

**Flood Risk Assessment and  
Drainage Report  
for the**

**Proposed Redevelopment  
of the**

**Lincolnshire Co-operative**

**Shop & Filling Station**

**Main Road, Whaplode,**

**Lincolnshire**

**PE12 6TJ**

**Prepared for**

**Lincolnshire Co-operative**

**Issue 01**

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***George Shuttleworth Ltd***

***Consulting Engineers***

43 Hall Drive,

Lincoln LN6 7SW

Tel: 01522 787710

[geo.shuttleworth@btconnect.com](mailto:geo.shuttleworth@btconnect.com)

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Issue : 01  
Author : G Shuttleworth BSc C Eng. MICE.  
Date : 25<sup>th</sup> August 2017

## **1.0 DEVELOPMENT SITE AND LOCATION**

- 1.1. The site of the proposed development is the Total Garage, High Road, Whaplode, Spalding PE12 6TJ. The OS Grid Reference of the application site is TF 327 423. The location is shown on the drawings provided in Appendix 1.
- 1.2. The site is currently used as a Fuel Filling Station and Shop. The site is bounded by High Road to the north and existing residential and commercial developments to the other boundaries.
- 1.3. The site covers some 0.165 hectares and is triangular in shape. It has a frontage of approximately 60m and extends approximately 42m from the highway.
- 1.4. Levels on the site typically vary between 3.9 in the north east corner to 2.6m in the south east corner.
- 1.5. The Architect's Drawing 1325-25, contained in Appendix 1, shows the existing site levels and features.
- 1.6. The site is located approximately 16km inland from The Wash, 6.5km from the tidal River Welland and 15km from the tidal River Nene.
- 1.7. The site is shown in Flood Zone 3 on the Environment Agency's Flood Map for Planning. A copy is provided in Appendix 1.

## **2.0 DEVELOPMENT PROPOSALS**

- 2.1. It is proposed to redevelop the site to provide an increased retail area and relocate the Fuel Filling Station.
- 2.2. Currently the site is 90% covered with impermeable surfaces. Following development the extent of the site covered by artificial surfaces will increase to 100% but some permeable artificial surfaces will be provided resulting in a net decrease in impermeable surfaces.
- 2.3. Details of the proposed development are shown on the Architect's Drawing 1325-30 contained in Appendix 1.
- 2.4. In accordance with Table 2 of the National Planning Policy Framework (NPPF) Technical Guidance Document a residential development would be classed as less vulnerable.
- 2.5. In accordance with Table 3 of the NPPF Technical Guidance Document less vulnerable developments in Flood Zone 3 are appropriate without the need to pass an Exception Test.
- 2.6. The estimated lifetime for the proposed development is no more than 100 years.

### **3.0 SEQUENTIAL TEST**

- 3.1. As stated earlier the site is in Flood Zone 3 on the Environment Agency Flood Maps for Planning.
- 3.2. The Sequential Test requires that sites in lower risk zones are considered first.
- 3.3. The proposed site falls within the Lincolnshire coastal strip which, with large areas at or below sea level, is vulnerable to failures of the existing raised defences and the impact of climate change.
- 3.4. Although the site is located in Flood Zone 3 the Flood Hazard Maps produced by the Environment Agency show that the site is not at risk from a breach or overtopping of the defences. Therefore the site is in one of the lower risk sites in the South Holland coastal strip
- 3.5. The site is an existing development, which requires refurbishment and increased sales areas, to maintain its economic viability
- 3.6. Taking into account the wider sustainability benefits for the area and the relatively lower flood risk the proposed development can be deemed to have passed the Sequential Test.

### **4.0 CLIMATE CHANGE**

- 4.1. The NPPF web based guidance provides guidance on potential effects of climate change on flooding which is based on information published by the Environment Agency.
- 4.2. The Environment Agency in February 2016 has published updated information on Climate Change. The new guidance advises that for more vulnerable developments in Humber Region the Flood Risk should be assessed against climate change allowances of 30% and 50% for river flows and increases in peak rainfall intensity of up to 40%.
- 4.3. It is understood that the Environment Agency Flood Maps have not been updated to take account of the revised climate change river flow information. However, it is understood that the critical flood levels stated in the SFRA do make allowance has been made for the potential affects of a rise in sea levels to 2115.
- 4.4. Higher peak rainfall intensities may increase the risk of surface water flooding from the surface water drainage systems in the vicinity of the site. Although the frequency of the flooding may increase provided exceedance flow paths are provided then there will be minimal effect on surface water flooding.
- 4.5. The surface water drainage system serving the site will need to be designed such that potential additional flows due to climate change do not cause flooding on this development and do not to contribute to an increased risk of flooding elsewhere in the catchment.
- 4.6. It should be noted that the projected increase peak rainfall intensities do not result in a similar increase in storage volume required i.e. peak intensity may increase by up to 40% but average rainfall will not increase by the same amount.

- 4.7. Previous guidance published by the Environment Agency states that for the period in which peak rainfall intensities may rise by up to 30%, the increase in the volume of run-off will only increase by 20%. Therefore it is reasonable to assume that for a 40% increase in rainfall intensity the increase in volume of run-off will not increase by more than 30%
- 4.8. It is proposed that the surface water collection and attenuation system for the development site is designed to take into account the potential effects of climate change.

## **5.0 SITE SPECIFIC FLOOD RISK**

- 5.1. The site is at risk of flooding from the following sources
- a) A breach or overtopping of the raised defences of the tidal River Welland, the Wash or the tidal River Nene
  - b) Surface Water Flooding
  - c) Flooding from infrastructure failure
  - d) Flooding from groundwater
  - e) Flooding from failure of the site surface water drainage system.

### ***Flooding from a Breach or Overtopping of the Raised Defences***

- 5.2. The site is shown to be in Flood Zone 3 on the Flood Maps for Planning. These maps show the risk of flooding without defences. The site is normally protected from flooding by the raised defences which are maintained by the Environment Agency.
- 5.3. Flood Information was requested from the Environment Agency and the information provided is contained in Appendix 1.
- 5.4. The Environment Agency has no records of historic flooding in the vicinity of the site.
- 5.5. The 1 in 200 year still water flood level on the River Welland at Marsh Road Sluice is 5.98m
- 5.6. The Environment Agency has stated that the existing raised defences provide a 1 in 150 year level of protection. It is understood that in assessing the level of protection a free board allowance is included such that the defence levels will be a minimum of 300mm above the 1 in 150 year flood level.
- 5.7. The tidal flood level was assessed in 2006 and sea levels are expected to rise due to climate change.
- 5.8. The Environment Agency has simulated the extents of flooding due to a number of breaches and overtopping of the existing defences.
- 5.9. It should be noted that with raised earth defences that prolonged overtopping will invariably lead to a breach of the defences.
- 5.10. The Flood Hazard Maps for this site show that the site is not at risk of flooding from breaching or overtopping for either the 2115 1 in 200 or 1 in 100 year events
- 5.11. The South Holland District Council Strategic Flood Risk Assessment (SFRA) contains Flood Hazard Mapping similar to that provided by the Environment Agency.

### ***Surface Water Flooding***

- 5.12. The Surface Water Flood Maps available on the government web-site illustrate the risk of surface water flooding in the area. A copy of the Surface Water Flood Map is provided in Appendix 1.
- 5.13. There are a number of open ditches and surface water sewers in the vicinity of the site. Some of the open ditches have now been culverted. There is a culverted watercourse running along the southern boundary of the site which has been culverted with a 525mm pipe.
- 5.14. As stated in Section 1 the site falls to the south east corner and the southern boundary, where the culverted watercourse is located in at least 1.0m lower than the proposed floor level of the building.
- 5.15. Any surface water flooding would only occur along the southern boundary, and given the topography of the surrounding land would escape to other open ditches and lower areas before building up to any significant depth.
- 5.16. Therefore the risk of internal flooding in the proposed building is minimal.

### ***Flooding from other Local Infrastructure***

- 5.17. We are unaware of any large water or sewage rising mains in the area but given the gradient across the site and the local topography a failure of a pressurised pipe is unlikely to cause flooding to a significant depth.

### ***Flooding from Groundwater***

- 5.18. In this low lying area groundwater is expected to be close to the surface of the site but given the fall across the site, the culverted pipe running along the southern boundary and the general topography of the surrounding area the risk of flooding due to high groundwater levels should be minimal.

### ***Flooding from the Site Surface Water Drainage System***

- 5.19. There is a risk of localised flooding from a failure of the surface water drainage system serving the site. However, the flooding would be restricted to the lower part of the site. To minimise this risk the surface water drainage system should be designed to cater for a 1 in 100 year event with an appropriate allowance for climate change.

### ***Flood Mitigation Measures***

- 5.20. No specific flood mitigation measures are required to deal with the risk of flooding from rivers or sea.
- 5.21. To minimise the risk of flooding from high groundwater levels or on or off site infrastructure it is proposed that floor levels, are set above adjacent ground levels and gradients across the site is maintained (i.e. no hollows created).

## **6.0 SURFACE WATER MANAGEMENT STRATEGY**

- 6.1. This Flood Risk & Drainage Assessment Report provides the information required to demonstrate a strategy for dealing with surface water run-off in a sustainable way such that the on and off site impacts are minimal.
- 6.2. Sustainable Drainage Systems (SuDS) have been considered for this development.
- 6.3. Following the preferred hierarchy of drainage stated in Part H of the Building Regulations and The Suds Manual the following disposal routes have been considered
  - a) Disposal via Infiltration
  - b) Disposal to a Watercourse
  - c) Disposal to Surface Water Sewer
- 6.4. A Desktop Geotechnical Study has been undertaken to assess if the site will be suitable for surface water disposal using infiltration systems.

