PROPOSED DEVELOPMENT

NORTH OF 68 STONEGATE, COWBIT, SPALDING, PE12 6AH

FLOOD RISK ASSESSMENT

View of site from north end

S M Hemmings B Sc C Eng MICE MIWEM,

69 Charlotte Way

Peterborough

PE3 9ER

This flood risk assessment has been prepared solely to support the planning application for a development at 68 Stonegate, Cowbit. 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

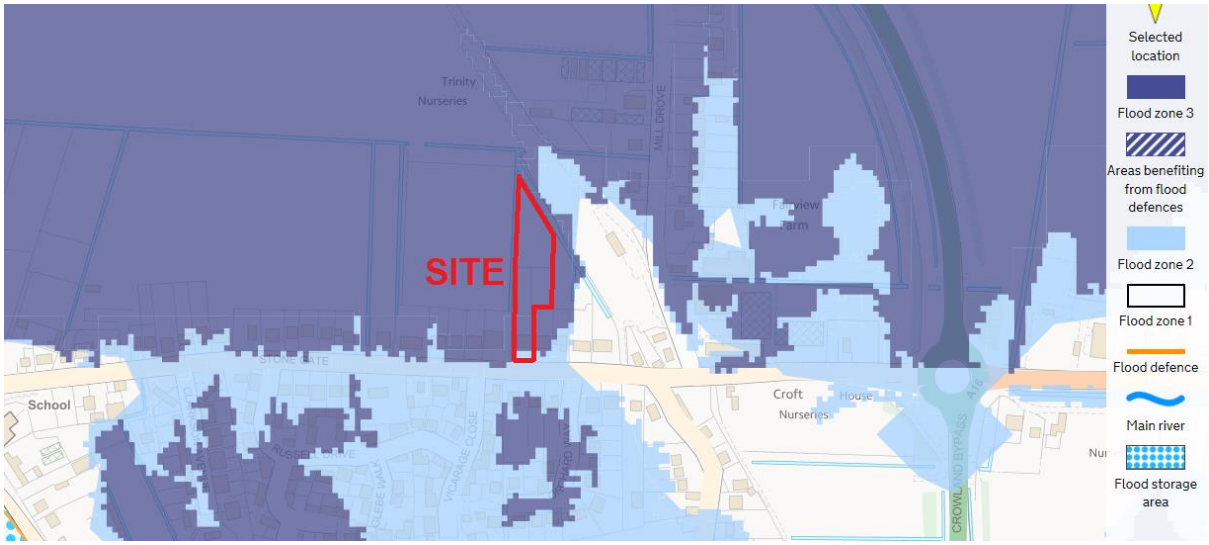
A development of three detached houses is proposed north of the existing house at 68 Stonegate, Cowbit, Spalding, PE12 6AH. The proposed development site is at present part of the large rear garden of the property. The site is in the central area of the village of Cowbit and is approximately 4 km from Spalding.

The site of the proposed development is within Flood Zone 3 as shown on the Environment Agency's Flood Zone map.

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 South Holland 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 National Grid Reference of the site is 526495 318160.

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 a dwelling house is classified as "more vulnerable".

As the site is within a defended area the proposed development can be designated to be within Flood Zone 3(a) "High Probability" as detailed on the Environment Agency's flood zone maps without defences, as defined in Table 1 of the Technical Guidance.

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 †	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 the site of this development is within flood zone 3. There are areas of Cowbit which are in flood zones 1 and 2, but there are no sites in these areas which are available for development. The village of Cowbit can be considered to be at lower flood risk than other areas and therefore an appropriate location for residential development.

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.

The South Holland District Council Core Strategy states that there is a limited number of sites outside the town of Spalding available for residential development. The site of this development can be considered an ideal level site within an existing residential area. There is a requirement for further land to be brought forward and used for

residential development to enable the Council to meet the RSS and Structure Plan requirement for 2021.

Therefore I consider that the sequential test has been passed.

