

REPORT

Boston Alternative Energy Facility

Appendix 13.2: Flood Risk Assessment

Client: Boston Alternative Use Projects Ltd

Reference: PB6934-RHD-01-ZZ-RP-N-2013_A13.2

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Date: 17 June 2019



HASKONINGDHV UK LTD.

Rightwell House
Rightwell East
Bretton
Peterborough
PE3 8DW
Industry & Buildings
VAT registration number: 792428892

+44 1733 334455 **T**
+44 1733 262243 **F**
email **E**
royalhaskoningdhv.com **W**

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Author(s): Natalie James, Helena Wicks, Carina Agnew

Drafted by: Natalie James, Helena Wicks, Carina
Agnew

Checked by: Helena Wicks

Date / initials: 10/06/19 HW

Approved by: Gary Bower

Date / initials: 17/06/19 GB

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Table of Contents

A13	Flood Risk Assessment	1
A13.1	Introduction	1
A13.2	Location and Development Description	1
A13.3	Facility	3
A13.4	Development and Flood Risk	5
A13.5	Definition of Flood Hazard	7
A13.6	Flood Risk Vulnerability	14
A13.7	Climate Change	17
A13.8	Flood Risk Management Measures	20
A13.9	Conclusions	24
A13.10	References	27

Table of Tables

Table A13.2.1	Summary of Flood Zone Definitions	8
Table A13.2.2	Tidal Water Levels: Calculated to 2019	10
Table A13.2.3	Flood Risk Vulnerability and Flood Zone 'Compatibility' (Reproduced from NPPF PPG)	15
Table A13.2.4	Sea Level Allowance for Each Epoch in mm per Year Using 1990 Baseline	17
Table A13.2.5	Still tidal water level for 2055	17
Table A13.2.6	Peak Rainfall Intensity Allowance in Small and Urban Catchments (use 1961-90 baseline) (Source: Table 2, Environmental Agency Climate Change Allowances (03/02/17))	20

Non-Technical Summary

This Flood Risk Assessment was prepared as Technical Appendix 13.2 to support **Chapter 13 Surface Water, Flood Risk and Drainage Strategy** of the Preliminary Environmental Information Report (PEIR) for the proposed Boston Alternative Energy Facility (known as the Application Site).

Under the NPPF Flood Risk and Coastal Change, Planning Practice Guidance, the Facility would be considered as 'Essential Infrastructure'. The Application Site forms part of a larger area of land that has been allocated for industrial and commercial employment development with reference to the Lincolnshire Minerals and Waste Local Plan – Site Locations (adopted 2017) and the South-East Lincolnshire Local Plan. The Facility is within the allocated area WA22-BO which has been assessed as a potentially suitable location for a broad range of open and enclosed industrial facilities, including resource recovery, waste treatment, transfer and recycling, and energy recovery.

The Application Site is located in Flood Zone 3; however, the Environment Agency has confirmed this is associated with tidal flood risk rather than fluvial flood risk.

Current primary tidal defences provide a 1 in 150-year standard of protection. Future planned flood defence improvement works, as part of the Boston Combined Strategy, will provide a 1 in 300-year standard of protection from tidal flooding, in line with 50 years of climate change adaptation values, to the Application Site.

Surface water flood risk to the Application Site is primarily very low, with small areas of increased surface water flood risk associated with existing drains / watercourses and localised low-lying points. The Application Site is largely agricultural, although there may be some highway drainage associated with Nursery Road along the western boundary of the Site.

The risk of flooding from sewers and groundwater is considered to be low. The Application Site is not located in an area at risk of flooding from canals or reservoirs.

Therefore, based on the identified flood risk to the Application Site and the proposed flood risk management techniques, including resilience measures, it is considered that the Application Site is appropriate in line with the National Planning Policy Framework.

A13 Flood Risk Assessment

A13.1 Introduction

A13.1.1 This Flood Risk Assessment was prepared as Technical Appendix 13.2 to support **Chapter 13 Surface Water, Flood Risk and Drainage Strategy** of the Preliminary Environmental Information Report (PEIR) for the proposed Boston Alternative Energy Facility.

A13.1.2 The purpose of this Flood Risk Assessment (FRA) is:

- To describe the existing environment in relation to flood risk;
- Present the assessment of the potential impacts during construction and operational phases of the Boston Alternative Energy Facility (the Facility);
- Provide details of potential mitigation measures; and
- Provide discussion where significant impacts are identified.

A13.1.3 This FRA has been prepared in accordance with the National Planning Policy Framework (NPPF), NPPF Planning Practice Guidance (PPG) for Flood Risk and Coastal Change and the Environment Agency's Climate Change Allowance guidance (2017a). The Climate Change Allowance guidance sets out the Environment Agency's recommended climate change allowances for development, when considering flood risk and coastal change for planning purposes.

A13.1.4 The principal aim of the above policies and guidance documents is to avoid inappropriate development in areas at risk of flooding and, wherever possible, to direct development away from areas at highest risk.

A13.2 Location and Development Description

Application Site Location

A13.2.1 The Application Site is on the western bank of The Haven, to the south of Boston, Lincolnshire and to the east of the adjacent Riverside Industrial Estate (**Figure 1.1**). A mixture of classification types is defined within the South-East Lincolnshire Local Plan (SELLP) (2019) for the Application Site. The east of the Application Site largely comprises current and former agricultural fields, which are greenfield. The western parts of the Application Site are marked as both established and proposed Employment Areas within the SELLP and are a mixture of brownfield and greenfield areas. The Lincolnshire Minerals and Waste

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Local Plan (LMWLP) (2017) notes that the entire Application Site has been allocated for industrial development (Site Allocation WA22-BO).

A13.2.2 The eastern boundary of the Application Site is defined, in part by flood defences along The Haven. The areas immediately to the north, west and south of the Application Site are defined by industrial and business units. The Application Site forms part of the wider emerging industrial and commercial area, defined by local planning documents, including the SELLP and LMWLP.

Geology

A13.2.3 The British Geological Survey (BGS) online mapping indicates that the Application Site is located over bedrock of the Ampthill Clay Formation, formed of mudstone. The solid geology is overlain at the Application Site by superficial deposits comprising Tidal Flat Deposits formed of clay and silt.

Hydrology

A13.2.4 The eastern boundary is defined in part by the flood defences along The Haven. The Haven is the tidal waterway of the River Witham between The Wash to the east and Great Sluice in Boston town upstream of the Facility. The Haven is classified as a 'Main River' by the Environment Agency and flows in a south-easterly direction into the Wash approximately 7 km to the south-east. The Haven forms part of the Witham transitional waterbody.

A13.2.5 The Port of Boston is located approximately 750 m upstream to the north-west.

A13.2.6 The eastern boundary of the Black Sluice Internal Drainage Board district is defined by the River Witham and The Haven at the location of the Application Site. As such the Application Site is located within the Black Sluice Internal Drainage Board district. Analysis of the publicly available Black Sluice Internal Drainage Board 'watercourse' data (Black Sluice IDB, undated) indicates that the Facility is located within the Wyberton Marsh catchment. The Wyberton Marsh catchment is a pumped system, which discharges into The Haven, at Wyberton Pumping Station, located approximately 2.5 km downstream of the Application Site.

