

CHAPTER 9: FLOOD RISK AND DRAINAGE

Introduction

9.1 This chapter considers the potential effect of the proposed development on the flood risk, both on site and to the immediate surrounding area. An environmental baseline has been prepared and potential effects identified for both the construction and operation phases. A method to assess these potential effects has been set out together with a consideration of the scope for mitigation.

Methodology

9.2 A qualitative assessment of potential effects on flood risk from construction has been undertaken for the Environmental Statement as defined through a combination of experience of similar development, consultation and professional judgement. The ES considers the risk to watercourses both directly from construction activities adjacent to/over these waterbodies, and indirectly via land drainage from silt rich runoff and chemical (e.g. fuel) spillages. The operation of the development, and resultant impacts on flood risk, has also been considered.

9.3 Significance will be assessed by comparing the importance of the receptor with the magnitude of effect. The importance of watercourses will be determined based on the criteria set out in Table 9.1.

Table 9.1: Flood Risk Importance Criteria

Importance	Criteria	Selected Examples
Very High	Attribute has a high quality and rarity on a regional or national scale	Critical social or economic uses (e.g. water supply and navigation); and Flood plain or defence protecting more than 100 residential properties from flooding.
High	Attribute has a high quality and rarity on a local scale	Important social or economic uses such as water supply, navigation or mineral extraction; and Flood plain or defence protecting between 1 and 100 residential premises from flooding.
Medium	Attribute has a medium quality and rarity on local scale	Limited social or economic uses; Flood plain or defence protection for 10 or fewer industrial properties from flooding.

Importance	Criteria	Selected Examples
Low	Attribute has a low quality and rarity on a local scale	Flood plain with limited constraints and a low probability of flooding of residential properties.

9.4 The magnitude of effect, will be determined based on the criteria in Table 9.2 taking into account the likelihood of the effect occurring. The likelihood of an effect occurring is based on a scale of certain, likely or unlikely.

Table 9.2: Magnitude of Effect Criteria

Magnitude	Criteria	Examples
Major Adverse	Results in loss of attribute and / or quality and integrity of the attribute.	Increase in peak flood level (1% annual probability) >100 millimetre (mm).
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute.	Increase in peak flood level (1% annual probability) >50 mm.
Minor Adverse	Results in some measurable change in attributes quality or vulnerability.	Increase in peak flood level (1% annual probability) >10mm.
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity.	Negligible change in peak flood level (1% annual probability) <+/-10mm.
Minor Beneficial	Results in some beneficial effect on attribute or a reduced risk of negative effect occurring.	Reduction in peak flood level (1% annual probability) >10mm.

The significance of effects has been determined using the matrix presented in Table 9.3.

Table 9.3: Assessment of Significance Matrix

Importance	Magnitude			
	Major	Moderate	Minor	Negligible
Very High	Very large	Large / very large	Moderate / large	Neutral
High	Large / very large	Moderate / large	Slight / moderate	Neutral
Medium	Large	Moderate	Slight	Neutral
Low	Slight / moderate	Slight	Neutral	Neutral

Source: Amended from HD 45/09 Volume 11, Section 3, Part 10 Road Drainage and the Water Environment.

9.5 The flood risk associated with the development will be assessed in accordance with the requirements of National Planning Policy Framework, 2012 (NPPF). The objective of this is to assess three main issues in relation to flood risk:

- Risk to the development from all potential sources of flooding;
- Risk of increasing flooding elsewhere due to the development; and
- Appropriate mitigation measures to limit the effect of flooding on the development and offsite flooding due to increased runoff.

9.6 The results from a standalone Flood Risk Assessment (FRA) and Drainage Statement (DS) are presented in Volume 2 of the ES. A summary is included within the following ES Chapter. The Chapter considers potential flood risk effects during construction and operation of the proposed scheme, in accordance with the standard requirements for EIA.