### ***Desktop Geotechnical Study***

- 6.5. From the HR Wallingford Greenfield run-off Calculation Tool available on their web-site the tool identifies the site as having Soil Type 2 on the Winter Rainfall Acceptance Potential (WRAP) Map. Soil Type 2 has relatively good drainage characteristics and is normally suitable for soakaway drainage systems. A copy of the Greenfield Run-off Calculation Sheet is provided in Appendix 1.
- 6.6. A site investigation has been carried out at the site, primarily for the purposes of structural design and assessing any potential contamination issues.
- 6.7. The stratum below the site is described as tidal mud flat deposits with made ground over silt wet sand and clay layers.
- 6.8. Copies of the borehole and trial pits logs are provided in Appendix 1. A copy of the full site investigation report can be made available on request.
- 6.9. Based on the description of the stratum obtained from the site investigation it is concluded that the site would be unsuitable for surface water disposal by infiltration.

### ***Disposal to a Watercourse***

- 6.10. There is a culverted watercourse running along the southern boundary of the site.
- 6.11. The existing development discharges surface water to this watercourse.
- 6.12. It is proposed to re-use the existing discharge connection.
- 6.13. The rate of discharge will be reduced from existing levels by increasing the amount of permeable surfaces on the site. The extent of the proposed gravelled areas and permeable parking spaces is shown on the Architects Drawing contained in Appendix 1.
- 6.14. If necessary, the discharges from the impermeable areas shall be attenuated within the permeable sub-base of the permeable surfaces.

## **7.0 OCCUPIERS & USERS OF THE DEVELOPMENT**

- 7.1. The current proposals will not see an increase in people based at the site.
- 7.2. There will be no one living at the proposed development.
- 7.3. Under normal circumstances the site will not be at risk of flooding, even from a breach or overtopping of the existing defences.
- 7.4. Therefore the site can be considered safe for the lifetime of the development.

## **8.0 RESIDUAL RISK**

- 8.1. There is a residual risk that more extreme events are experienced than those evaluated in this report.
- 8.2. In such events the site could potentially flood to a shallow depth but due to the distance from the defences, ample advance warning of the potential for flooding would be given and if necessary the property can be evacuated for the duration of the event.

## **9.0 FOUL SEWERAGE**

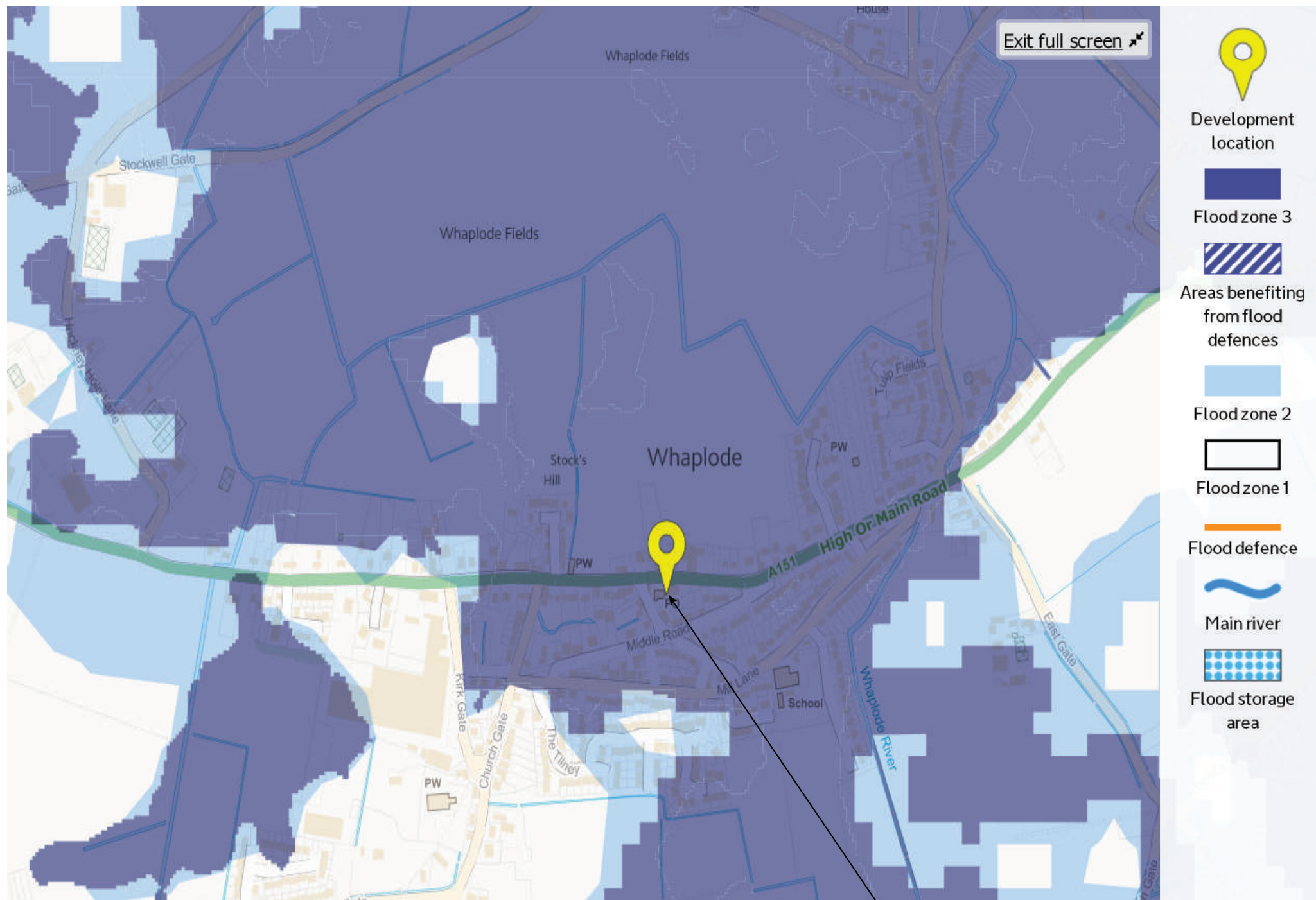
- 9.1. The existing site is connected to the public foul sewerage system and it is proposed that the existing connection is re-used.

## **10.0 CONCLUSIONS**

- 10.1. The site is shown in Flood Zone 3 on the Flood Maps for Planning produced by the Environment Agency. However, the site is not shown to be in an area at risk of flooding from a breach or failure of the defences
- 10.2. This report demonstrates that it is practical to install a sustainable surface water drainage system to serve the development such that the risk of flooding elsewhere in the catchment is not increased.
- 10.3. Taking into account the above points it is concluded that the proposed development can be considered appropriate in this location.

## **11.0 APPENDIX 1 SUPPORTING INFORMATION**

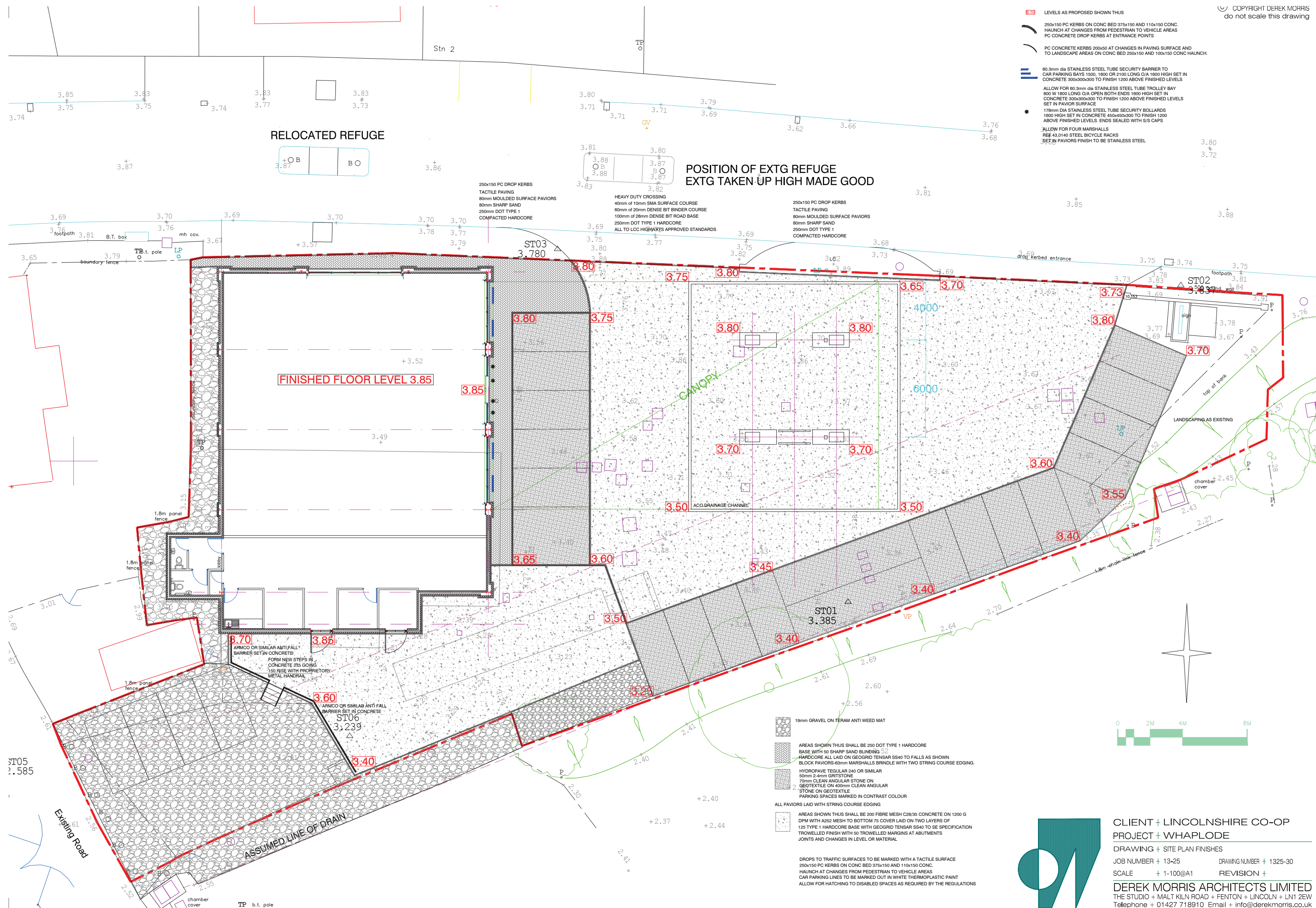
- a) Flood Map for Planning – with Site Location
- b) Architects Drawing 1325-25 - Existing Site Features & Levels
- c) Architects Drawing 1325-30 – Proposed Development including Surfaces & Levels
- d) EA Flood Information
- e) Surface Water Flood Map
- f) HR Wallingford Greenfield Run-Off Calculations
- g) Site Investigation Trial Pit and Borehole Records



SITE LOCATION

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do not scale this drawing





George Shuttleworth  
geo.shuttleworth@btconnect.com

**Our ref:** CCN/2017/53986

**Date:** 8 August 2017

Dear George

**Provision of Flood Risk Information for Main Road, Whaplode.**

Thank you for your request to use our flood risk information in the development of the Flood Risk Assessment (FRA) for the above site. The information is set out below and attached. It is important you read any contextual notes on the maps provided.