A13.2.7 Ordnance Survey (OS) mapping identified a number of ordinary watercourses or land drains located within the Application Site boundary. However, following development of the Biomass UK No 3 Ltd power station some of these were removed, and surface water has been redirected to an attenuation pond to the south-east of the Application Site. The existing Application Site comprises a

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series of former agricultural fields and grassland to the east which is classed as greenfield with areas to the west identified as Employment Areas within the SELLP and comprises a mixture of brownfield and greenfield land. Watercourses or ditches are also located along several of the Application Site boundaries, following hedge lines and / or field boundaries. Online data indicates that all ordinary watercourses / drains on the Application Site are not currently maintained by the Black Sluice Internal Drainage Board.

A13.2.8 **Figure A13.2.1** shows the Application Site relative to key locations including the Port of Boston and Wyberton Pumping Station.

Existing Flood Defences

A13.2.9 A request for the Product 4 and 8 data packages was submitted to the Environment Agency to inform this FRA. Flood risk information was provided by the Environment Agency in October 2018 (Environment Agency, 2018c) which included information related to the existing flood defences in the area.

A13.2.10 The Environment Agency's flood risk information confirms that the Application Site benefits from the presence of existing tidal flood defences, which provide a 1 in 150-year standard of protection. The tidal defences at this location are formed of earth embankments and have been classed as being in 'Good' condition by the Environment Agency. Effective crest levels for the defences have been confirmed by the Environment Agency to be 6.1 mAOD (metres Above Ordnance Datum).

A13.2.11 The Application Site also benefits from the presence of a linear secondary flood defence, known as Roman Bank. The Environment Agency flood data does not identify this as an Environment Agency flood defence and as such no effective crest levels have been provided. It is assumed that the secondary flood defence is classed as a private defence (See **Chapter 8 Cultural Heritage** for more information). Analysis of remotely sensed topographic LiDAR data with a 25cm resolution shows the crest level of the Roman Bank is approximately 5.2 mAOD.

A13.3 Facility

A13.3.1 The Facility will incorporate an energy recovery plant to export electricity to the grid and associated facilities to support the operational phase of the development. A full description of the Facility is provided in **Chapter 5 Project Description**. The Facility has an expected operational period of 25 years after which its ongoing operation will be reviewed. The associated facilities include:

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- A wharf with cranes and berthing points for up to three ships;
- A storage area to house the incoming Refuse Derived Fuel (RDF);
- A processing facility to prepare the feedstock to a consistent specification;
- Conveyors for transferring the processed material;
- Three gasification units and associated steam turbines that will generate power, which will then be exported to the National Grid via a grid connection and substation;
- A lightweight aggregate manufacturing plant to process the residue from the gasification process;
- Infrastructure required for carbon capture; and
- A storage area for loading of the lightweight aggregate onto a ship for removal.

A13.3.2 The construction of the wharf is anticipated to take approximately 18 months and would comprise one of the earliest elements of the construction phase.

Area Wide Proposed Flood Defence Works

Boston Combined Strategy

A13.3.3 The Application Site is located in an area which benefits from tidal flood defences with an existing 1 in 150-year standard of protection. Flood risk information was provided, as part of the Product 4 and 8 data packages, by the Environment Agency in October 2018 (EA, 2018c) including information relating to the improvement works to the tidal defences within the area.

A13.3.4 Further information related to the flood defence works in the wider area were provided at a meeting between Boston Alternative Energy Facility, the Environment Agency and Royal HaskoningDHV on 13th December 2018. These improvement works are part of the Boston Combined Strategy. The Boston Combined Strategy consists of five phases of flood defence improvements which will ultimately provide Boston town with a 1 in 300-year standard of protection against tidal flooding.

Boston Barrier

A13.3.5 Phase 3 of the Boston Combined Strategy is the Boston Tidal Barrier which will provide protection against tidal surges to Boston town and is due to be completed by late 2019. However, the Barrier is required to go through a commissioning process and there will also be construction works on the Port of Boston wet dock

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throughout 2019 – 2020 as part of the overall Barrier project. Therefore, the completed Boston Tidal Barrier is due for completion by Winter 2020.

A13.3.6 Upon completion the Boston Barrier will have a crest height of 7.55 mAOD which includes a freeboard allowance for wave action due to wash from ships. The Application Site is located downstream of the Boston Barrier and will not directly benefit from the barrier's tidal flood protection.

Haven Banks

A13.3.7 Phase 5 of the Boston Combined Strategy is the Havens Banks Project, an adaptive defence scheme enabling the Haven Banks to adapt to climate change. The Haven Banks Project shall raise the earth embankment defences by approximately 150 – 200 mm over two or three lifting stages and is programmed for construction between Summer 2019 and Winter 2020.

A13.3.8 The Application Site is located within the frontage that will be subject to improvement and upgrade works as part of the Haven Banks Project. Improvement works associated with the Haven Banks project will be constructed along the frontage in front of the Application Site prior to the commencement of the Facility.

A13.3.9 The Haven Banks Project will comprise a minimum crest height of 6.5 mAOD when all works are completed, providing a 1 in 300-year Standard of Protection in line with 50 years of climate change adaptation values.

A13.3.10 Therefore, the proposed wharf will require a crest level to be constructed such that it maintains a continual defence line and so that it shall tie into the improved flood defences (as part of the Haven Banks project) at either end of the Application Site. Maintenance of the flood defences along the Application Site frontage is likely to become the responsibility of the Landowner. However, the Environment Agency may require continued access to the frontage to check its condition and integrity.

A13.4 Development and Flood Risk

National Planning Policy Framework

A13.4.1 The NPPF PPG for Flood Risk and Coastal Change (NPPF, 2019) provides direction on how flood risk should be considered at all stages of the planning and development process. The planning system should ensure that new development is safe and not exposed unnecessarily to the risks associated with

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flooding. This FRA sets out the planning and wider context within which the Facility needs to be considered along with the flood risk to the Application Site.

Local Development Documents

Preliminary Flood Risk Assessment

A13.4.2 Lincolnshire County Council, in their role as Lead Local Flood Authority (LLFA) produced a Preliminary Flood Risk Assessment (PFRA) in June 2011. The PFRA is a countywide preliminary assessment of flood risk from surface water, groundwater and ordinary watercourse sources. Following completion of the PFRA the Lincolnshire Flood Risk Management Partnership was developed and formally established in April 2010. Its members include:

- Lincolnshire County Council;
- Environment Agency (Anglian Region, Northern Area);
- 14 Internal Drainage Boards;
- Seven District Councils;
- Two Water Companies;
- Natural England;
- The Regional Flood & Coastal Committee (Anglian Region, Northern Area); and
- The Lincolnshire Resilience Forum.

A13.4.3 The Partnership is designed to provide co-ordinated management and delivery of flood risk and drainage functions at all relevant organisations across Lincolnshire.

Strategic Flood Risk Assessment

A13.4.4 Boston Borough Council produced a Strategic Flood Risk Assessment (SFRA) in October 2010 which identifies several sources of flooding within the borough, including tidal and fluvial sources. The Site is located adjacent to The Haven, which has been identified as a source of tidal flooding by the SFRA. The Site is located within the 'Boston Town' study area of the SFRA, and details of the report's findings are included in **Section A13.5**.

South-East Lincolnshire Local Plan

A13.4.5 The South-East Lincolnshire Local Plan 2011 – 2036 is a joint venture created by the South-East Lincolnshire Joint Strategic Planning Committee. The Local

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Plan was submitted to the Secretary of State in June 2017 and was adopted on 8th March 2019.