Planning Policy Context

The Development Plan

Local Plan

9.7 Boston Borough Council currently uses two plans for decision making purposes. These two documents are:

- Boston Borough Local Plan (April 1999)
- Boston Borough Interim Plan (Non-Statutory Development Control Policy) 2006

Strategic Flood Risk Assessment

9.8 The Boston Borough Council Strategic Flood Risk Assessment (SFRA) (Level 1) was prepared by AECOM in October 2010. The SFRA was driven by the requirements of PPS25 (now superseded by the NPPF) for local planning authorities to review the variation in flood risk across their district, and to steer vulnerable development (e.g. housing) towards areas of lowest risk or to demonstrate that there are sustainable mitigation solutions available that will ensure that the risk to property and life is minimised (throughout the lifetime of the development) should flooding occur. It provides an assessment of the Borough area based on the Environment Agency flood zones and includes further information on the Flood Hazard, should a breach in defences occur, and the Relative probability of flooding taking flood defences into account.

9.9 Relevant information from the SFRA has been used to inform the appraisal of flood risk to the site.

9.10 The Level 2 Strategic Flood Risk Assessment was prepared by AECOM during October 2010 as part of the above document. The Level 2 SFRA builds upon the findings of the Level 1 SFRA, assessing in further detail the potential risk of flooding to sites where development is expected to occur over the next five to ten years and thus where more detailed assessment of flood risk is required. These areas include Boston Town (within

which the proposed Chestnut Homes development site is located), Bicker, Butterwick, Fishtoft, Freiston, Kirkton, Old Leake, Sutterton, Swineshead and Wrangle.

- 9.11 The Lincolnshire County Council Preliminary Flood Risk Assessment (PFRA) and River Witham Catchment Flood Management Plan (CFMP) were also reviewed.

Other Material Considerations

National Planning Policy Framework (NPPF, 2012)

- 9.12 The NPPF was published on 27 March 2012 (superseding Planning Policy Statement 25 (PPS25)) and is supported by the Planning Practice Guidance to the NPPF, published March 2014.
- 9.13 NPPF seeks to ensure that climate change is taken into account over the longer term including factors such as flood risk, coastal change, water supply and changed to biodiversity and landscape. New development should therefore be planned to avoid increased vulnerability to the range of effects arising from climate change. Where new development is brought forward in areas which are vulnerable to the range of effects arising from climate change, care should be taken to ensure that flood risk can be managed through sustainable adaptation measures.
- 9.14 In relation to flood risk, inappropriate development in areas at high risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere and taking into account the effects of climate change.
- 9.15 Any assessment of the potential effects on the water environment must also take account of relevant European and national legislation, as well as with national and local planning policies. Key European and national legislation is discussed below:

The Flood and Water Management Act (2010)

- 9.16 The Flood and Water Management Act 2010 intends to provide better, more comprehensive management of flood risk for people, homes and businesses. It also

tackles bad debt, improve the affordability of water bills, and help ensure continuity of water supplies. In particular, it encourages the uptake of sustainable drainage systems by removing the automatic right to connect to sewers and providing for unitary and county councils to adopt SUDS for new developments and redevelopments.

The Land Drainage Act (1991), as amended by The Water Act (2003)

- 9.17 The Land Drainage Act 1991 as amended by the Water Act 2003, places responsibility for maintaining flows in watercourses on landowners. Classified watercourses maintained by the Environment Agency (EA) are termed "Main Rivers." The EA has powers to control works in, over, under, on the banks of, within 7 to 10m of the top of the bank of the river, and of all floodplain areas under the Land Drainage Act 1991 (as amended) and Water Resources Act 1991 (as amended) through the issuing of Land Drainage Consents.

The Water Resources Act (1991), as amended by The Water Act (2003)

- 9.18 Under the Water Resources Act 1991 (section 85) it is an offence to cause or knowingly permit poisonous, noxious, or polluting matter, or any solid waste matter to enter controlled waters (which include rivers). The consenting regime for discharges to controlled waters is set out in the Environmental Permitting (England and Wales) Regulations 2010.