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, and for the 0.1% 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 – 250mm, 250mm – 500mm and 500mm -1.0m. Extent of flooding .. High Hazard rating…… Less than 0.75 (Low hazard) and 0.75 – 1.25 (danger for some). Peak Velocity .. 0 – 0.3 metres/second
For the year 2115	Depth of flooding … 250mm – 500mm and 500mm -1.0m. Extent of flooding .. High Hazard rating…… 0.75 – 1.25 (Danger for some) and 1.25 – 2.0 (danger for all). Peak Velocity .. 0 – 0.3 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 tidal section of the River Welland

Tables in the SFRA show the following details of the defence bank on the east side of the tidal section of the River Welland north of the A16 road bridge and 7.2km north of the development site, between chainage 19.8km and 20.8km.

	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	6.27m OD	6.60m OD	7.41m OD

With an average defence crest level between 7.80 and 7.90 m OD the freeboards are as follows:

	2007	2055	2115
Peak 1 in 200 year freeboard	1870mm	1540mm	730mm
Peak 1 in 1,000 year freeboard	1580mm	1250mm	440mm

Tables in the SFRA show the following details for the defence bank on the south side of the Coronation Channel between chainage 2.5 km and 3.2 km.

	2007	2115
Peak 1 in 100 year flood level	4.36m OD	4.69m OD
Peak 1 in 1,000 year flood level	4.38m OD	4.69m OD

The bank levels on this section vary between 5.35m OD and 5.9m OD. Therefore it can be seen there is a minimum freeboard of 650mm to the predicted design maximum levels in 2115.

Tables in the SFRA show the following details for the Barrier Bank which is the defence bank on the east side of the fluvial section of the River Welland between chainage 4.5 km and 5.0 km.

	2007	2115
Peak 1 in 100 year flood level	4.57m OD	4.69m OD
Peak 1 in 1,000 year flood level	4.59m OD	4.69m OD

The bank levels on this section are 5.9m OD. Therefore it can be seen there is a minimum freeboard of 1200mm to the predicted design maximum levels 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.

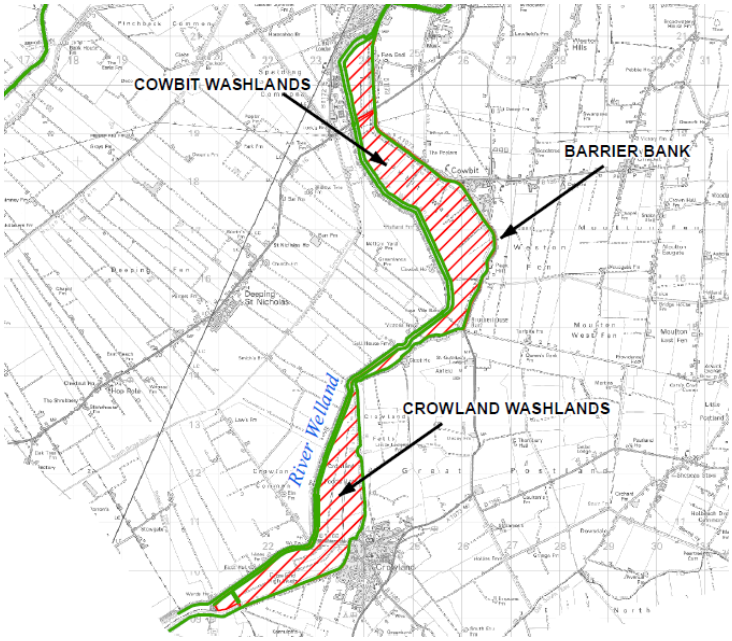
The site is located approximately 6.9 km south of the tidal section of the River Welland, which has a tidal defence bank which is maintained by the Environment Agency.

The site is located approximately 500 metres east of the Barrier Bank

The site is located approximately 3.6 km from the south bank of the Coronation Channel which is maintained by the Environment Agency.

The internal watercourses in the area are maintained by South Holland IDB.

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. 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 topographical study of the site has been carried out and these details will be submitted as part of the planning application. Levels from the topographical study have been reproduced on a simplified plan which is shown on page 13 of this report.

The level of Stonegate south of the existing house is 3.00m OD, and the floor level of the existing house is approximately 2.65m OD. The ground levels around the house are approximately 2.50m OD and all of the garden to the north is lower than the area around the house.