- A13.4.6 The Application Site forms part of a larger area of land that has been allocated for industrial and commercial employment development with reference to the South-East Lincolnshire Local Plan. The Application Site is located within a proposed Main Employment Area, identified as BO006 Riverside Industrial Estate, Boston under Policy 7: Improving South-East Lincolnshire's Employment Land Portfolio.

Lincolnshire Mineral and Waste Local Plan

- A13.4.7 The Lincolnshire Minerals and Waste Local Plan – Site Locations (adopted in 2017) identifies the Application Site to be in the allocated area WA22-BO which has been assessed as a potentially suitable location for a broad range of open and enclosed industrial facilities and specifically identifies waste treatment, recycling and energy recovery.

A13.5 Definition of Flood Hazard

- A13.5.1 A Flood Risk Assessment must consider the issues associated with all sources of flooding in accordance with NPPF and the supporting PPG for Flood Risk and Coastal Change. These have been considered in this FRA with respect to the Application Site. The following sections provide a review of publicly available flooding information and relevant planning documents.

Probability of Flood Risk – Flood Zones

- A13.5.2 **Table A13.2.1** outlines the definitions of each Flood Zone and associated probability, which has been taken from Table 1 of the NPPF PPG. The NPPF through the application of the Sequential Test aims to steer development towards areas at lowest risk of flooding (Flood Zone 1) and away from medium and high flood risk areas (Flood Zone 2 and 3).

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Table A Error! No text of specified style in document.. **2.1 Summary of Flood Zone Definitions**

Flood Zone	Probability of Flooding	Return Periods
1	Low	Land having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).
2	Medium	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1%); or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% - 0.1%).
3a	High	Land having a 1 in 100 or greater annual probability of river flooding (>1%); or Land having a 1 in 200 or greater annual probability of sea flooding (>0.5%).
3b	High – Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

Historic Flooding

A13.5.3 The Product 4 and 8 data package confirms a tidal surge flood event occurred in December 2013 which affected the southern half of the Application Site.

A13.5.4 A data enquiry was submitted to Lincolnshire County Council, in their role as Lead Local Flood Authority (LLFA) related to historic flood incidents affecting the Application Site. Communication with the LLFA confirmed this tidal surge occurred on 5th December 2013.

A13.5.5 Further information related to the tidal surge flood event was provided by the LLFA through the Lincolnshire Resilience Forum's Response & Recovery 'After Action' Report (Lincolnshire Resilience Forum, 2018). A Flood Warning was issued for the area by the Environment Agency on the morning of 5th December 2018, and later upgraded to a Severe Flood Warning by the evening of the same day.

A13.5.6 The report states that between 18 km and 20 km of flood defences were overtopped and defences breached at four locations across the district. Defence breaches occurred at Boston Haven, Gibraltar Point, Tetney Marsh and Friskney. The maximum total water level, including the tidal surge water levels, at Immingham coastal monitoring location (the closest to the Application Site) were recorded as 5.2 mAOD on 5th December 2018.

Flooding from Rivers

A13.5.7 The Application Site is located on the western bank of The Haven. The Boston Borough Council SFRA includes plans showing relative probability of flooding

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from both fluvial and tidal sources. These plans show the Application Site to have a low probability of flooding from fluvial sources.

A13.5.8 Consultation with the Lincolnshire and Northamptonshire Area office of the Environment Agency¹ has confirmed the Application Site is not covered by modelled fluvial flood extents. This consultation also confirmed that the greatest flood risk in this area is tidal and that Hazard Mapping depths should be used to inform planning applications.

Flooding from Tidal Sources

A13.5.9 The Environment Agency has confirmed the primary source of flooding to the Application Site is from The Haven, which is predominantly tidal in this reach. Mapping from the Environment Agency (**Figure A13.2.2**) confirms that the Application Site is located in Flood Zone 3 and therefore it would be affected by tidal flooding during the 1 in 200-year event, ignoring the presence of any flood defences.

A13.5.10 The flood risk information confirms that the Application Site benefits from the presence of existing earth embankment tidal flood defences, which provide a 1 in 150-year standard of protection at 6.1 mAOD. The Application Site also benefits from a secondary flood defence, Roman Bank, with a crest level of approximately 5.2 mAOD (See **Section A13.2** for more details). Further planned tidal defence improvement works as part of the Boston Combined Strategy are discussed in **Section A13.3**.

A13.5.11 The Environment Agency confirmed that Hazard Mapping should be used to inform planning applications, but that tidal levels should be used in conjunction with the Hazard depths¹³. Tidal still water levels for the South Humber, East and The Wash were provided by the Environment Agency for several return periods. Two tidal still water level points are located on The Haven, which is part of The Wash dataset. Grand Sluice is located upstream from the Application Site and Hobhole Drain is located downstream from the Application Site. Tidal data for The Wash has a base date of 2006.

A13.5.12 The Environment Agency's tidal climate change allowances have been used to calculate the 1 in 200 year and 1 in 1,000 year still water levels for 2019 (**Table A13.2.2**). The still water level during the 1 in 200-year event in 2019 at both nodes has been calculated to be 5.98 mODN (metres Ordnance Datum Newlyn)

¹ Email communication with PSOLINCS@environment-agency.gov.uk, Received; 24/10/2018.

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and 6.32 mODN during the 1 in 1,000 year event at Hobhole. No water level data has been provided for the 1 in 1,000-year event at the Grand Sluice node.

Table AError! No text of specified style in document..2.2 Tidal Water Levels: Calculated to 2019

Node	Location relative to the Application Site	Return Periods	
		1 in 200 year	1 in 1,000 year
Grand Sluice	Upstream from Site	5.98	-
Hobhole	Downstream from Site	5.98	6.32

A13.5.13The primary flood defence has a current crest level of 6.1 mAOD. Therefore, the primary defence provides a 1 in 200-year standard of protection against the 1 in 200 year still water level (2019). The Application Site is shown to be affected by the 1 in 1,000 year tidal still water level (2019). However, the Haven Banks project (see **Section A13.3**) will provide a 1 in 1,000-year standard of protection to the Application Site when completed in Winter 2020, with a minimum crest height of 6.5 mAOD.

A13.5.14The Boston Borough Council SFRA includes plans showing relative probability of flooding from both fluvial and tidal sources. These plans show the Application Site to have a low to medium probability of flooding from tidal sources. The SFRA also shows that in the event of a breach in The Haven's tidal defences in 2115 the Application Site's flood hazard is classified as 'Danger to All'. The SFRA does not indicate that this hazard mapping considers the beneficial effect that the presence of the secondary flood defence line would have on the flood hazard. The SFRA does not include any maps showing the locations of the breach events used to create the district wide flood hazard mapping.

A13.5.15The Environment Agency provided Hazard Mapping data for the 1 in 200 year and 1 in 1,000-year breach events occurring in 2006 and 2115. The Hazard Mapping for each of the four scenarios included information on maximum flood depth, maximum velocity and the maximum hazard. No information was provided in relation to rapid inundation zones.