Building Regulations Part H (2000)

- 9.19 Buildings Regulations Part H provides guidance in terms of foul drainage, wastewater treatment systems and cesspools, rainwater drainage, building over sewers, separate systems for drainage and solid waste disposal.
- 9.20 In relation to flood risk, Buildings Regulations Part H states a hierarchy of where surface water should discharge. This hierarchy should be followed where practicable, and is listed below:

- 1) Infiltration

- 2) Watercourses
- 3) Public sewers

Sewers for Adoption (7th Edition, 2012)

9.21 Sewers for Adoption is a document which has become the standard for the design and construction of sewers to adoptable standards in England and Wales. It acts as a guide to assist developers in preparing their submission to a sewerage undertaker before they enter into an Adoption Agreement under Section 104 of the Water Industry Act 1991.

Information Sources and Consultation

9.22 This assessment of flood risk has been based on a desk study of readily available information, including:

- Online Ordnance Survey maps viewed to identify any watercourses and surface water bodies within 500m of the proposed development;
- Environment Agency Online Interactive Flood Maps:
 - Risk of Flooding from Rivers and Sea;
 - Groundwater;
 - Flood Warning Areas and Risk; and
 - Flooding from Reservoirs;
- General Parameter Plans outlining the masterplan;
- Boston Borough Council Strategic Flood Risk Assessment - Levels 1 and 2 (2010);
- Lincolnshire County Council Preliminary Flood Risk Assessment (2011);
- River Witham Catchment Flood Management Plan (2009)

9.23 Consultation was also undertaken with the Environment Agency, Boston Borough Council and Black Sluice Internal Drainage Board in the preparation of this report.

Existing Situation

- 9.24 A study area of 500m around the site has been assessed, which is sufficient to identify any watercourses that might directly affect, or be affected by, the proposed scheme. The following section provides a summary of the environmental baseline for flood risk.

Tidal and Fluvial Flooding

- 9.25 The Environment Agency Interactive maps show the majority of Boston Town to be located within Flood Zone 3a and as such the whole area is classed as having a high probability of fluvial or tidal flooding. The proposed development site is within this a 1% Annual Exceedence Probability (AEP), or 1 in 100 year return period, of fluvial flooding and a 0.5% AEP (1 in 200 year) or greater chance of tidal flooding.
- 9.26 As the majority of Boston is located within Flood Zone 3a the Boston Borough Council SFRA uses more detailed maps to differentiate, taking present flood defences into consideration.
- 9.27 The River Witham Catchment Flood Management Plan (CFMP) states that Boston Town, including the tidal Haven, is at substantial risk of tidal flooding and climate change will significantly increase the flood risk to Boston. The CFMP recommends that further action be taken in both the short and longer term to reduce risk of tidal flooding in Boston, including the effects of climate change.

Relative Probability of Flooding

- 9.28 Within the SFRA, hydraulic modelling of the 1% (1 in 100 year) and 0.1% (1 in 1000 year) fluvial flood event and 0.5% (1 in 200 year) and 0.1% (1 in 1000 year) tidal flood event was carried out to determine the relative probability of flooding at the proposed development site taking present flood defences into account. Flooding was assumed to occur when a flood embankment overtopped. Where the defence was an earth embankment it was assumed that breaching would follow.
- 9.29 This modelling indicates that the site is classified as having a medium relative probability of tidal flooding once the flood defences are taken into account.