The area of the original tennis courts and land to the west of this is at levels of between 2.00m and 2.35m OD. Further north the land is lower with levels of between 1.70m and 2.15m 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 or the Wash
2. Failure or Overtopping of the Coronation Channel
3. Failure or overtopping of the Barrier Bank

4. High water levels in IDB drainage channels.
5. Localised flooding in the area.

1. <u>Failure or overtopping of tidal defences of the River Welland or the Wash</u>

The nearest tidal defences are the banks of the River Welland north of Spalding, which are 6.9km north of the site.

The SFRA maps indicate floodwater from a breach in the tidal bank in a 1 in 200 year event in 2115 would probably reach the A151 Spalding to Holbeach Road, but not spread any further south.

Therefore this source of flooding can be considered remote and will be adequately mitigated by the raising ground floor levels above the predicted flood level in a 1 in 100 year event in 2115.

2. <u>Failure or Overtopping of the Coronation Channel</u>

The SFRA states that the maximum design level in the Coronation Channel is 4.69m OD. The minimum crest level of the south bank of the Channel is 5.35m OD, which gives a minimum freeboard of 650mm. However, generally there is a freeboard of at least 800mm along this bank of the Channel.

The SFRA predicts that the residual flood depth in a 1 in 100 year event in 2115 could be between 250mm and 1.0 metre. This would be result of a breach occurring in the bank of the Coronation Channel or in the Barrier Bank when the Cowbit Washes are flooded.

The new A16 road north of Cowbit will have some effect in slowing down the flow from a breach in a 1 in 100 year event.

This risk will be adequately mitigated by the raising ground floor levels above the predicted flood level in a 1 in 100 year event in 2115.

3. <u>Failure or overtopping of the Barrier Bank</u>

The Barrier Bank is the eastern bank of the Cowbit 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 and alleviate high water levels in the River Welland. When this occurs the level of water in the washes will quickly rise to probably around 4.70m OD.

As the road level on top of the bank is 5.9m OD, there is no possibility of the bank being overtopped along this length between Backgate and Stonegate. The possibility of a breach occurring in this section of bank is remote as there is a very shallow back slope to the bank, and there is the road on the top of the bank. There is a greater chance of the bank breaching north of Stonegate or south of Backgate where the bank slopes are steeper.

The SFRA predicts that the residual flood depth in a 1 in 100 year event in 2115 could be between 250mm and 1.0 metre. This could be the result of a breach in the Barrier Bank.

This risk will be adequately mitigated by the raising ground floor levels above the predicted flood level in a 1 in 100 year event in 2115.

4. High Water Levels in IDB drains

Although the whole of this area is below high tide level and levels in the rivers, the retained water levels in the drainage channels ensure that the risk of flooding is extremely low. South Holland IDB maintains a system of sluices, pumping stations, and drainage channels which convey surface water into the River Welland, the Wash and the River Nene to control water levels throughout the South Holland IDB area.

South Holland IDB maintain drainage channels in this area. There is an IDB watercourse approximately 20 to 30 metres north of the development site which flows westwards then north to flow into the Clowacre Drain. This flows eastwards to discharge into the Wheatmere Drain (B35) which flows southwards into the South Holland Main Drain (B30). The water level in the South Holland Main Drain is controlled by Wisemans Pumping Station.

Wisemans Pumping Station is operated and maintained in excellent condition by South Holland IDB and the likelihood of flooding due to this source is low. IDB systems are designed to provide a freeboard of between 600mm and 1000mm to all land in a 1 in 10 year return period rainfall event. South Holland IDB watercourses generally state that their watercourses provide a standard of 1 in 100 years with a freeboard of 300mm in urban areas. In an extreme event water levels will rise but this will be a slow process and it would be at least 24 hours before levels were high enough to begin to flood low land in the area, and after this the level of the flood water would need to rise another 1.0 metre before the development site would be affected.

The channels maintained by South Holland IDB in urban areas are classified as high priority watercourses and as such receive a higher maintenance priority.

There are possibilities of failure of outfall sluices, but these are mitigated by the high level of maintenance given to these structures by the IDB. If a failure did occur the IDB would immediately be warned of the problem by their telemetry system and take action to repair the fault or to bring in temporary pumps to reduce the risk of any flooding in the area. Similarly any failures of culverts or other blockages would be dealt with immediately.

Therefore the risk of flooding from IDB drainage channels can be considered to be extremely low, and will be adequately mitigated by the raising ground floor levels above the predicted flood level in a 1 in 100 year event in 2115.