We aim to review our information on a regular basis, so if you are using this data more than twelve months from the date of this letter, please contact us again to check it is still valid.

**Flood Map**

The attached map includes the current Flood Map for your area. The Flood Map indicates the area at risk of flooding, **assuming no flood defences exist**, for a flood with a 0.5% chance of occurring in any year for flooding from the sea, or a 1% chance of occurring for fluvial (river) flooding. It also shows the extent of the Extreme Flood Outline which represents the extent of a flood with a 0.1% chance of occurring in any year, or the highest recorded historic extent if greater.

In some locations, such as around the fens and the large coastal floodplains, showing the area at risk of flooding assuming no defences may give a slightly misleading picture in that if there were no flood defence water would spread out across these large floodplains. This flooding could cover large areas of land but to relatively shallow depths and could leave pockets of locally slightly higher land as isolated dry islands. It is important to understand the actual risk of the flooding to these dry islands, particularly in the event of defence failure.

The Flood Map also shows the location of formal raised flood defences and flood storage reservoirs. It represents areas at risk of flooding for present day only and does not take account of climate change.

The Flood Map only indicates the extent and likelihood of flooding from rivers or the sea. It should also be remembered flooding may occur from other sources such as surface water sewers, road drainage, etc.

**History of Flooding**

With regards to the history of flooding I can advise we do not have any records of flooding in this area. It is possible other flooding may have occurred we do not have records for, and other organisations, such as the Local Authority or Internal Drainage Boards, may have records.

## **Tidal Flood Risk Information**

### **Tidal Defence Information**

The tidal defences protecting this site consist of earth embankments. They are in good condition and reduce the risk of flooding to a 0.67% (1 in \*150) chance of occurring in any year. We inspect these defences routinely to ensure potential defects are identified.

### **Tidal Flood Levels**

The attached table shows our current best estimate for extreme tide levels.

Levels for the Humber Estuary have an assessment date of 2014, with others having an assessment date of 2006, which should be used in any consideration of future increases due to climate change.

### **Modelled Hazard Mapping**

For certain locations we have carried out modelling to map the maximum values of flood depth, velocity and hazard rating (danger to people) resulting from overtopping and / or breaching of defences at specific locations for a number of scenarios.

At present this information is available along the full coastal / tidal floodplain, except the tidal Witham Haven in Boston (upstream of Hobhole) where only breaching and not overtopping has been modelled and the tidal River Welland upstream of Fosdyke Bridge where neither breaching nor overtopping are available. Hazard mapping is also available for fluvial flood risk in Northampton, Thrapston, Lincoln, Brigg, Wainfleet and some isolated rural locations.

The number of locations we have this information for is expected to increase in time.

### **Hazard Mapping – Breaching**

The attached maps show the maximum values of flood depth, velocity and hazard rating (danger to people) resulting from breaching of the defences at specific locations for the scenarios below. For some locations the breach mapping also includes flooding from overtopping if this is expected in that scenario. The location of modelled tidal breaches is shown on a separate attached map.

- Year 2115      0.5% (1 in 200) chance
- Year 2115      0.1% (1 in 1000) chance

Your site is not affected by breaching of the defences for the present day (2006) scenarios.

### **Development Planning**

If you have requested this information to help inform a development proposal, then you should note the information on GOV.UK on the use of our information for Flood Risk Assessments. We recommend that you undertake a formal pre-application enquiry using the form available from the website.

<https://www.gov.uk/planning-applications-assessing-flood-risk>

<https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion>

Climate change will increase flood risk due to overtopping of defences. Please note the climate change data included has an allowance for 20% increase in flow. Updated guidance on how climate change could affect flood risk to new development - 'Flood risk assessments: climate change allowances' was published on GOV.UK in February 2016. The appropriate updated climate change allowance should be applied in a Flood Risk Assessment.

You should also consult the Strategic Flood Risk Assessment produced by your local planning authority.

### **Supporting Information**

Please see the Standard Notice or licence for details of permitted use. The Standard Notice can be found at the link below.

<http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

We respond to requests for recorded information we hold under the Freedom of Information Act 2000 (FOIA) and the associated Environmental Information Regulations 2004 (EIR).

Further information on flood risk can be found on the GOV.UK website at:

<https://www.gov.uk/browse/environment-countryside/flooding-extreme-weather>

### **Other Flood Risk Management Authorities**

The information provided with this letter relates to flood risk from main river or the sea. Additional information may be available from your Lead Local Flood Authority (ie county council or unitary authority) or, where they exist, the Internal Drainage Board.

### **Further Contact**

I hope we have correctly interpreted your request. If you are not satisfied with our response to your request for information you can contact us within two calendar months to ask for our decision to be reviewed.

If you have any queries or would like to discuss the content of this letter further please contact Sarah Curl using the details below.

Yours faithfully



**FOR Alastair Windler**

**Partnerships and Strategic Overview Team Leader - Welland and Nene**

Direct dial 020 847 49385

Direct e-mail [PSOWN@environment-agency.gov.uk](mailto:PSOWN@environment-agency.gov.uk)

Enc.

Flood Map

Estimated Tide Levels

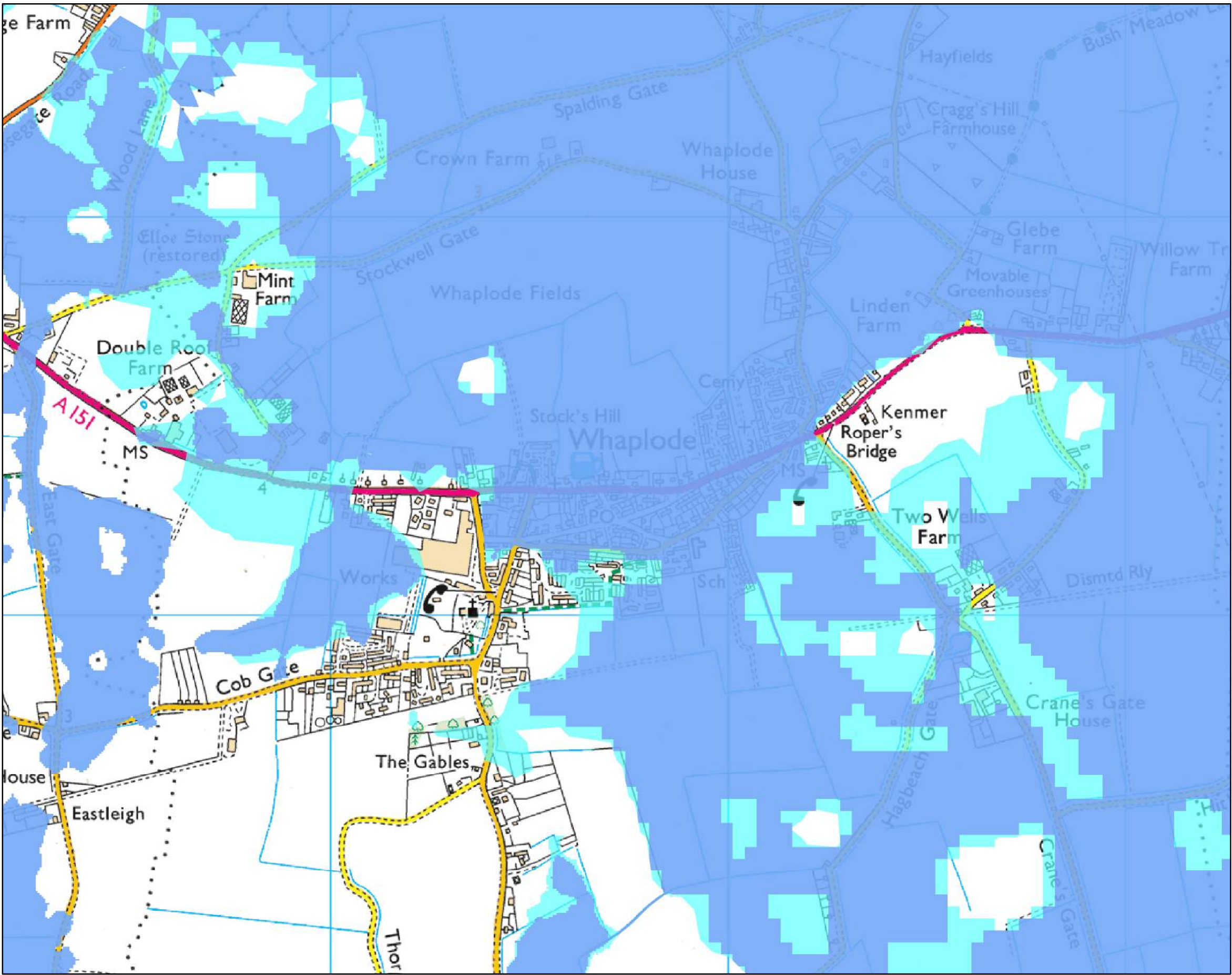
Tidal Breach Locations Map

Hazard Mapping – Breaching (2 maps)



Awarded to Lincolnshire & Northamptonshire Area

Flood Map centred on TF 32721 24316 - created August 2017 [Ref: CCN-2017-53986]



Scale 1:10,000



- Main River
- Raised Defences
- Flood Storage Areas
- Area at Risk of Flooding from Rivers or The Sea
- Extreme Flood Outline

Dark blue shows the area that could be affected by flooding, either from rivers or the sea, if there were no flood defences. This area could be flooded:

- from the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year.
- or from a river by a flood that has a 1% (1 in 100) or greater chance of happening each year.