A13.5.16Breach locations, utilised by the Environment Agency, are included in **Plate A13.2.1**. These include breach locations along the frontage within the Application Site. These maps are at a better resolution than the SFRA mapping and consider breach locations in proximity to the Application Site. Therefore, these are considered more relevant to the FRA than the SFRA mapping. Hazard

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mapping incorporating overtopping has not been included at the Application Site location.

A13.5.17 The maximum depth of water during a 1 in 200-year breach event for 2006 to the Application Site is shown to be predominantly between 1.0 and 1.6 m, with very small areas on the Application Site shown to be at risk of flood depths over 1.6 m (**Plate 13.2.1**).

A13.5.18 The maximum depth of water during a 1 in 1,000-year breach event for 2006 to the Application Site is shown to be predominantly between 1.0 and 1.6 m with areas of at risk of flood depths over 1.6 m (**Plate 13.2.2**).

A13.5.19 The overall existing risk of tidal flooding to the Application Site is low, as the Facility is protected by the presence of defences. The residual risk of tidal flooding to the Application Site following a breach event is moderate to low, as the defences are classed as being in a 'Good' condition.

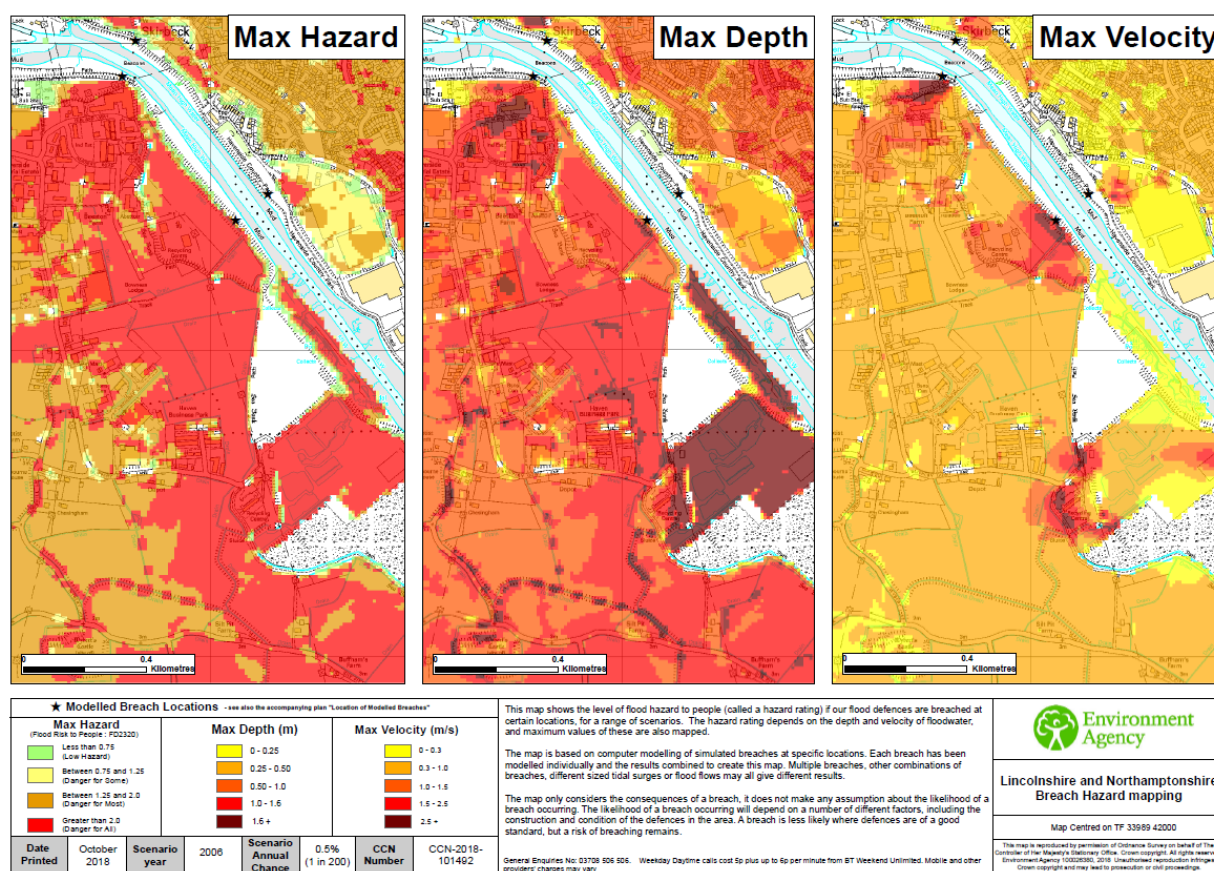


Plate AError! No text of specified style in document..**2.1 Breach Hazard Mapping for a 1 in 200-Year Event in Year 2006.**

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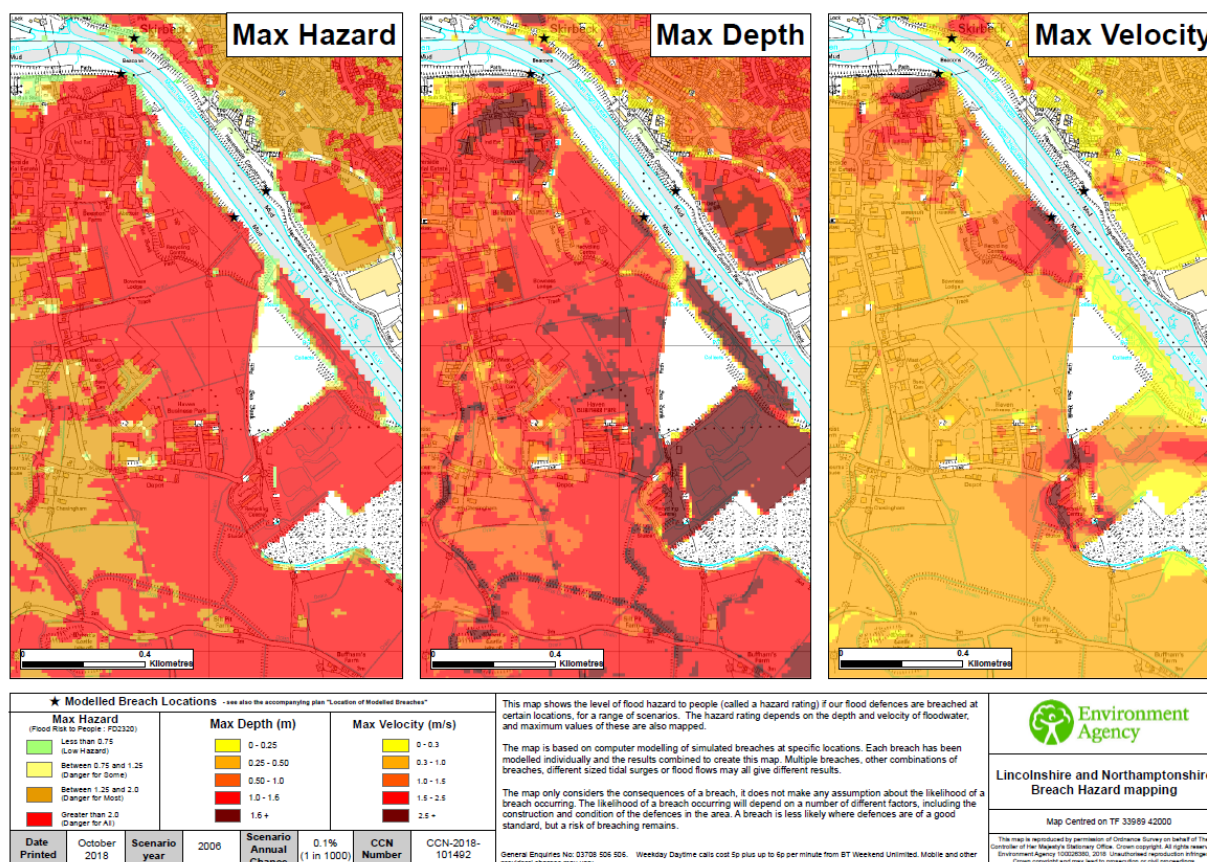


Plate A Error! No text of specified style in document..2.2 Breach Hazard Mapping for a 1 in 1,000-Year Event in Year 2006.