5. Localised Flooding in the area

Although there is an adequate surface water drainage system in Stonegate there is still a risk of accumulations of surface water in the area of the development behind the existing house. There is a dyke on the western boundary of the property which has not been maintained for some time. It is also unclear whether or not this connects into the IDB drain which is located north of the site. However as long as the surface water from the roofs is discharged into suitably designed soakaways then the raising of the ground floor levels above the predicted flood level in a 1 in 100 year event in 2115 will adequately mitigate the risk.

Extent of known Flooding

During the preparation of this assessment, no evidence was discovered of the existing house or garden or any of the adjoining properties having been flooded in the past.

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.

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 15 to 18). 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 1.25 – 2.0 (danger for most) reference should be made to Category D8 which gives the following standing advice:

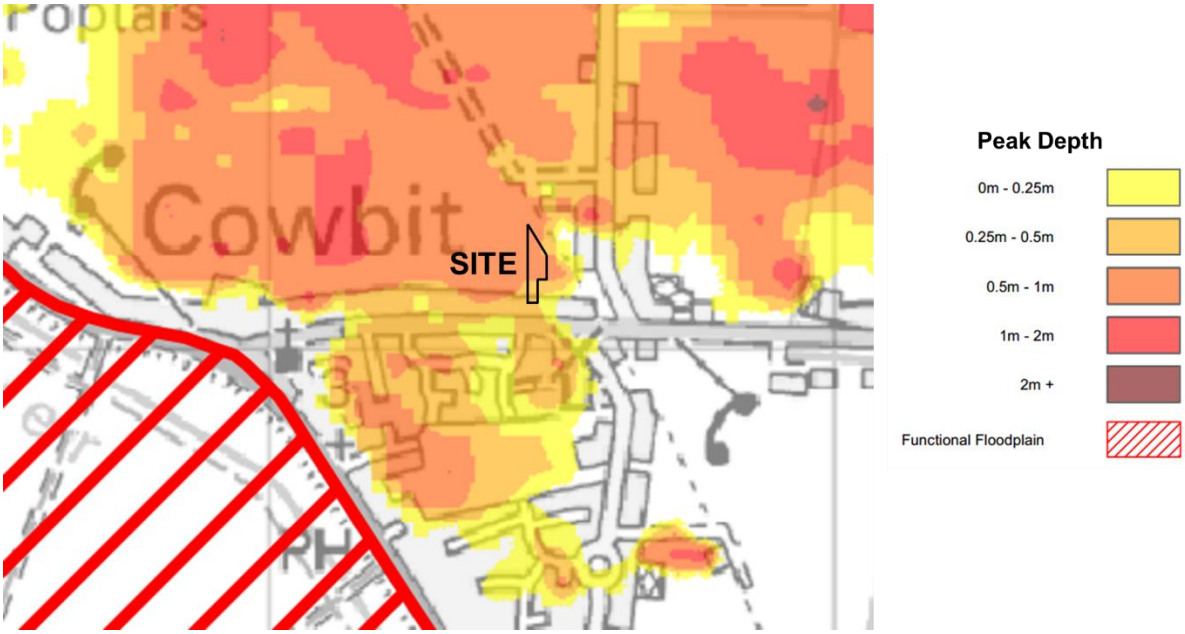
Finished floor levels (FFL) should be informed by the predicted flood depth maps (refer to the relevant 2115 1% fluvial or 0.5% tidal maximum depth map) and set as required (single storey proposals must use the 0.1% event 2115 scenario for setting FFL's.

Depths 0.5m – 1m: FFL must be set 1m above ground level, with flood resilient construction to a height of 300mm above the predicted flood depth.

The conclusions set out below will consider the ground levels on the site and additional information from previous FRA's carried out in this area 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.

Conclusions

The plan (shown below) of predicted depths of flooding in the recently updated SFRA predict residual flood depths of between 250mm and 1.0 metre across the site in a 1 in 100 year fluvial or 1 in 200 year tidal event in 2115.



The ground levels in the rear part of the site where flood level are predicted to be between 500mm and 1.0 metre in depth vary between 1.72m and 2.37m OD. If the lowest and highest levels are averaged the range of levels can be amended to 1.80m to 2.30m OD. From this it can be estimated that the maximum flood level would be 2.80m OD.