Light blue shows the extent of the Extreme Flood Outline, which represents the extent of a flood event with a 0.1% chance of occurring in any year, or the highest recorded historic extent if greater.

These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements. Sites outside the two extents, but behind raised defences, may be affected by flooding if the defences are overtopped or fail.

Created by the Partnerships and Strategic Overview Team, Kettering

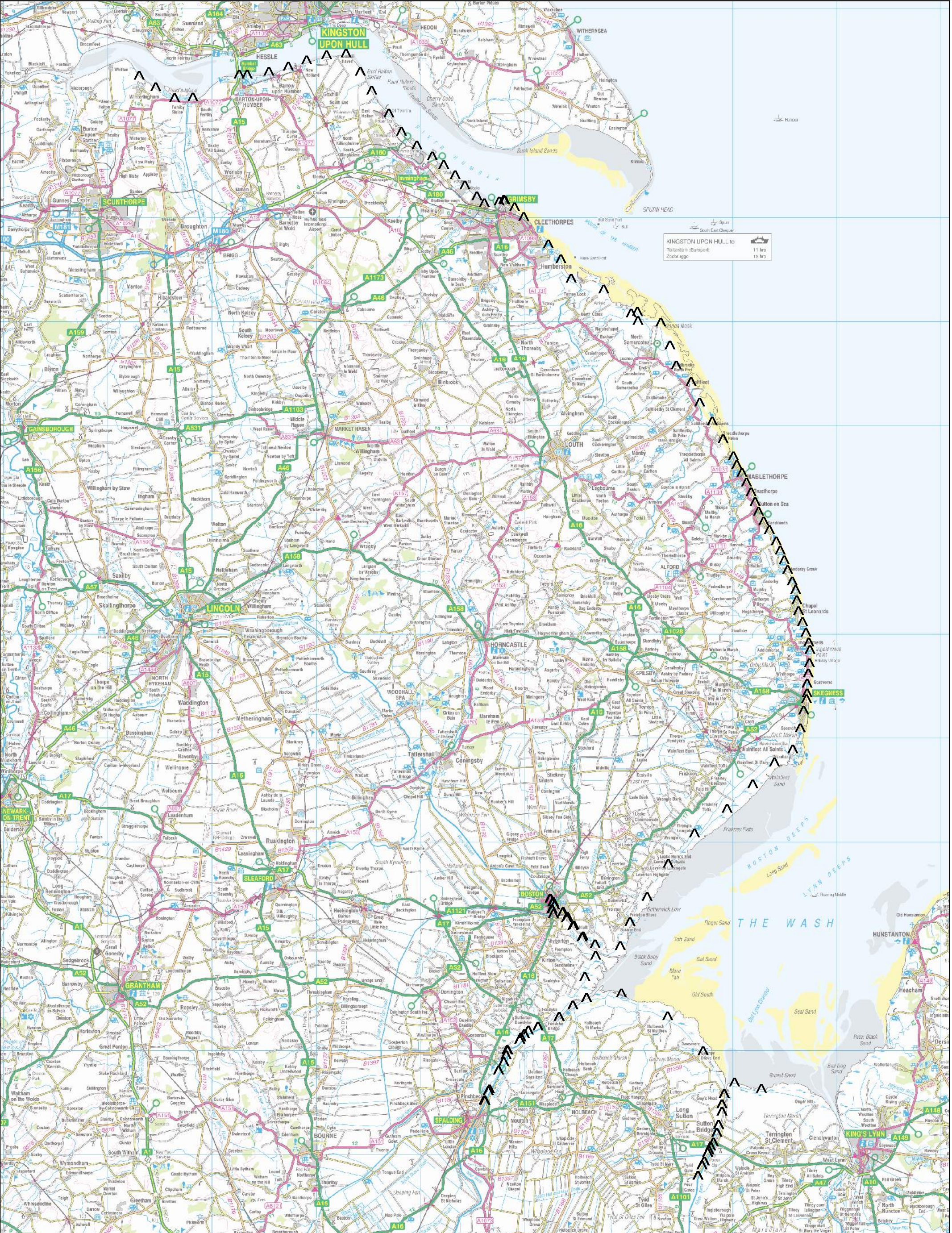


# Tidal Water Levels for the South Humber, East Coast and The Wash

The table below shows still water levels for locations, from the above location map, around the South Humber Estuary, East Coast and The Wash. It is important to note the following:

- The base date for the data is 2014 for the South Humber and 2006 for the East Coast and The Wash.
- The data are still water levels. Depending on the use of the data it may be necessary to consider wave heights and / or joint probability analysis of water level and other variables.
- The water level quoted is the ‘Best Estimate’ water level. Depending on the use of the data it may be necessary to carry out sensitivity testing. Upper and Lower 95% confidence bandings are available upon request.
- Levels for other annual chance scenarios are available if required.

| Ref        | Location           | Easting | Northing | Annual Chance ( 1 in x) of Tide Level |      |      |      |      |      |
|------------|--------------------|---------|----------|---------------------------------------|------|------|------|------|------|
|            |                    |         |          | metres ODN                            |      |      |      |      |      |
|            |                    |         |          | 1                                     | 10   | 50   | 100  | 200  | 1000 |
| HUMBER     |                    |         |          |                                       |      |      |      |      |      |
| H030       | Tetney             | 535420  | 403180   | 3.94                                  | 4.29 | 4.56 | 4.69 | 4.82 | 5.15 |
| H050       | Buck Beck          | 532700  | 406580   | 4.03                                  | 4.36 | 4.62 | 4.74 | 4.87 | 5.18 |
| H060       | Grimsby            | 527878  | 411346   | 4.10                                  | 4.43 | 4.70 | 4.82 | 4.95 | 5.27 |
| H080       | Haborough Marsh    | 520790  | 415740   | 4.26                                  | 4.61 | 4.88 | 5.01 | 5.14 | 5.47 |
| H090       | Immingham          | 519141  | 417449   | 4.26                                  | 4.61 | 4.88 | 5.01 | 5.14 | 5.47 |
| H100       | South Killingholme | 518700  | 417120   | 4.41                                  | 4.77 | 5.05 | 5.18 | 5.32 | 5.66 |
| H130       | North Killingholme | 516530  | 420000   | 4.51                                  | 4.87 | 5.15 | 5.28 | 5.42 | 5.77 |
| H150       | East Halton        | 514450  | 422870   | 4.59                                  | 4.96 | 5.25 | 5.39 | 5.53 | 5.89 |
| H170       | Goxhill            | 511970  | 425440   | 4.67                                  | 5.04 | 5.34 | 5.47 | 5.61 | 5.95 |
| H200       | New Holland        | 508020  | 424330   | 4.87                                  | 5.26 | 5.55 | 5.68 | 5.81 | 6.12 |
| H210       | Barrow Haven       | 506380  | 422620   | 4.92                                  | 5.31 | 5.60 | 5.73 | 5.86 | 6.17 |
| H220       | Ferriby            | 497550  | 421150   | 5.04                                  | 5.42 | 5.67 | 5.77 | 5.86 | 6.04 |
| H230       | Winterton          | 493420  | 422830   | 5.14                                  | 5.51 | 5.74 | 5.83 | 5.90 | 6.02 |
| H250       | Blacktoft          | 484247  | 424190   | 5.25                                  | 5.62 | 5.83 | 5.90 | 5.96 | 6.04 |
| H270       | Goole              | 474857  | 422960   | 5.46                                  | 5.85 | 6.07 | 6.15 | 6.21 | 6.29 |
| East Coast |                    |         |          |                                       |      |      |      |      |      |
| ~          | Great Eau          | 545500  | 393800   | 3.80                                  | 4.19 | 4.46 | 4.57 | 4.69 | 4.96 |
| ~          | Boygrift           | 553300  | 379800   | 3.84                                  | 4.24 | 4.53 | 4.65 | 4.77 | 5.05 |
| ~          | Burgh Sluice       | 555190  | 358620   | 4.26                                  | 4.45 | 4.76 | 4.90 | 5.03 | 5.34 |
| Wash       |                    |         |          |                                       |      |      |      |      |      |
| ~          | Hobhole            | 536610  | 339940   | 4.82                                  | 5.30 | 5.64 | 5.78 | 5.93 | 6.27 |
| ~          | Lawyers Sluice     | 540750  | 334550   | 4.84                                  | 5.32 | 5.66 | 5.80 | 5.95 | 6.29 |
| ~          | West Lighthouse    | 549150  | 325750   | 4.88                                  | 5.37 | 5.71 | 5.86 | 6.01 | 6.35 |
| ~          | Grand Sluice       | 532400  | 344500   | 4.88                                  | 5.33 | 5.65 | 5.78 | 5.93 | ~    |
| ~          | Fosdyke Bridge     | 531700  | 332200   | 4.91                                  | 5.38 | 5.71 | 5.85 | 5.99 | ~    |
| ~          | Marsh Road         | 526000  | 324000   | 5.04                                  | 5.44 | 5.73 | 5.85 | 5.98 | ~    |
| ~          | Wisbech            | 546100  | 310000   | 4.83                                  | 5.25 | 5.53 | 5.66 | 5.78 | ~    |
| ~          | Dog In Doublet     | 527300  | 299300   | 3.67                                  | 4.00 | 4.22 | 4.32 | 4.42 | ~    |



^ Modelled Breach Locations



This map indicates the location of where we have modelled the consequence of breaches in the defences along the coastline and tidal rivers. We have mapped the the maximum values of Hazard Rating (Danger to People), Depth and Velocity.

We have not assumed that all breaches occur at the same time, but have modelled each breach individually and overlaid the results to find the maximum values.

Our modelling only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. Our defences generally provide a good standard of flood defence but a risk of breaching remains.