Flooding from Groundwater

A13.5.20 Groundwater emergence can occur when water stored beneath the ground reaches the surface and is generally associated with porous rocks e.g. sands and gravels. However, depths of water would have to accumulate to impact receptors before it is considered to cause flooding. It is understood that the Environment Agency hold borehole information for the Application Site and surrounding area. At the time of writing this FRA, relevant information has yet to be supplied. An assessment of groundwater flood risk is difficult without more detailed investigation into groundwater records, geological conditions and predictive methods to correlate rainfall to groundwater flooding.

A13.5.21 Due to the proximity of the Application Site to The Haven, and the presence of IDB maintained drains, raised groundwater levels may be evident across the Application Site. No details of groundwater flood risk have been identified in the reviewed local development documents.

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Flooding from Surface Water

A13.5.22 The Environment Agency's Flood Risk from Surface Water (2018b) map shows the majority of the Application Site to be at very low risk of flooding from surface water sources. Small areas of low, medium and high risk of flooding from surface water are located across the Application Site. These areas appear to be largely associated with the existing surface water drainage network within the Application Site as well as topographic low points.

A13.5.23 The Environment Agency's Surface Water Flood Depth map (**Figure A13.2.3**) shows that during a 1 in 30-year storm event surface water flood depths would be below 300 mm. During the 1 in 100-year storm event water depths are shown to be largely below 300 mm with very small areas, within or adjacent to the existing drainage channels, shown to have water depths between 300 and 900 mm. During the 1 in 1,000-year storm event water depths are shown to be no greater than 900 mm.

A13.5.24 The risk of surface water flooding within the Application Site is generally very low, with an increased flood risk located in proximity to the existing drainage channels and topographically low-lying land.

Flooding from Reservoirs, Canals and Other Sources

A13.5.25 The Environment Agency's Flood Risk from Reservoirs map (2018a) shows the Application Site is not located within an area at risk of flooding from reservoir failure. Therefore, there is no risk of flooding from reservoirs.

A13.5.26 No canals are located in proximity to the Application Site and therefore there is no risk of flooding from this source.

Summary of Flooding

A13.5.27 The Application Site is located in Flood Zone 3; however, the Environment Agency has confirmed this is associated with tidal flood risk rather than fluvial flood risk. The Application Site would be at high risk of tidal flooding if it were not defended. However, primary defences with an effective crest level of 6.1 m AOD currently provide a 1 in 150-year standard of protection. Areas of the Application Site also benefit from a secondary flood defence, known as the Roman Bank, with a crest level of approximately 5.2 mAOD.

A13.5.28 Future works, as part of the Boston Combined Strategy, planned for completion in Winter 2020 will increase crest levels to a minimum of 6.5 mAOD, providing a

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1 in 300-year standard of protection from tidal flooding, in line with 50 years of climate change adaptation values, to the Application Site.

A13.5.29 Surface water flood risk to the Application Site is primarily very low, with small areas of increased surface water flood risk associated with existing drains / watercourses and localised low-lying points. The Application Site is largely agricultural, although there may be some highway drainage associated with Nursery Road along the western boundary of the Site.

A13.5.30 The risk of flooding from sewers is considered to be low. The Application Site is not located in an area at risk of flooding from canals or reservoirs.

A13.5.31 Therefore, the primary source of flooding that may affect the Application Site is from tidal flooding with a minimal risk of surface water flooding.

A13.6 Flood Risk Vulnerability

Sequential and Exception Test

A13.6.1 The aim of the NPPF PPG Sequential Test is to ensure that a sequential approach to steer new development to areas with the lowest probability of flooding i.e. Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, the Local Planning Authority (LPA) can consider reasonably available sites in Flood Zone 2. Only when there are no reasonably available sites for development in Flood Zone 1 and 2, should the suitability of sites in Flood Zone 3 be considered.

A13.6.2 Following application of the Sequential Test, if it is not possible for the development to be located in zones with a lower probability of flooding whilst remaining consistent with wider sustainability objectives, the Exception Test can be applied, if appropriate. For the Exception Test to be passed:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and
- A site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

A13.6.3 Both elements of the Exception Test must be passed for development to be allocated or permitted. Within each flood zone, surface water and other sources

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of flooding also need to be taken into account in applying the sequential approach to the location of development.

Sequential Test Vulnerability Assessment

A13.6.4 The vulnerability of different types of development is classified in the NPPF Technical Guidance. The definition of Highly Vulnerable, More Vulnerable, Less Vulnerable, Water Compatible and Essential Infrastructure from the NPPF Technical Guidance is given as follows:

- **Highly Vulnerable** – Buildings used for: Police, ambulance and fire stations and command centres; basement dwellings; caravans and mobile homes; and installations requiring hazardous substances consent.
- **More Vulnerable** – Buildings used for: hospitals; dwellings and accommodation; residential institutional accommodation; non-residential health services, educational facilities; drinking establishments; nightclubs and hotels.
- **Less Vulnerable** – Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food and takeaways; offices; general industry and storage etc.
- **Water Compatible** – Development used for: flood control infrastructure; amenity open space, nature conservation and outdoor sports facilities; water / sewerage pumping stations; docks marinas and wharves; and navigation facilities.
- **Essential Infrastructure** – Essential transport infrastructure, wind turbines and essential utility infrastructure which has to be located in a flood risk area for operational reasons including electricity generating power stations.

A13.6.5 Table 3 in the NPPF sets out suitable development based on the Flood Zone and Flood Risk Vulnerability and is reproduced in **Table A13.2.3**.