The map shows flood depths of between 250mm and 500mm levels around the existing house, and with levels of between 2.30m and 2.68m OD this is consistent with the above estimation of a predicted flood level of 2.80m OD.

The risk of flooding to the building from IDB drains can be considered low, especially as the ground floor level will be raised to a minimum level of 2.80m OD.

The IDB have adequate arrangements to bring in contractors and use their own staff if a failure of any part of the pumping stations or the sluices occurred. If drains become full any flooding that would occur would happen very slowly and affect lower land in the area before the development site. It would be very unlikely to reach a level above 2.75m OD and flood the proposed development.

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

Recommendations

In any area at risk of flooding it is preferable that new dwellings should be of two story 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.

The ground floor level of the proposed new buildings should be a minimum level of 2.80m OD which is between 250mm and 1.0 metre above the existing ground levels on the site, and is approximately 150mm above the ground floor level of the existing house on the site.

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 floor level of the new building.

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 and the hardstandings should be discharged if possible into soakaways and these should be designed to BRE Digest 365 and approved under Building regulations.

S M HEMMINGS B Sc C Eng MICE MIWEM

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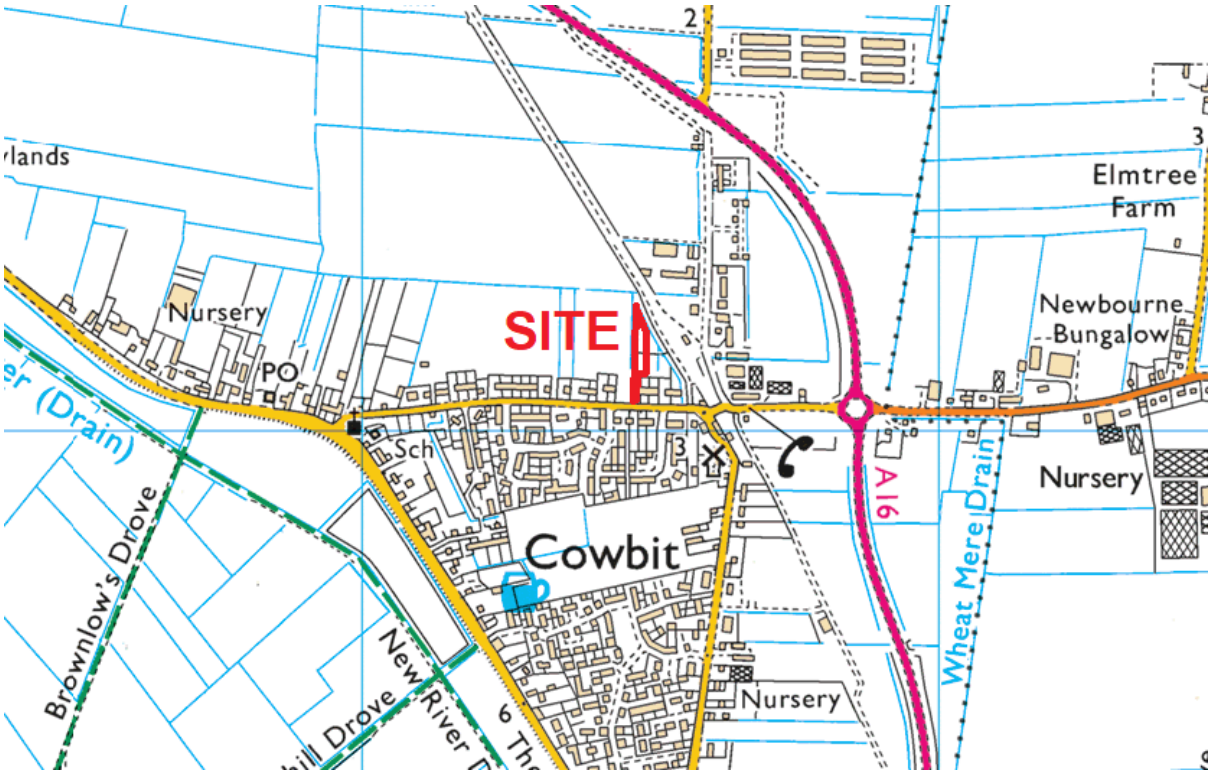
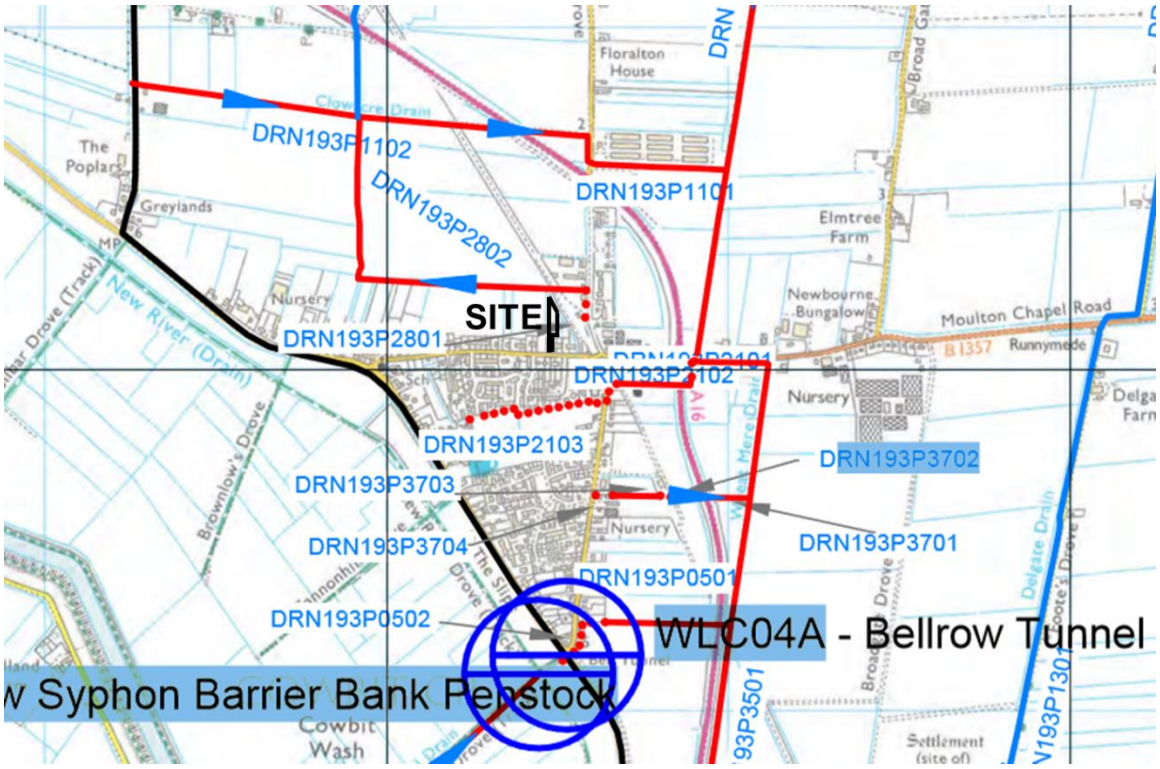
11th June 2018