Please contact the Environment Agency for information on how these maps are used in the management of flood risk.

General Enquiries No: 03708 506 506.  
Weekday daytime calls cost 5p plus up to 6ppm from BT Weekend Unlimited. Mobile and other providers charges may vary

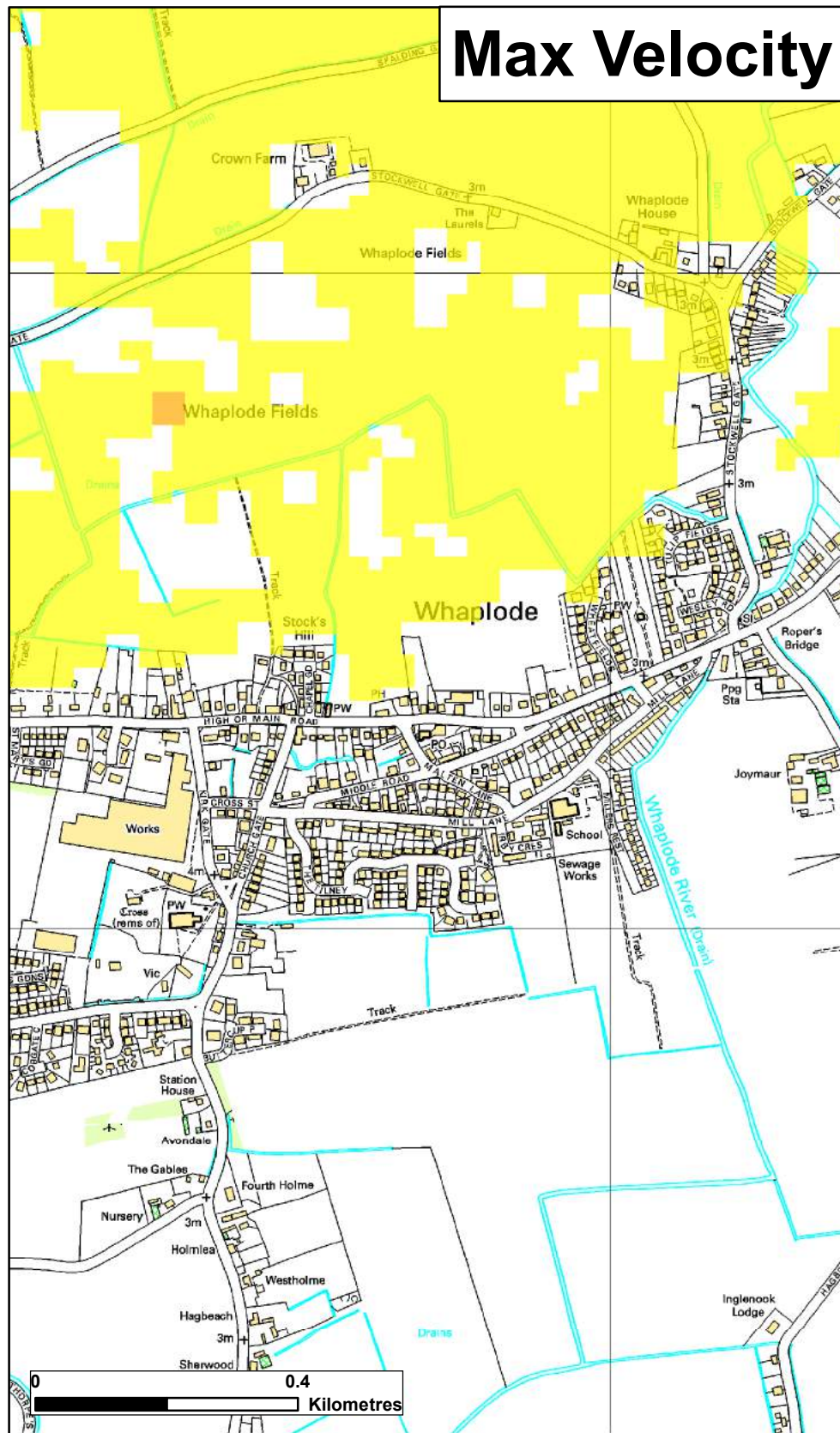
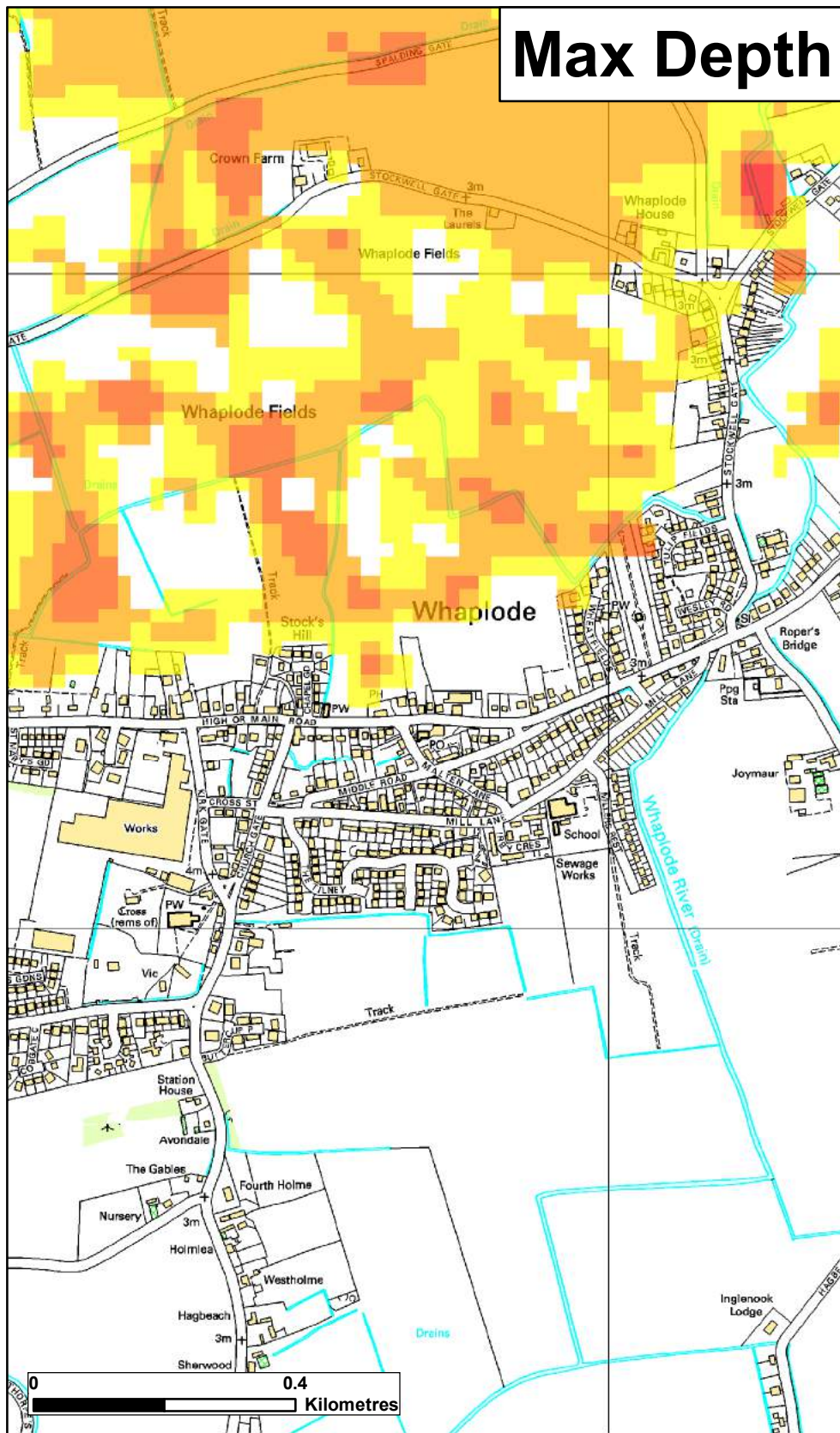
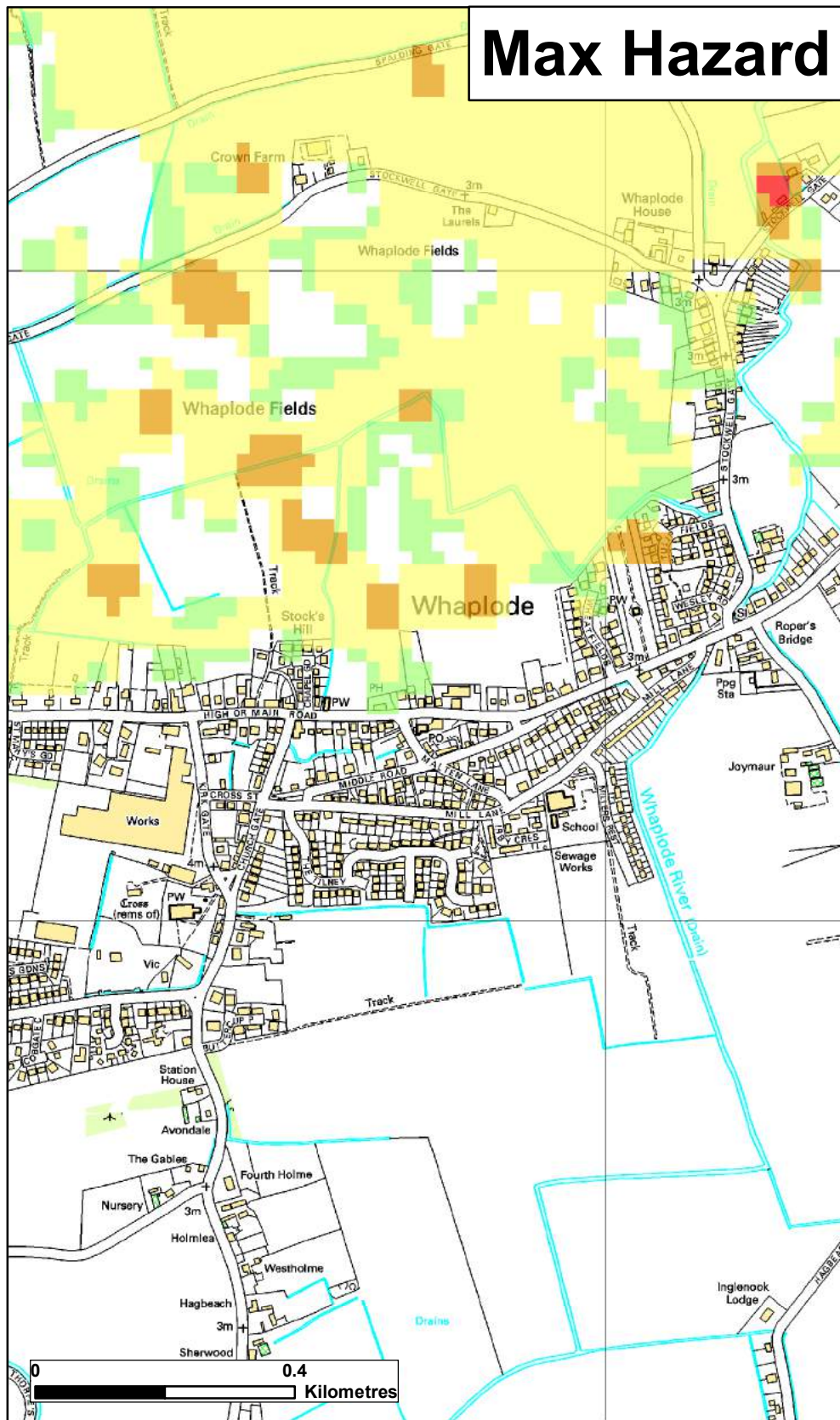