Table AError! No text of specified style in document..**2.3 Flood Risk Vulnerability and Flood Zone 'Compatibility' (Reproduced from NPPF PPG)**

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
1	✓	✓	✓	✓	✓
2	✓	Exception test required	✓	✓	✓
3a	Exception test required	X	Exception test required	✓	✓

Project Related

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
3b	Exception test required	X	X	X	✓

Site Vulnerability Assessment

- A13.6.6 Under the NPPF Flood Risk and Coastal Change, Planning Practice Guidance, the Facility would be considered as 'Essential Infrastructure' (Table 2 of the NPPF). 'Essential Infrastructure' development is considered appropriate by the NPPF in Environment Agency Flood Zones 1 and 2. In Flood Zone 3a and 3b 'Essential Infrastructure' development is required to undertake the Exception Test.
- A13.6.7 The Environment Agency Flood Zone Map (**Figure A13.2.2**) shows the Application Site to be located in Flood Zone 3; however, the Environment Agency has confirmed that the Application Site currently benefits from tidal flood defences with a 1 in 150-year standard of protection. The Boston Combined Strategy, which incorporates the new Boston Barrier and an adaptive defence scheme along The Haven, will when constructed provide a 1 in 300-year standard of protection to the Application Site.
- A13.6.8 The Facility has a requirement to be located adjacent to The Haven to facilitate the future delivery of materials via boat and unloading of those materials utilising the proposed new wharf.
- A13.6.9 The Application Site forms part of a larger area of land that has been allocated for industrial and commercial employment development with reference to the Lincolnshire Minerals and Waste Local Plan – Site Locations (adopted 2017) and the South-East Lincolnshire Local Plan. The Facility is within the allocated area WA22-BO which has been assessed as a potential suitable location for a broad range of open and enclosed industrial facilities, including resource recovery, waste treatment, transfer and recycling, and energy recovery.
- A13.6.10 On the basis that the Facility must be located in proximity to The Haven for operational purposes, risk of flooding to the Application Site is a residual risk and the Application Site has been allocated within local plan development documents, this FRA finds that the Sequential and Exception Test are

Project Related

appropriately demonstrated. Measures to limit flood risk to the Facility are considered in **Section A13.8**.

A13.6.11 Notwithstanding the above, the final decision regarding the application of the Sequential and the Exception Test is for the Planning Inspectorate to confirm whether they agree that the Application Site satisfactorily passes the tests.

A13.7 Climate Change

A13.7.1 Given the potential sources of flooding outlined within **Section A13.5**, there are two main aspects of climate change likely to impact the Application Site; increase in tidal water levels and an increase in the duration and intensity of rainfall events likely to affect surface water flooding.

Sea Level Allowances

A13.7.2 The Environment Agency issued updated guidance in February 2016 (amended in February 2019) on climate change allowances to be considered within Flood Risk Assessments. Sea level allowances have been designated for four epochs, across three areas of England using a baseline sea level of 1990 (**Table A13.2.4**).

A13.7.3 The Facility is industrial and has an expected operation period of 25 years before its ongoing operation is reviewed. For the calculation of the effects of climate change on still tidal water levels a lifespan up to 2055 has been used (**Table A13.2.5**).

Table AError! No text of specified style in document..**2.4 Sea Level Allowance for Each Epoch in mm per Year Using 1990 Baseline**

	1990 to 2025	2026 to 2055	2056 to 2085	2086 to 2115
East, East Midlands, London, South East	4 mm	8.5 mm	12 mm	15 mm
South West	3.5 mm	8 mm	11.5 mm	14.5 mm
North West, North East	2.5 mm	7 mm	10 mm	13 mm

Table AError! No text of specified style in document..**2.5 Still tidal water level for 2055**

Node	Location relative to Site	Still water level (mODN) (2055)	
		1 in 200 year	1 in 1,000 year
Grand Sluice	Upstream from site	6.26	-
Hobhole	Downstream from site	6.26	6.60

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A13.7.4 The Boston Combined Strategy consists of five phases of flood defence improvements which will ultimately provide Boston town with a 1 in 300-year standard of protection against tidal flooding. The Haven Banks Project will comprise a minimum crest height of 6.5 mAOD. The proposed primary flood defence has a crest level of 6.8 mAOD.

A13.7.5 The Environment Agency provided Hazard Mapping modelled data for the 1 in 200 year and 1 in 1,000-year breach events occurring in 2115. The Hazard Mapping for each of the scenarios included information on maximum flood depth, maximum velocity and the maximum hazard.

A13.7.6 The maximum depth of water during a 1 in 200-year breach event for 2115 to the Application Site is shown to be predominantly over 1.6 m (**Plate A13.2.3**). The maximum depth of water during a 1 in 1,000-year breach event for 2115 to the Application Site is shown to also be predominantly over 1.6 m (**Plate A13.2.4**).