Residual Flood Risk

- 9.30 Residual risks of flooding arise from either extreme events with exceptionally high return periods (200+ years) or events which, due to their unpredictable nature, are not readily amenable to quantitative analysis, for example premature structural failure, serious operational or equipment failures or freak accidents which cannot be foreseen. The principal residual flood risk in the Boston area would be a result of premature failure of the flood embankments well before the defences were overtopped.
- 9.31 Mapping indicates that the entirety of the proposed development site is at high risk of residual flooding and is categorised as presenting a 'Danger to All' with regards to hazard. It does however note that this is a worst case representation of the Hazard Zone extent and is not associated with a specific probability of occurrence.
- 9.32 Based on the available information, the site is considered to be at **moderate** risk of tidal flooding and at **low** risk of fluvial flooding.

Pluvial Flooding (Overland Flow)

- 9.33 The Lincolnshire County Council PFRA indicates that the proposed development site is outside the area of risk posed by surface water flooding. The Flood Map for Surface Water (FMfSW) presented within the PFRA shows no incidences of flooding at a level greater than 0.3m.
- 9.34 EA Risk of Flooding from Surface Water mapping indicates that there is a Very Low risk (<0.1% AEP) of pluvial flooding across the majority of the site. There are areas where the site is considered at Low risk (between 0.1% and 1% AEP) and these are associated with the IDB drains that bisect the site.
- 9.35 Based on the available information, the site is considered to be at **low to moderate risk** of pluvial flooding.

Groundwater Flooding

- 9.36 The Boston Borough Council SFRA states that the site is not at risk of flooding from groundwater emergence. This is supported by the Environment Agency interactive maps which indicate that the site is not situated on top of an aquifer.
- 9.37 During initial consultation the EA state that they are not aware of any history of groundwater flooding at this location or any within the 500m study area considered. The site is underlain by unproductive strata with a superficial geology of clay and silt with bedrock of mudstone, and as such groundwater below the site is not considered to be a sensitive receptor. The groundwater body is discussed in more detail in Chapter 16 of this ES, relating to Ground Conditions.
- 9.38 Based on the available information, the site is considered to be at **negligible risk** of groundwater flooding and so flooding from this source has not been considered further.

Flooding from Sewers

- 9.39 The Boston Borough Council SFRA suggests that a small number of properties in the Wyberton area flooded in 2007, most likely as a result of the surcharging of the combined and foul sewer network.
- 9.40 There has been on-going liaison with Anglian Water and Boston Borough Council regarding the drainage feasibility work and there will be on-going requirements to take account of existing services, the assessment of flood risk and the requirements for diversion of sewers when the detailed design is progressed.
- 9.41 It is however noted that Anglian Water are responsible for maintaining their assets, so the probability of a public sewer failing is considered low. Further consultation with Anglian Water would be required to establish the location of sewer assets, as well as sewer incidents, in relation to the proposed site. The risk of private sewer flooding would also need to be addressed through further investigation.
- 9.42 Based on the available information, the site is considered to be at **low risk** of sewer flooding.

Flooding from Internal Drainage Board Drains

- 9.43 The proposed development site is located within the Black Sluice Internal Drainage Board (BSIDB) which was consulted during the development of this report. Ordnance Survey maps indicate that there are six IDB field drains within the boundaries of the site. IDB records indicate that two of these drains, Town Drain and the drain along the A16, are owned by the IDB and the remaining four are privately owned. All of these drains are maintained on a rolling schedule that includes the removal of vegetation in the summer/autumn and de-silting of selected watercourses in the winter. No modelled flood levels for these watercourses are available; however this is not unusual for minor water courses. As a result a qualitative assessment of flood risk has been undertaken.
- 9.44 A review of aerial imagery indicates that these drains are embanked, thus containing water levels at all but extremely high flows. The BSIDB takes responsibility for maintaining these drains and where drains are privately owned BSIDB provides advice and support in this regard. No incidents of historical flooding from this source have been recorded.
- 9.45 Based on the information available the flood risk from IDB drains and private drains is considered to be **low**.

