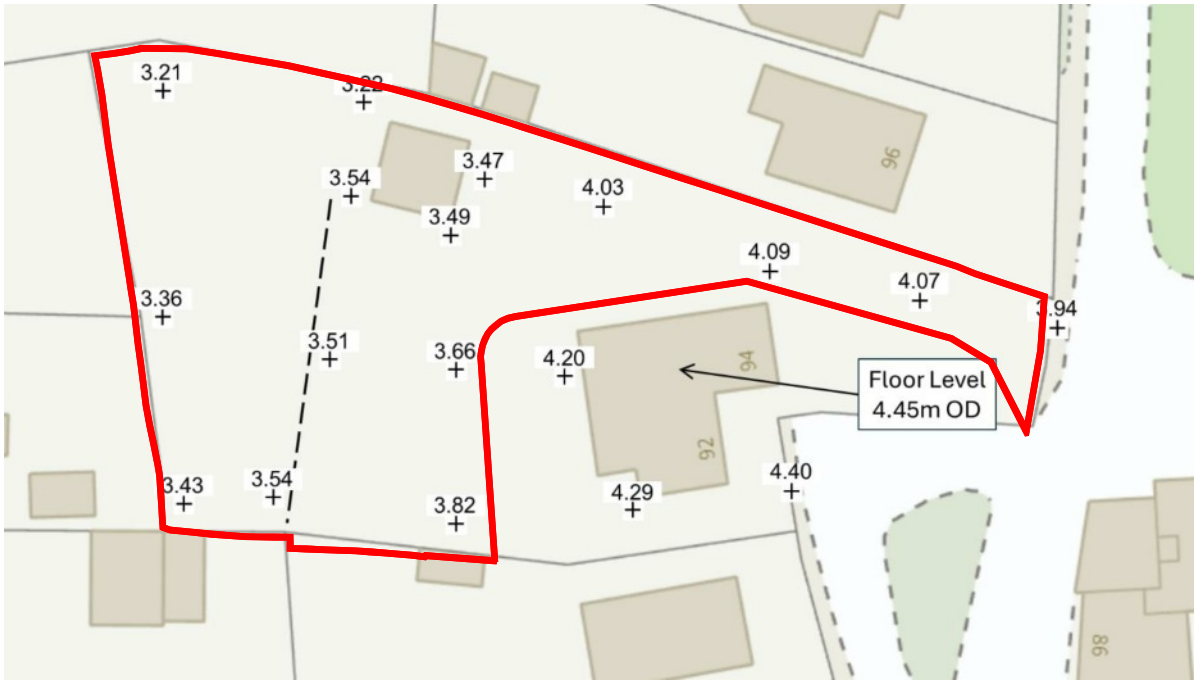
13th November 2025

LOCATION PLAN

PLAN OF IDB DRAINS

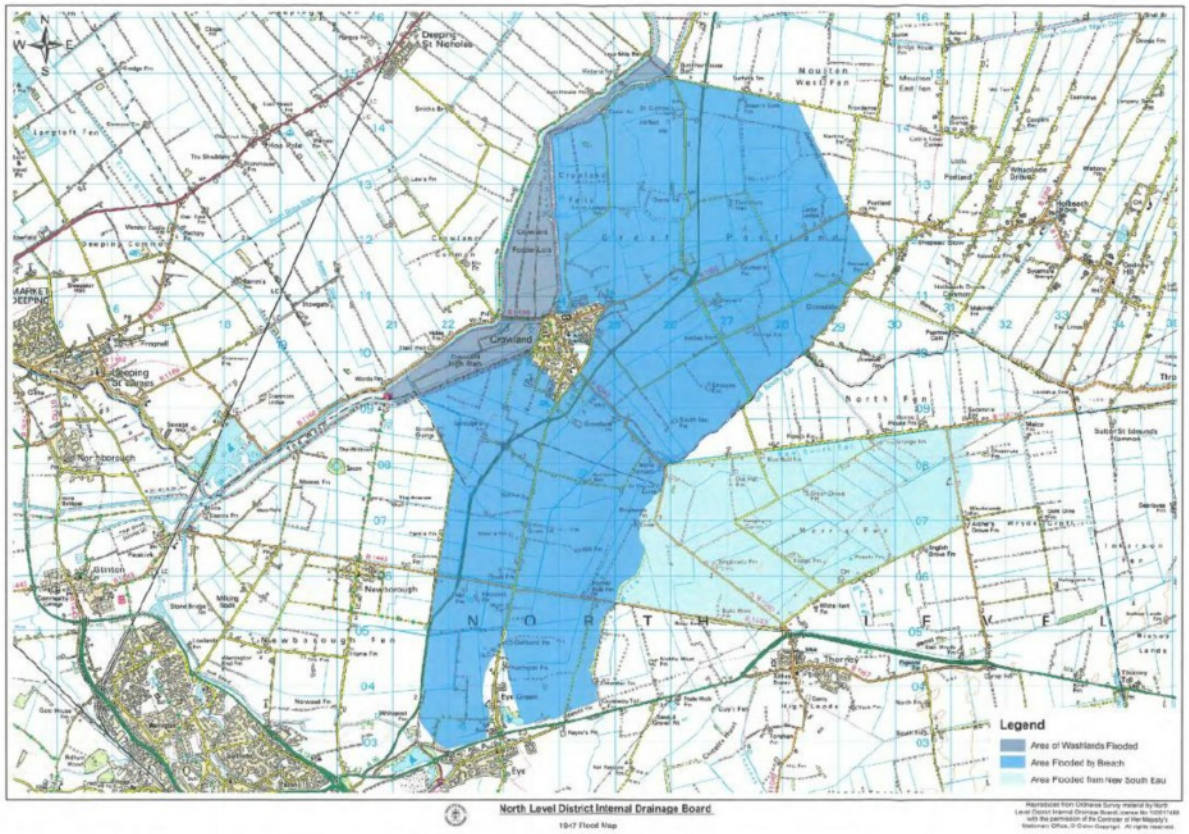


PLAN SHOWING SITE LEVELS



PLAN OF PROPOSED DEVELOPMENT

PLANS OF FLOODED AREAS AROUND CROWLAND IN 1947



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

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 1 the central and 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

The report has identified that the main sources of flooding to the proposed development are from the River Welland and the IDB drainage system

As the development is in flood zone 1 and is classed as more vulnerable, the central climate change allowance, which is 25%, should firstly be considered. After considering the effects of this increase the higher central, which is 35%, 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 25% and 35% will not significantly change the conclusion in the SFRA of what might happen if a breach occurred in the Barrier Bank. If there are additional flows along this part of the River Welland it will lead to the storage systems of the Cowbit and Crowland Washes operating and additional overtopping over lower banks rather than any significant increase in levels in the river.

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.

North Level 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 North Level 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 level of the proposed new dwellings should be a minimum of 1.0 metre above the existing ground level with flood resilient construction to a height of 300mm above the predicted flood depth, and demountable defences to 600mm above finished floor, is satisfactory.