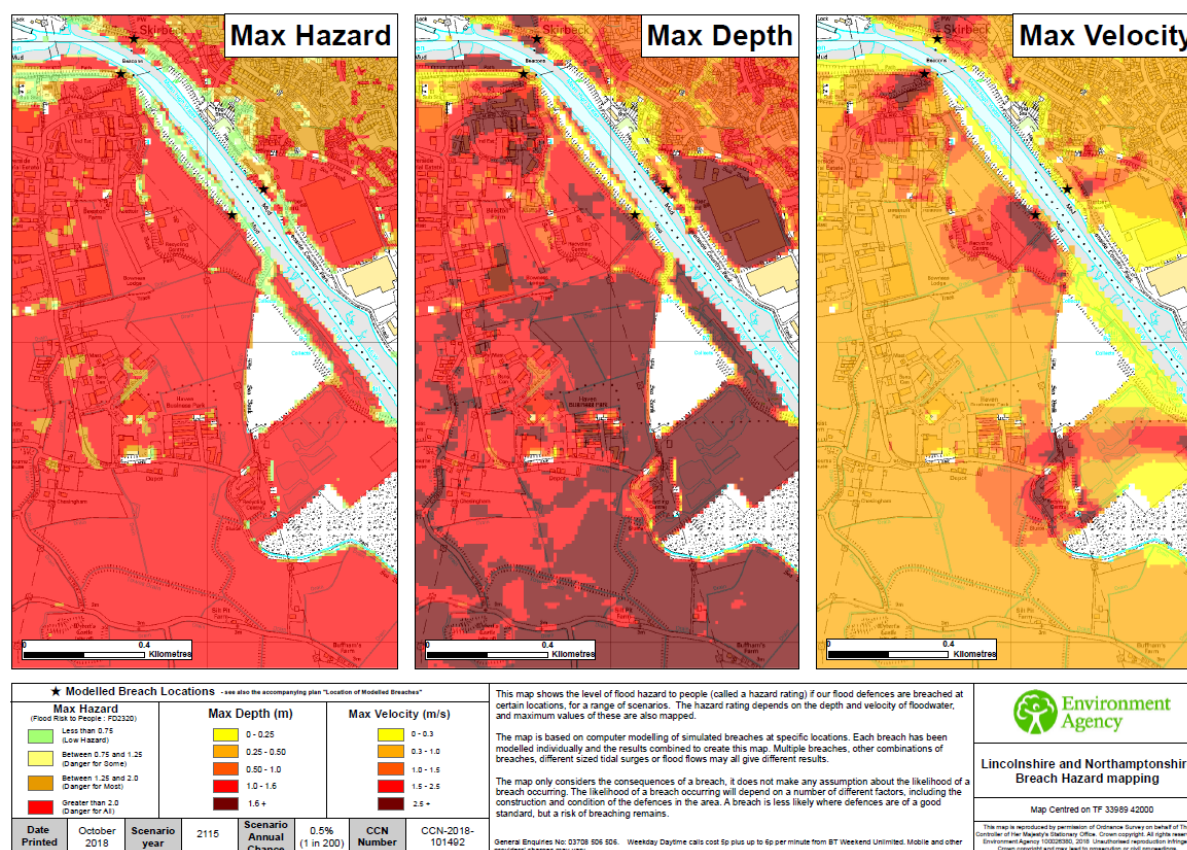


Plate A13.2.3 Breach Hazard Mapping for a 1 in 200-Year Event for the Year 2115

Project Related

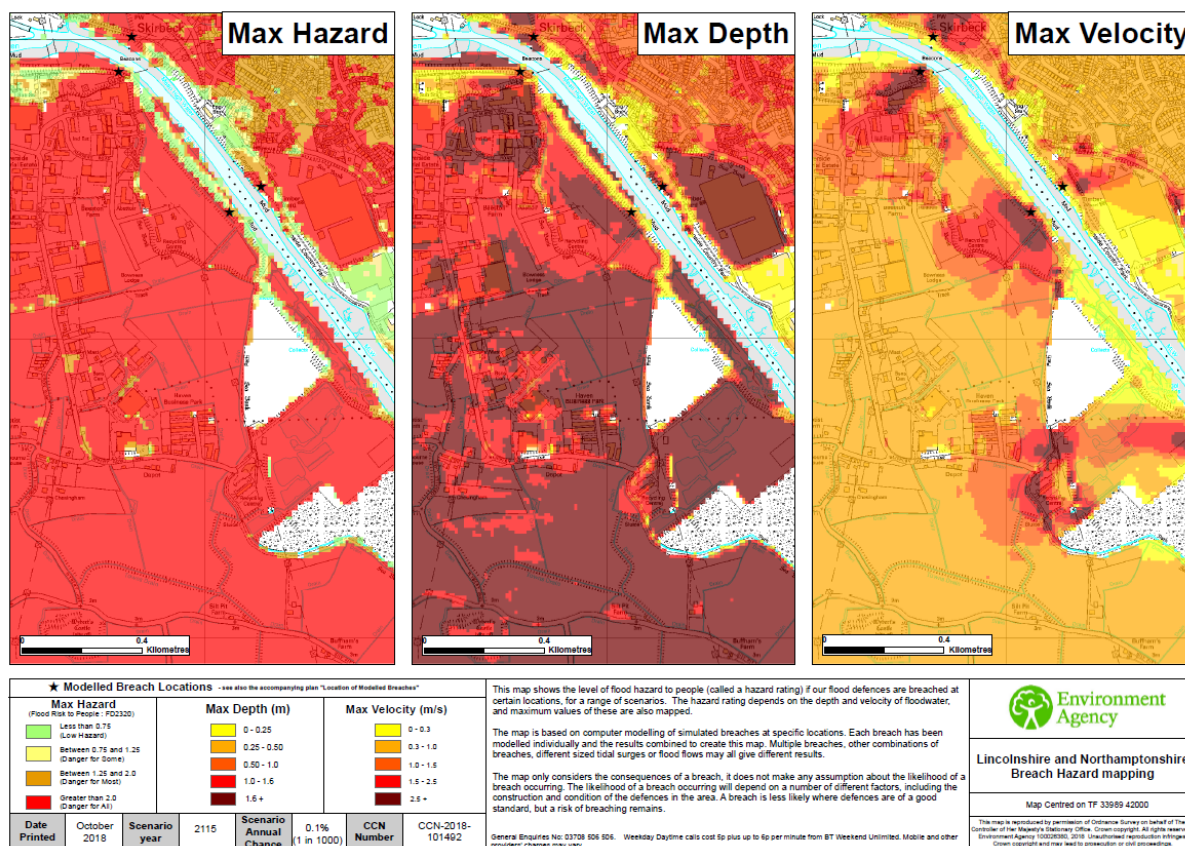


Plate A Error! No text of specified style in document..2.4 Breach Hazard Mapping for a 1 in 1,000-Year Event for the Year 2115

Peak Rainfall Intensity

A13.7.7 The Environment Agency guidance on peak rainfall intensity taking into account climate change is outlined in **Table A13.2.6**. Both the central and upper end bands should be assessed to understand the range of impacts that may affect the Application Site.

A13.7.8 The Facility is industrial and has an expected operation period of 25 years before its ongoing operation is reviewed. The '2050's' epoch is therefore appropriate for

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this assessment and both the 10% and 20% allowance should be considered for the development of the surface water drainage design for the Facility.

Table AError! No text of specified style in document..**2.6 Peak Rainfall Intensity Allowance in Small and Urban Catchments (use 1961-90 baseline) (Source: Table 2, Environmental Agency Climate Change Allowances (03/02/17))**

Applies across all of England	Total Potential Change Anticipated for the '2020s' (2015-2039)	Total Potential Change Anticipated for the '2050s' (2040-2069)	Total Potential Change Anticipated for the '2070s' (2070-2115)
Upper End	10%	20%	40%
Central	5%	10%	20%

A13.8 Flood Risk Management Measures

A13.8.1 There is always a potential for there to be a residual flood risk to people and property due to the failure of systems and defences, or more extreme events than those defined in the NPPF, or uncertainties associated with modelled water levels.

A13.8.2 Residual risk may remain after flood management or mitigation measures have been installed. Therefore, an FRA should consider the residual flood risk and the need for any further measures to ensure the residual risk is managed appropriately.

Environmental Design and Embedded Mitigation

Flood Defences

A13.8.3 Work on the Facility is programmed to be carried out after completion of the Boston Barrier and the Haven Banks project. As such the Facility, will benefit from the standard of protection provided by the Boston Combined Strategy.

A13.8.4 The Facility incorporates both primary and secondary flood defence lines. The primary flood defence line would be formed by the proposed wharf and would replace the existing Environment Agency flood defences at the Application Site.

A13.8.5 The proposed primary defence line would tie in with the improved flood defences provided as part of the Environment Agency's Havens Banks Project.

A13.8.6 The design of the wharf carried out in communication with the Landowner has set the crest height for the wharf at 6.8 mAOD. The secondary defence protecting

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part of the Site is formed of the existing linear defence known as Roman Bank, which has a natural crest level of approximately 5.2 mAOD.

Finished Floor Levels

A13.8.7 The Environment Agency standing advice (2017c) states for development in Flood Zone 2 or 3 finished floor levels indicates that ground floor levels should be a minimum of which is higher of:

- 300 mm above general ground level of the Site; or
- 600 mm above the estimated river or sea flood level.

A13.8.8 The standing advice also states that if finished floor levels cannot be raised above the estimated flood level extra resistance and resilience measures should be considered.

A13.8.9 When reviewing the general ground level of the Site (i.e. 5 mAOD) the finished floor level would need to be set to 5.3 mAOD. However, modelled still tidal water levels for 2019 are 5.98 mAOD for the 1 in 200-year event, and as such finished floor levels would be required to be set no lower than 6.58 mAOD.

A13.8.10 As previously noted, the Application Site currently benefits from tidal defences with a 1 in 150-year standard of protection and the Boston Combined Strategy and new primary flood defence will provide the Facility with a 1 in 300-year standard of protection following completion. As the Application Site benefits from tidal defences along The Haven, the risk of tidal flooding is considered to be a residual risk related to breaching of the defences. The Environment Agency states the tidal defences consist of earth embankments which are in a 'Good' condition.

A13.8.11 Due to the nature and condition of the defences the risk of a breach flood event occurring which would affect the Facility is considered to be low. It is not a requirement to set finished floor levels based on a residual flood risk. However, extra flood resistance and resilience measures could be incorporated into the Facility to allow water to pass through any structures to avoid structural damage.

Flood Resistant and Resilient Design

A13.8.12 The Environment Agency extra flood resistance and resilience measures guidance (2017b) states for water depths that are greater than 0.6 m any buildings or development on the Application Site should be designed to allow water to pass through the structure to avoid structural damage by:

- Using materials with low permeability to at least 0.3 m;

Project Related

- Making it easy for water to drain away after flooding; and
- Ensuring there is access to all spaces to enable drying and cleaning.