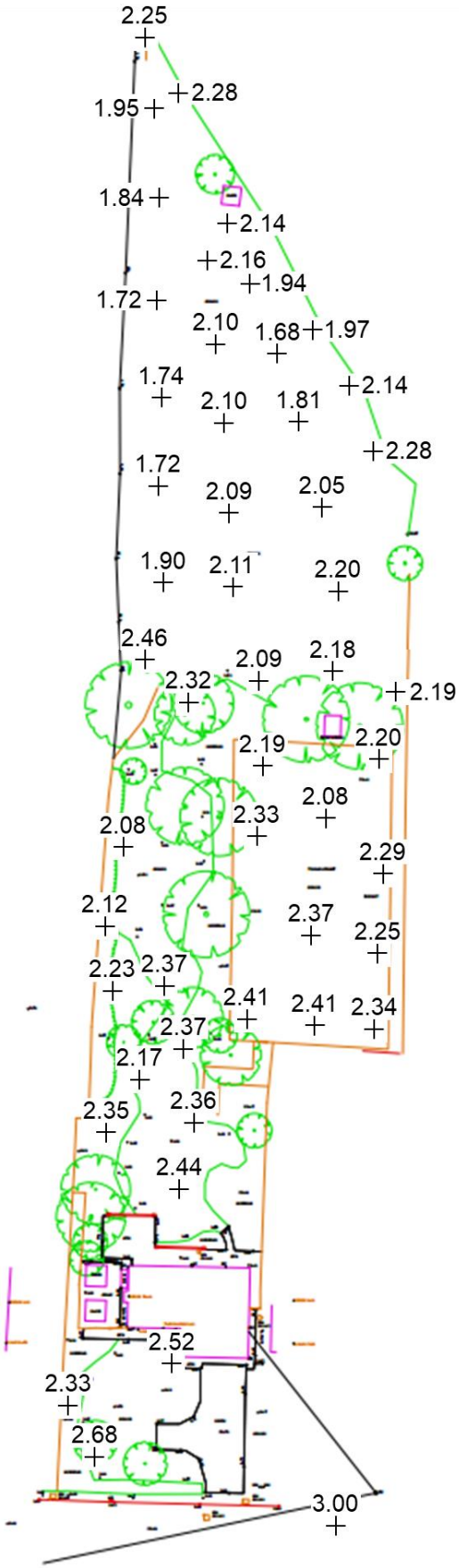
LOCATION PLAN



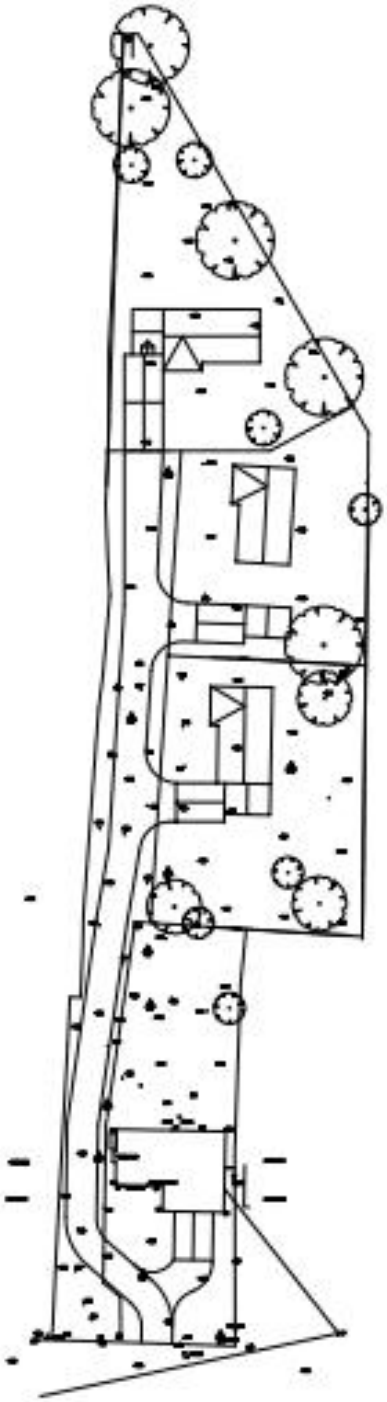
PLAN OF IDB DRAINS



PLAN SHOWING SITE LEVELS



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 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 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

1) Flooding from Tidal River Welland

The FRA has identified the first source of flooding where the new climate change recommendations could affect the predictions of flood levels in 2115 at the development site is 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 for the maps in the SFRA and 40mm for maps issued by the Environment Agency. Although the maps in the SFRA indicate flood depths of up to 500mm could occur on the site this report has concluded that it is unlikely to be

the result of tidal flooding. The small increase in maximum tide levels will not change the predictions of flood depth on this site.

2) Flooding from River Welland, Coronation Channel and the IDB drainage system

As the development is in flood zone 3 and is classed as more vulnerable, the central climate change allowance, which is 35%, should firstly be considered. After considering the effects of this increase the higher central, 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% and 65% will not significantly change the conclusion in the SFRA of what might happen if a breach occurred in the bank of the Coronation Channel or the Barrier Bank. If there are additional flows along this part of the Coronation Channel and 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.

South Holland 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 South Holland 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 floor levels should be raised to a level of 2.80m OD which is between 250mm and 1.0 metre above the existing ground level, is satisfactory.