Produced by the Partnership and Strategic Overview Team, Lincoln  
General Enquiries No: 03708 506 506

Northern Area Tidal Hazard Mapping

Location of Modelled Breaches

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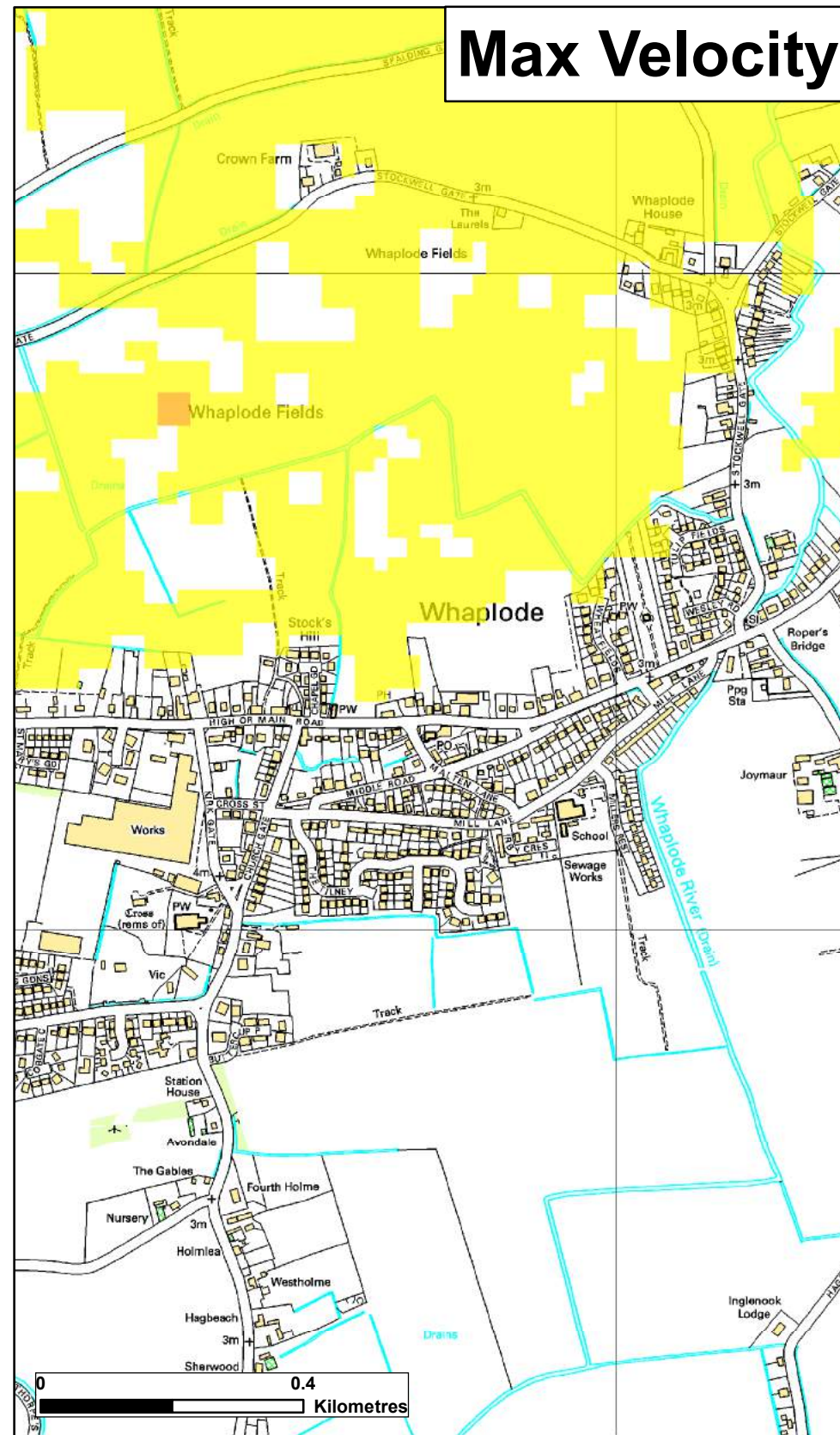
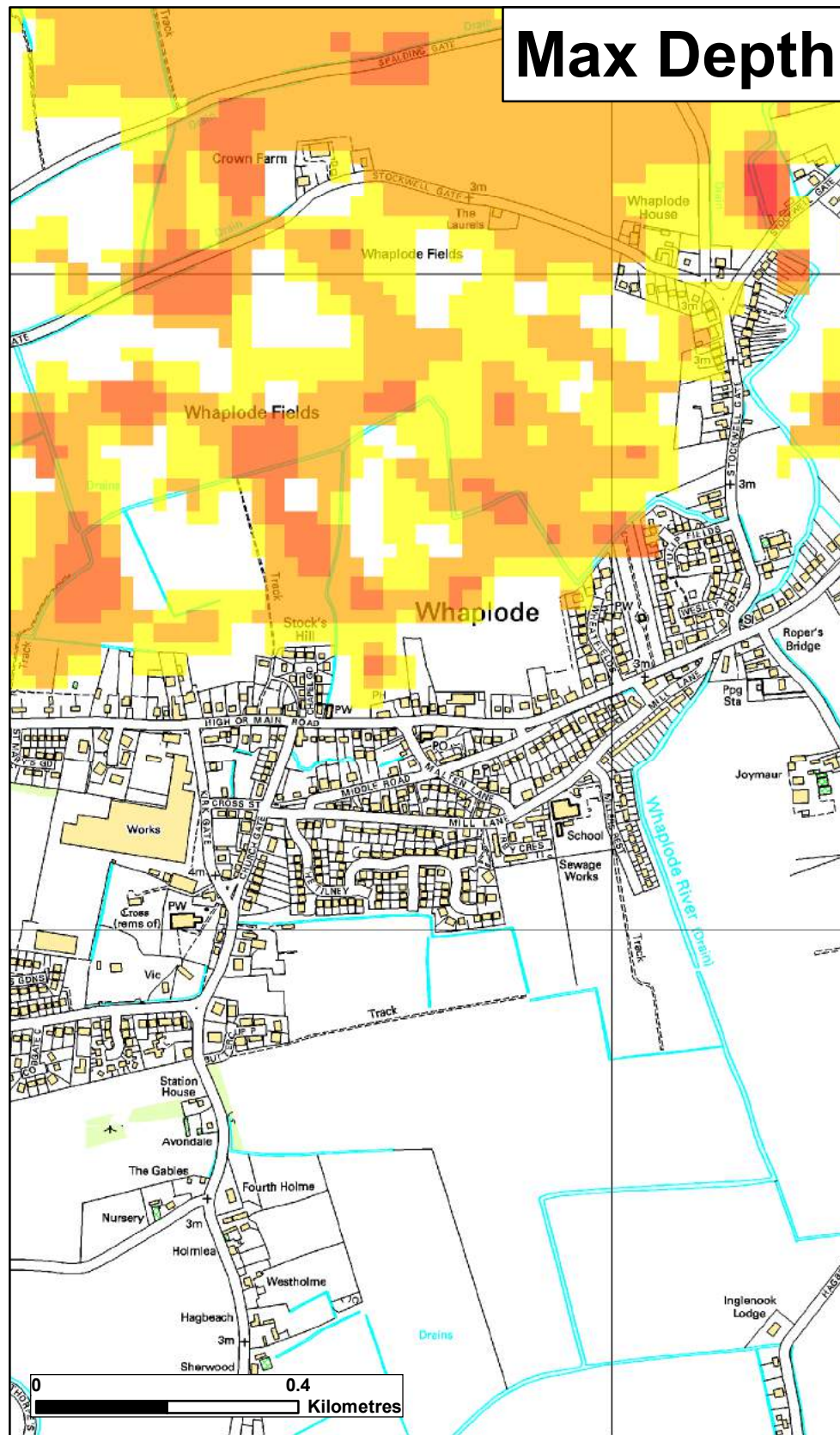
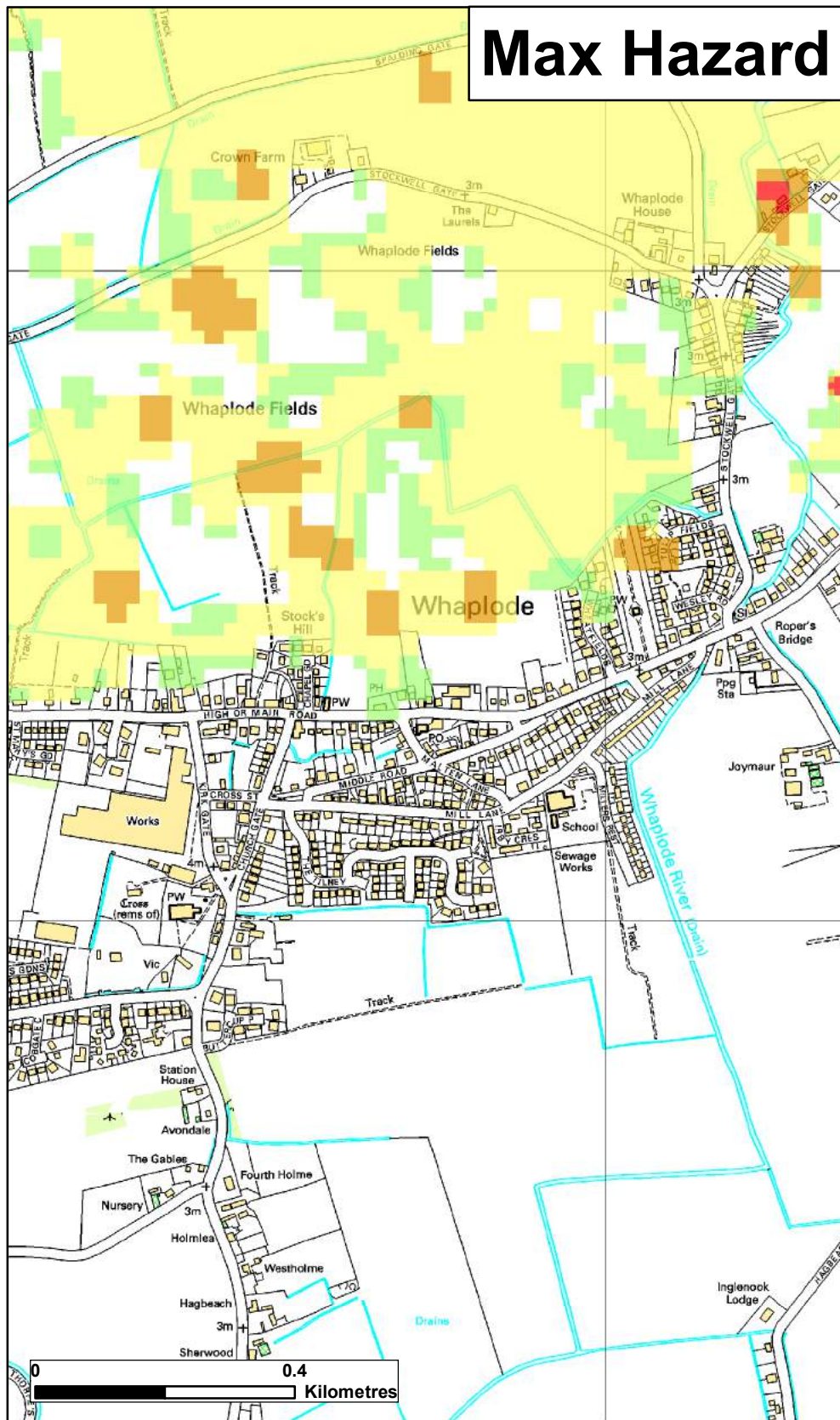
|                                                                                                                                                                                                                      |             |                                                                                                                                 |      |                                                                                                                             |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>★ Modelled Breach Locations</b> - see also the accompanying plan "Location of Modelled Breaches"                                                                                                                  |             |                                                                                                                                 |      |                                                                                                                             |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |
| <b>Max Hazard</b><br>(Flood Risk to People : FD2320)                                                                                                                                                                 |             | <b>Max Depth (m)</b>                                                                                                            |      | <b>Max Velocity (m/s)</b>                                                                                                   |                 | <p>This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.</p> <p>The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.</p> <p>The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.</p> |                |
| <ul style="list-style-type: none"><li>Less than 0.75 (Low Hazard)</li><li>Between 0.75 and 1.25 (Danger for Some)</li><li>Between 1.25 and 2.0 (Danger for Most)</li><li>Greater than 2.0 (Danger for All)</li></ul> |             | <ul style="list-style-type: none"><li>0 - 0.25</li><li>0.25 - 0.50</li><li>0.50 - 1.0</li><li>1.0 - 1.6</li><li>1.6 +</li></ul> |      | <ul style="list-style-type: none"><li>0 - 0.3</li><li>0.3 - 1.0</li><li>1.0 - 1.5</li><li>1.5 - 2.5</li><li>2.5 +</li></ul> |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |
| <b>Date Printed</b>                                                                                                                                                                                                  | August 2017 | <b>Scenario year</b>                                                                                                            | 2115 | <b>Scenario Annual Chance</b>                                                                                               | 0.5% (1 in 200) | <b>CCN Number</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | CCN-2017-53986 |