Flooding from Artificial Sources

Ponds

- 9.46 Ordnance Survey maps indicate that there are three ponds located within approximately 350m of the northern boundary of the site. As no modelled flood levels are available for these water bodies a qualitative assessment of the flood risk has been undertaken. As the ponds are managed artificial waterbodies it is assumed that the risk of flooding from this source will also be adequately managed. As a result the risk of flooding to the proposed development site from these ponds is considered to be **negligible** and they have not been considered further within this assessment.

Reservoir

- 9.47 The Environment Agency Interactive Maps show that the site is located outside the extent of risk of flooding from reservoirs and so is considered to be at **negligible** risk from this source. As such flooding from reservoirs has not been considered further.
- 9.48 Based on the available information, the proposed development is considered to be at **negligible** risk of flooding from artificial sources.

Future Baseline – Climate Change

- 9.49 It is assumed that the lifetime of this development will be 100 years. Climate change is predicted to cause an increase in storm rainfall of 5% rising to 30% in the period 2085-2115. A 30% increase in storm rainfall will increase the rate and volume of storm runoff from the site, although the effect of this increase on the site itself will be minimal. The new on-site drainage system should, therefore, be designed to accommodate this potential increase and to prevent any increase in the rate of discharge from the site above present levels.

Sensitivity of Receptors

- 9.50 In order to enable a meaningful assessment of environmental effect to be made in accordance with the guidance in HD45/09, the sensitivity of flood risk receptors must be defined. The classification has been derived based on professional judgement and using the baseline information discussed above.
- 9.51 The significant receptors of flood risk are people and property that may be at risk from any flooding, including the proposed development and properties located off-site. The proposed development is within Flood Zone 3a, which is by definition subject to a high probability of flooding from rivers or seas in any year.
- 9.52 The proposed development includes residential use which is classified as 'More Vulnerable' development within the NPPF; this denotes a development type which is relatively sensitive to flooding.

9.53 Through consideration of the above, the flood risk receptors are considered to be of 'High' sensitivity.

Impact of Development

Construction Phase

9.54 During construction the following effects could occur if appropriate good practice and mitigation measures are not put in place:

- Flooding from tidal and fluvial sources;
- Flooding on site due to restriction of flow by mud/debris entering the surface water drainage system;
- Risk of flooding due to temporary increases in impermeable area; and
- Flooding due to damage of water mains or sewers.

9.55 As identified in the baseline, the site is located within Flood Zone 3a there is the residual risk of a tidal breach occurring on site. As such there is potential for construction workers to be negatively impacted by flooding should a breach occur during construction work taking place on site.

9.56 During the construction phase there is the potential for mud and debris arising from the construction works to enter the surface water drainage system, causing blockages and restricting the flow. Similarly the IDB drains that currently drain the site could suffer reduced conveyance capacity should mud and debris enter these systems. This could result in localised on-site flooding, especially after heavy or prolonged rainfall. Entry of mud and debris into the surface water drainage system is considered to present a potential moderate adverse effect of flooding to site itself and the surrounding area which could result in a flood risk to people or property.

9.57 The construction process could potentially lead to a risk of off-site flooding if impermeable areas are temporarily increased without mitigation measures in place. Temporary hard standing or compacted soil could result in rapid surface water runoff to local drainage systems or increase overland flow. As the site is currently in an agricultural area an increase in impermeable area would be considered to have a moderate effect. Additionally, the removal or blockage of existing drainage, or

rendering it temporarily inoperable during construction, could also lead to an increase in runoff, especially during heavy or prolonged rainfall.

- 9.58 Due to its agricultural nature the number of water mains and sewers located at the proposed development site are likely to be few. However, there may be some services associated with the A16 which bisects the site. These may be encountered during excavation for construction, or may require diversion as part of the proposals. If the construction process does not adequately take into account the location of existing water mains and sewers, there could be a risk of flooding from water mains and sewers from unintentional damage during construction.