A13.8.13 There are several additional flood mitigation measures which could be incorporated to minimise flood risk through the use of flood resilient construction practices, specifically of relevance to the lightweight aggregates facility which is to be located behind the primary defence line but in front of the secondary defences. The following are examples that are appropriate for this element of the Facility:

- Where possible, raising electrical equipment, plant, machinery and electrical sockets above the 1 in 200-year breach flood level taking into account climate change; and
- Recommend a concrete and / or tiled surface on the ground floors that can be easily cleaned and dried following potential flood water ingress.

Surface Water Drainage Strategy

A13.8.14 The Application Site is currently largely undeveloped, and the majority of the land is permeable. The Facility will increase the impermeable area on the Application Site. In accordance with the NPPF PPG, consideration should be given to the potential for incorporating Sustainable Drainage Systems (SuDS) within the fabric of the development. The impact of climate change (increased rainfall intensity and duration) has the potential to increase the volume of surface water runoff from the Application Site.

A13.8.15 A sealed surface water drainage system will be built as part of the enabling works to manage any potential increase in surface water runoff, with a primary aim of capturing surface water for use in the lightweight aggregates facility on site. Any surplus water would be discharged into the site drainage system (in accordance with an environmental permit) and connected to the surface water drainage system constructed as part of the 'Biomass UK No 3 Ltd' power station.

A13.8.16 A Surface Water Drainage Strategy was undertaken by H.H. Adkins in 2013 to support the planning application for 'Biomass UK No 3 Ltd' power station. The Surface Water Drainage Strategy for the 'Biomass UK No 3 Ltd' power station

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was designed to manage surface water runoff from development across the entire site for a 1 in 100-year storm event with a 30% climate change allowance.

A13.8.17 Details of the proposed surface water drainage system for the Facility will be included within a Surface Water Drainage Strategy including plans of the proposed drainage layout, to support the final DCO application.

A13.8.18 Surplus surface water that is not used as part of the lightweight aggregates process shall be managed through the use of an attenuation pond located to the south of the Application Site before discharging via surface water ditches at a controlled rate into the IDB drain adjacent to the Application Site.

Flood Information Service

A13.8.19 The Environment Agency operates a flood warning service available to businesses and residents located in areas of flood risk. The Application Site is located within a flood warning area and it is advised that all relevant staff and the operators sign up to this service. This can be undertaken by registering online at <https://www.gov.uk/sign-up-for-flood-warnings>.

Safe Access and Egress

A13.8.20 The Application Site benefits from tidal defences with a 1 in 150-year standard of protection which is predicted to increase to a 1 in 300-year standard of protection following completion of tidal defence improvements as part of the Boston Combined Strategy. Safe access and egress can be achieved from the Application Site whilst defences remain functional.

A13.8.21 In the event of a defence breach during the 1 in 200-year event (2006) water depths on the Application Site have been modelled as being between 1.0 and 1.6 m. During the 1 in 200-year event (2115) water depths on the Application Site have been modelled to be over 1.6 m.

A13.8.22 The Environment Agency Hazard Mapping confirms that during a breach event for both the 2006 and 2115 scenario there would be a 'danger for all'. On the basis, that the primary source of flood risk to the Facility is tidal flooding then should there be a storm surge forecast or flood warning issued, in line with the proposed operational procedures for closure of the Boston Barrier users of the site should take action to ensure safe egress from the Application Site. Information related to the operational procedures for the proposed Boston Barrier

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have been requested from the Environment Agency but had yet to be supplied at the time of writing this FRA.

A13.8.23 Additionally, due to the operational nature of the Facility no personnel are anticipated to be required to sleep onsite and an emergency flood warning and evacuation plan should be implemented for the Application Site which includes the identification of areas for safe refuge.

Flood Warning and Evacuation Plan

A13.8.24 Due to the high hazard rating to the Application Site, should there be a breach in the defences during construction or operation the Facility will require a clear flood warning and evacuation plan. This should include procedures to receive flood warnings (including communication lines to cover shift patterns and / or staff leave), and closure of or evacuation of the Facility with sufficient lead time to ensure no personnel or vehicles are left within the Application Site during times of a flood warning.

A13.8.25 Areas of emergency refuge should also be identified within the Application Site to be located above the modelled breach flood depths. These aspects, including features to mitigate, are likely to require further consultation with the Environment Agency.

A13.9 Conclusions

A13.9.1 This FRA has reviewed the existing flood risk to the Application Site and future flood risk to the Facility. Given that:

- Topographic levels at the Application Site are between 2 – 5 mAOD;
- The Facility is located within Flood Zone 3;
- The Application Site benefits from the presence of linear tidal flood defences, formed of earth embankments with an effective crest level of 6.1 mAOD, which provide a 1 in 150 year standard of protection;
- The Facility incorporates the creation of new formal flood defences, which shall be tied into the wider flood defences in the area and have an effective crest level of 6.8 mAOD;
- The flood defence improvement works known as the Boston Combined Strategy will ultimately provide Boston town with a 1 in 300-year standard of protection;
- The key potential source of flooding to the Application Site is from The Haven (i.e. tidal flooding);

Project Related

- Tidal still water level, during the present day 1 in 200-year event, has been calculated to be 5.98 mAOD and 6.32 mAOD during the present day 1 in 1,000-year event. The present day 1 in 200-year tidal still water level is below the effective crest level (i.e. 6.1 mAOD) for the existing defence in this location;
- Tidal still water level during the 1 in 200-year event for 2055 has been calculated to be 6.26 mAOD and 6.60 mAOD during the 1 in 1,000-year event for 2055. Based on the implementation of a minimum defence crest level of 6.8 mAOD the Application Site will continue to be protected from tidal flooding during the lifetime of the Facility; and
- Hazard mapping data shows modelled flood depths, should there be a breach in the defences, across the Application Site to be predominately 1.0 – 1.6 m deep.

A13.9.2 The following are key conclusions identified as part of the FRA:

- The risk of flooding from fluvial, surface water, groundwater and sewer flooding sources is considered to be low;
- There is no risk of flooding from reservoir or other artificial sources;
- The presence of the defence in this location is such that the risk of tidal flooding is considered to be low and limited to a residual risk should there be a failure in the defences; and therefore,
- On the basis of the flood risk to the Application Site and the proposed flood risk management techniques, including resilience measures, it is considered that the Facility is appropriate in line with the National Planning Policy Framework.

A13.9.3 The following recommendations are provided to mitigate the residual flood risk to the Application Site:

- It is recommended that the Facility incorporate flood resistant and resilient design;
- Surface water drainage shall be managed mostly through onsite use in the lightweight aggregate facility, with surplus water managed via the use of an attenuation pond prior to discharge at a controlled rate into the IDB maintained drain adjacent to the Application Site;
- Should there be a storm surge forecast or flood warning issued, users of the site should take action to ensure safe egress from the Application Site. Additionally, an emergency flood warning and evacuation plan should be

Project Related

implemented for the Application Site which includes the identification of areas for safe refuge; and

- Due to the high hazard rating, should there be a breach in the defences; the Facility, both during and following construction, will require a clear flood warning and evacuation plan.

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