**Lincolnshire and Northamptonshire Tidal Breaching Hazard Mapping**

Map Centred on TF 32721 24316

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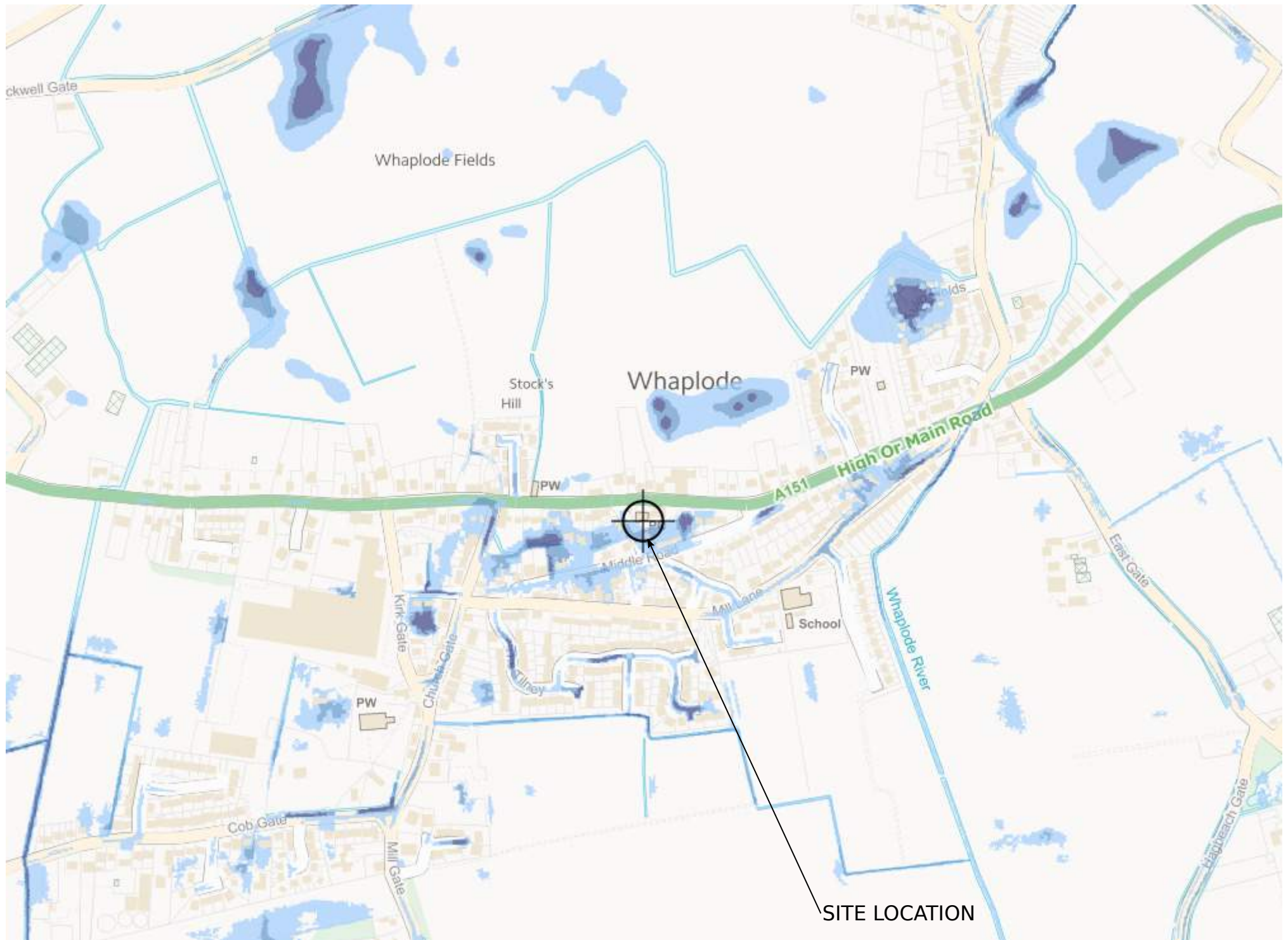
|                                                                                                                                                                                                                      |             |                                                                                                                                 |      |                                                                                                                             |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>★ Modelled Breach Locations</b> - see also the accompanying plan "Location of Modelled Breaches"                                                                                                                  |             |                                                                                                                                 |      |                                                                                                                             |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |
| <b>Max Hazard</b><br>(Flood Risk to People : FD2320)                                                                                                                                                                 |             | <b>Max Depth (m)</b>                                                                                                            |      | <b>Max Velocity (m/s)</b>                                                                                                   |                  | <p>This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.</p> <p>The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.</p> <p>The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.</p> |                |
| <ul style="list-style-type: none"><li>Less than 0.75 (Low Hazard)</li><li>Between 0.75 and 1.25 (Danger for Some)</li><li>Between 1.25 and 2.0 (Danger for Most)</li><li>Greater than 2.0 (Danger for All)</li></ul> |             | <ul style="list-style-type: none"><li>0 - 0.25</li><li>0.25 - 0.50</li><li>0.50 - 1.0</li><li>1.0 - 1.6</li><li>1.6 +</li></ul> |      | <ul style="list-style-type: none"><li>0 - 0.3</li><li>0.3 - 1.0</li><li>1.0 - 1.5</li><li>1.5 - 2.5</li><li>2.5 +</li></ul> |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |
| <b>Date Printed</b>                                                                                                                                                                                                  | August 2017 | <b>Scenario year</b>                                                                                                            | 2115 | <b>Scenario Annual Chance</b>                                                                                               | 0.1% (1 in 1000) | <b>CCN Number</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | CCN-2017-53986 |