Operational Phase

- 9.59 During operation of the development the following effects could occur if appropriate good practice and mitigation measures are not put in place:
- Flooding from tidal and fluvial sources;
 - Flooding due to an increase in impermeable areas;
 - Flooding from proposed surface water management; and
 - Flooding from proposed sewers.
- 9.60 The proposed development site has been identified as being at high risk of flooding from tidal sources and as such there is the potential for this to have a negative impact on the development should an overtopping or breach event occur.
- 9.61 The mitigation measures outlined below have the potential to increase the flood risk to the surrounding area following the implementation of the proposed development platform. In mitigating flood risk to the site, care must be taken to ensure that flood risk to the surrounding area is not increased as a result.
- 9.62 During operation there is the potential risk of increasing flood risk elsewhere due to changes in drainage regime and increased impermeable areas.
- 9.63 The proposed development will increase the impermeable areas on-site, and a projected increase in rainfall intensity over the lifetime of the development is likely to increase surface water runoff from the site. Storage/attenuation and run off rates

should be confirmed at the detailed design stage to ascertain likely surface water discharges from the site.

- 9.64 Redeveloping the site and changing the surface water drainage strategy and tidal regime has the potential to change overland flow routing, which could result in an increased flood risk to receptors within the study area.
- 9.65 Hall Infrastructure Design Ltd has produced the outline Drainage Strategy for the proposed development, a copy of which is included in Volume 2 of the ES. The concept drainage proposal includes the use of infiltration SUDS and source control SUDS throughout all sub-phases of the development including permeable pavements, soakaways and a storage drain.
- 9.66 The Drainage Strategy includes calculations of greenfield runoff rates for the various sub-phases of the development across a range of rainfall events, taking climate change into consideration. Indicative sizes of SUDS have been provided in the drainage strategy to ensure that there is adequate attenuation and storage on site (up to the 1 in 100 year + climate change rainfall event) so that the flow leaving the site is not greater than the greenfield runoff rate and is not increased as a result of the development.
- 9.67 Surface water leaving the site will be limited to greenfield runoff rates and surface water will be stored on site in areas of less vulnerable development. All SUDS will be designed in accordance with best practice at the time (currently set out in CIRIA Report 697 - The SUDS Manual) and surface water sewers will be designed to Sewers for Adoption (7th Edition) and Building Regulations Part H standards. As surface water systems will be appropriately designed, sized and cited, the risk from flooding of proposed surface water management systems is considered to be **low**.
- 9.68 The Hall Infrastructure Design Ltd Drainage Strategy sets out the proposed discharge locations for the proposed development. The most feasible discharge location is a direct discharge to Frampton Wastewater Treatment Works, which is located approximately 1.7km to the south. Discharge to the wastewater treatment works will require the construction of a new foul water pumping station and new foul water rising main.

- 9.69 As the foul water system will be designed in accordance with Sewers for Adoption (7th Edition) and Building Regulations Part H standards, and that it discharges directly to the wastewater treatment works, the risk of flooding from proposed foul sewers is considered to be **low**.

Mitigation Measures

Construction Phase

- 9.70 Construction works will be undertaken in accordance with method statements and a Construction Environmental Management Plan that takes account of the following best practice guidance:
- Construction Industry Research and Information (CIRIA) Report 624 (2004) Development and Flood Risk – guidance for the construction industry;
 - CIRIA Report 650 (2005) Environmental Good Practice on Site; and
 - CIRIA Report 697 (2007) The SUDS Manual
- 9.71 Construction works may require a number of consents/licences from Anglian Water and/or Environment Agency that will need to be in place prior to commencement of works. Any works affecting the existing public sewer network need to be undertaken in accordance with the requirements of Sewers for Adoption (7th edition). Consultation with BSIDB indicates that development must be carried out in accordance with the Boards byelaws and in particular, Byelaw No.3 regarding to the discharging of water and Byelaw No.10 regarding the siting of structures. It is noted that no structures will be permitted within 9 metres of the boards open or piped watercourses.
- 9.72 The use of SUDS will be considered where practicable to attenuate flow, to protect and enhance water quality as well as to provide amenity value. Surface water discharges from the development are likely to require attenuation. This attenuation will include consideration of the projected increase in rainfall due to climate change. The treatment of surface water runoff will be considered at this stage to maximise benefits.

- 9.73 Proposals have been put forward to carry out ground raising across certain areas of the site. This would enable the development of a mix of housing types (one, two and three storey buildings) creating a more varied development, and enable drainage systems to be installed with more ease. For this proposal to be taken further hydraulic modelling will be required at the detailed design stage to understand the change in hazard, depths and velocities around any development platform in the floodplain over the lifetime of the development.
- 9.74 Where there is flood risk to workers on site during the construction process an Emergency Response Plan will be prepared. This will include an evacuation plan including the identification of safe access and egress routes. Additional mitigation will include signing up for EA flood warnings and monitoring of weather reports.

Operational Phase

- 9.75 Operational phase mitigation will consist of drainage proposals that will be included in the scheme's design. The need for treatment and containment measures will be based on risk assessment as defined by the method set out earlier. In the first instance, opportunities for sustainable drainage systems will be considered.
- 9.76 The FRA outlines that the site lies within Flood Zone 3a and is therefore at risk of tidal and fluvial flooding. Further investigation has indicated that the predominant source of flood risk is tidal and as a result mitigation proposed for tidal flooding is also deemed sufficient mitigation for fluvial flooding.
- 9.77 As discussed in more detail within the accompanying FRA, included in Volume 2 of the ES, ground raising in the form of a development platform has been outlined as the preferred option for flood risk mitigation across the site. Two development platform scenarios have been considered. Development Platform Scenario 001 ground raises 90% of the site and under Development Platform Scenario 002 50% of the residential parcel and 50% of the stadium parcel were raised. The results of hydraulic modelling suggest that the ground will be raised by between 1m and 2m above existing ground levels. From a flood risk perspective, taking impacts on the surrounding area into account, Development Platform 002 is the preferred option.

- 9.78 An additional Development Platform Scenario (003) was modelled following a revision of the masterplan in which parts of the residential areas designated for dwellings are raised whilst the access roads through these areas remain at current ground levels. The results of this modelling are presented in the FRA, which is included in Volume 2 of the ES. Only one model run has been completed for this 003 scenario and further modelling will be carried out at the detailed design stage should this be deemed a viable option.
- 9.79 A further option is under consideration which will be modelled at detailed design stage following further consultation with the Environment Agency and BBC. An option to ground raise 1m across the site with flood resilient construction accounting for the required freeboard has been raised in the FRA which is subject to further consideration.
- 9.80 In combination with the installation of a development platform it is suggested that flood resilient construction techniques are incorporated into building design. It is recommended that flood resilient measures are used up to 300mm for buildings located on top of the development platform and up to 600mm for development sited at existing ground level.
- 9.81 An Emergency Plan will be developed in conjunction with local emergency service providers and Lincolnshire Fire and Rescue to ensure that inhabitants of the site remain safe for the lifetime of the development. Residents will be encouraged to sign up for EA flood warnings and safe access and egress routes to areas at lower flood risk will be identified.

Monitoring Programme

- 9.82 During operation of the site ongoing monitoring of the emergency plan will be carried out to ensure that the flood mitigation measures put in place remain relevant. Updating of the plan, including escape routes and warning systems, should occur as and when necessary.

Robustness of Analysis

- 9.83 The assessment of the effect of the proposed development on flood risk, both on the site and to the immediate vicinity, has been carried out in line with the best available information at the time of writing this report.
- 9.84 Hydraulic modelling of the flood risk on site has been undertaken for each of the proposed mitigation scenarios to determine the probable effect of the proposed development. The 2D TUFLOW model was obtained from the Environment Agency and the three development platform scenarios outlined above modelled. The risks to the surrounding area have been quantified and mitigation measures have been proposed on the basis of the analysis carried out.