**Lincolnshire and Northamptonshire Tidal Breaching Hazard Mapping**

Map Centred on TF 32721 24316

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# SURFACE WATER FLOOD MAP



Calculated by: George Shuttleworth

Site name: Filling Station

Site location: Whaplode

## Site coordinates

Latitude: 52.80006° N

Longitude: 0.02983° W

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Reference: 6005107

Date: 2017-07-21T10:27:40

## Methodology

IH124

## Site characteristics

|                      |     |
|----------------------|-----|
| Total site area (ha) | 1.0 |
|----------------------|-----|

## Methodology

|                        |                             |
|------------------------|-----------------------------|
| Qbar estimation method | Calculate from SPR and SAAR |
| SPR estimation method  | Calculate from SOIL type    |

|             | Default | Edited |
|-------------|---------|--------|
| SOIL type   | 2       | 2      |
| HOST class  | ---     | ---    |
| SPR/SPRHOST | 0.3     | 0.3    |

## Hydrological characteristics

|                               | Default | Edited |
|-------------------------------|---------|--------|
| SAAR (mm)                     | 564     | 564    |
| Hydrological region           | 5       | 5      |
| Growth curve factor: 1 year   | 0.87    | 0.87   |
| Growth curve factor: 30 year  | 2.45    | 2.45   |
| Growth curve factor: 100 year | 3.56    | 3.56   |

## Notes:

(1) Is  $Q_{BAR} < 2.0$  l/s/ha?

Normally limiting discharge rates which are less than 2.0 l/s/ha are set at 2.0 l/s/ha.

(2) Are flow rates  $< 5.0$  l/s?

Where flow rates are less than 5.0 l/s consents are usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is  $SPR/SPRHOST \leq 0.3$ ?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite may be a requirement for disposal of surface water runoff.

## Greenfield runoff rates

|                      | Default | Edited |
|----------------------|---------|--------|
| Qbar (l/s)           | 1.42    | 1.42   |
| 1 in 1 year (l/s)    | 1.23    | 1.23   |
| 1 in 30 years (l/s)  | 3.47    | 3.47   |
| 1 in 100 years (l/s) | 5.04    | 5.04   |



# **HUMBERSIDE MATERIALS LABATORY Ltd.**

Atherton Way, Brigg  
North Lincs DN20 8AR  
Tel & Fax 01652 652753  
email [info@humbersidematerialslab.co.uk](mailto:info@humbersidematerialslab.co.uk)

## **TRIAL PIT LOG**

**Trial pit  
No  
1**

Client :- York Sills  
Site :- Coop Whaplode  
Project No :- 3748

Location :- see site plan  
Date :- 05-Aug-15

Coordinates E: N:  
Elevation :-  
Excavated by :- JCB

| Depth (m) | Lithology / Description                                                 | Elevation | Samples | Water level | Notes                        |
|-----------|-------------------------------------------------------------------------|-----------|---------|-------------|------------------------------|
| 0         | Macadam surfacing<br>vaious concrete layers                             | 0         |         |             |                              |
| 0.2       | Brick rubble FILL in silt matrix                                        | 0.2       |         |             |                              |
| 0.4       | Black brown SILT with occasional brick fragments (Madeground)           | 0.4       |         |             |                              |
| 0.6       |                                                                         | 0.6       | 1       | D           |                              |
| 0.8       | Dark brown SILT with occasional brick fragments, glass etc (Madeground) | 0.8       |         |             | black seam with slight odour |
| 1         |                                                                         | 1         |         |             |                              |
| 1.2       | Light brown orange SILT                                                 | 1.2       |         |             |                              |
| 1.4       |                                                                         | 1.4       |         |             |                              |
| 1.6       |                                                                         | 1.6       |         |             |                              |
| 1.8       |                                                                         | 1.8       |         |             |                              |
| 2         |                                                                         | 2         |         |             |                              |
| 2.2       |                                                                         | 2.2       |         |             |                              |
| 2.4       |                                                                         | 2.4       |         |             |                              |
| 2.6       |                                                                         | 2.6       |         |             |                              |
| 2.8       |                                                                         | 2.8       |         |             |                              |
| 3         |                                                                         | 3         |         |             |                              |
| 3.2       |                                                                         | 3.2       |         |             |                              |
| 3.4       |                                                                         | 3.4       |         |             |                              |
| 3.6       |                                                                         | 3.6       |         |             |                              |
| 3.8       |                                                                         | 3.8       |         |             |                              |

Sample Key  
B Bulk  
D Disturbed  
W Water  
SS Split spoon  
C Cone

Notes :-

File Ref :- 88 / 3748  
Logged by :- M Green



# **HUMBERSIDE MATERIALS LABATORY Ltd.**

Atherton Way, Brigg  
North Lincs DN20 8AR  
Tel & Fax 01652 652753  
email [info@humberstonematerialslab.co.uk](mailto:info@humberstonematerialslab.co.uk)

## **TRIAL PIT LOG**

**Trial pit  
No  
2**

Client :- York Sills  
Site :- Coop Whaplode  
Project No :- 3748

Location :- see site plan  
Date :- 05-Aug-15

Coordinates E:      N:  
Elevation :-  
Excavated by :- JCB

| Depth (m) | Lithology / Description     | Elevation | Samples | Water level | Notes    |
|-----------|-----------------------------|-----------|---------|-------------|----------|
| 0         | Macadam surfacing           | 0         |         |             |          |
|           | Limestone sub-base          |           |         |             |          |
| 0.2       | Concrete                    | 0.2       |         |             |          |
|           | Brick fill in a silt matrix |           |         |             |          |
| 0.4       |                             | 0.4       |         |             |          |
|           | Orange brown SILT           |           |         |             |          |
| 0.6       |                             | 0.6       | 1       | D           | HV 33kPa |
| 0.8       |                             | 0.8       |         |             |          |
|           | Grey silty CLAY             |           |         |             |          |
| 1         |                             | 1         | 2       | D           | HV 40kPa |
| 1.2       |                             | 1.2       |         |             |          |
| 1.4       |                             | 1.4       |         |             |          |
| 1.6       |                             | 1.6       |         |             |          |
| 1.8       |                             | 1.8       |         |             |          |
| 2         |                             | 2         |         |             |          |
| 2.2       |                             | 2.2       |         |             |          |
| 2.4       |                             | 2.4       |         |             |          |
| 2.6       |                             | 2.6       |         |             |          |
| 2.8       |                             | 2.8       |         |             |          |
| 3         |                             | 3         |         |             |          |
| 3.2       |                             | 3.2       |         |             |          |
| 3.4       |                             | 3.4       |         |             |          |
| 3.6       |                             | 3.6       |         |             |          |
| 3.8       |                             | 3.8       |         |             |          |

Sample Key  
B Bulk  
D Disturbed  
W Water  
SS Split spoon  
C Cone

Notes :-

File Ref :- 88 / 3748  
Logged by :- M Green



# HUMBERSIDE MATERIALS LABATORY Ltd.

Atherton Way, Brigg  
North Lincs DN20 8AR  
Tel & Fax 01652 652753

email [info@humbersidematerialslab.co.uk](mailto:info@humbersidematerialslab.co.uk)

## BOREHOLE LOG

Borehole  
No  
3

Client :- York Sills  
Site :- Coop Whaplode  
Project No :- 3748

Location :- see site plan  
Date :- 21-Aug-15

Coordinates E: N:  
Elevation :-  
Excavated by :- Shell & Auger  
Drilled by :- SIS

| Depth (m) | Lithology / Description                           | Elevation | Samples | Water level | SPT | Notes |
|-----------|---------------------------------------------------|-----------|---------|-------------|-----|-------|
| 0         | Macadam surfacing                                 | 0         | 1 D     |             |     |       |
|           | limestone                                         |           | 2 D     |             |     |       |
|           | Concrete                                          |           |         |             |     |       |
| 1         | brown sand with brick and concrete FILL           | 1         | 3 SS    |             | 7   |       |
|           | Orange brown SILT                                 |           |         |             |     |       |
| 2         | Orange brown SILT with black bands                | 2         | 5 SS    |             | 4   |       |
| 3         | Black brown very silty SAND (wet)                 | 3         | 7 SS    |             | 11  |       |
|           | Fine brown silty SAND with some shells            |           |         |             |     |       |
| 4         |                                                   | 4         | 9 SS    |             | 9   |       |
| 5         |                                                   | 5         | 10 D    |             |     |       |
| 6         |                                                   | 6         |         |             |     |       |
| 7         |                                                   | 7         |         |             |     |       |
| 8         |                                                   | 8         |         |             |     |       |
| 9         |                                                   | 9         |         |             |     |       |
| 10        |                                                   | 10        |         |             |     |       |
| 11        |                                                   | 11        |         |             |     |       |
| 12        |                                                   | 12        |         |             |     |       |
| 13        |                                                   | 13        |         |             |     |       |
| 14        | Fine grey brown SAND with small shells            | 14        | 12 D    |             |     |       |
| 15        |                                                   | 15        |         |             |     |       |
| 16        | Firm to stiff brown silty CLAY with chalk gravels | 16        |         |             |     |       |
| 17        |                                                   | 17        | 13 SS   |             |     |       |
|           |                                                   |           | 15 D    |             |     |       |
| 18        |                                                   | 18        |         |             |     |       |
| 19        |                                                   | 19        | 16 SS   |             |     |       |
| 20        |                                                   | 20        |         |             |     |       |

Sample Key  
B Bulk  
D Disturbed  
W Water  
SS Split spoon  
C Cone  
U Undisturbed

Notes :-

File Ref :- 88 / 3748  
Logged by :- M Green