Summary and Conclusions

- 9.85 This chapter has considered the potential effects of the proposed development on flood risk both to and from the site. It has been carried out using the methodology outlined in section 9.2.
- 9.86 The key receptors identified are the people and properties both on the site and in the immediate vicinity. These are shown to be of high importance.
- 9.87 The construction and operation impacts of the proposed development site have been assessed. More in depth analysis has been carried out as part of a standalone FRA, included in Volume 2 of this ES.
- 9.88 The site has been shown to be at **high** to **moderate** risk of fluvial and tidal flooding. The site is at **low** risk of pluvial and sewer flooding and flooding from IDB drains. The risk of flooding from groundwater and artificial sources (ponds and reservoirs) is considered **negligible**.
- 9.89 Three scenarios for ground raising have been proposed as mitigation in the event of a tidal breach on site. This should be considered in conjunction with flood resilient construction methods and the development of a robust emergency plan.

9.90 Preliminary drainage proposals have been outlined, including attenuation to Greenfield runoff rates and the use of SUDS where practicable. Further consideration to the drainage design will be given at the detailed design stage.

9.91 Following mitigation, and provided work is carried out in line with good practice, the risk of flooding to the site is considered to be **low**. The predominant residual impact that remains is in the form of breaching and/or overtopping of the tidal flood defences however, it is considered that this has been mitigated for to the highest possible degree.

References

AECOM (2010) Boston Borough Council Strategic Flood Risk Assessment [Online]
<http://www.boston.gov.uk/CHttpHandler.ashx?id=5479&p=0>

Boston Borough Council (1999) Boston Borough Local Plan, Adopted Version [Online]
<http://www.boston.gov.uk/CHttpHandler.ashx?id=5506&p=0>

Boston Borough Council (2006) Interim Plan (Non-Statutory Development Control Policy) [Online] <http://www.boston.gov.uk/CHttpHandler.ashx?id=5506&p=0>

Communities and Local Government (2010) Planning Policy Statement 25: Development and Flood Risk [online]
<http://www.communities.gov.uk/documents/planningandbuilding/pdf/planningpolicystatement25.pdf>

Construction Industry Research and Information Association (CIRIA) guidance documents (various)

Department for Communities and Local Government (2012) National Planning Policy Framework [online]
<http://www.communities.gov.uk/planningandbuilding/planningsystem/planningpolicy/planningpolicyframework/>

Department for Communities and Local Government (2014) Planning Practice Guidance [online] <http://planningguidance.planningportal.gov.uk/>

Environment Agency (2009) River Witham Catchment Flood Management Plan [Online] <http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/gean0909bpcc-e-e.pdf>

Environment Agency (2013) Interactive Mapping [online]
http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e

HM Government (1991) Land Drainage Act 1991 [online]
<http://www.legislation.gov.uk/ukpga/1991/59/contents>

HM Government (1991) Water Resources Act 1991 [online]

<http://www.legislation.gov.uk/ukpga/1991/57/contents>

HM Government (2003) The Water Act 2003 [online]

<http://www.legislation.gov.uk/ukpga/2003/37/contents>

HM Government (2010) Building Regulations, Approved Document H. [Online]

http://www.planningportal.gov.uk/uploads/br/BR_PDF_AD_H_2010.pdf

HM Government (2010) Flood and Water Management Act 2010 [online]

<http://www.legislation.gov.uk/ukpga/2010/29/contents>

Lincolnshire County Council (2011) Preliminary Flood Risk Assessment [Online]

<http://www.lincolnshire.gov.uk/residents/environment-and-planning/flood-risk-management/assessing-the-risk-of-surface-water-flooding-across-lincolnshire/103044.article?tab=downloads>

WRC (2010) Sewers for Adoption, 7th Edition. Swindon, UK.