

DRAINAGE AND FLOOD RISK

13.1 INTRODUCTION

13.1.1 This chapter assesses the impact of the AMEP on drainage and flood risk. The aim of the assessment is to determine whether, and if so how, the proposed development will affect the hydrology, surface water drainage and flooding of the site and its surrounds.

13.1.2 Extensive consultations about flood risk and drainage matters have been undertaken with the Environment Agency (EA), the North East Lindsey Drainage Board (NELDB) and Anglian Water.

13.1.3 The chapter addresses all the issues relating to drainage and flood risk matters mentioned in the Scoping Opinion and associated consultation responses.

13.1.4 The chapter also describes the legislative and policy context with respect to drainage and flood risk and sets out the methods used to identify the baseline conditions at the application site and within the surrounding areas. The chapter then examines the potential for flood risk in accordance with planning guidance and the specific requirements of the EA. The chapter records:

- the baseline conditions;
- the potential impacts of the development during the construction and operational phases;
- mitigation measures;
- residual impacts; and
- the potential cumulative impacts of the development in combination with other adjacent developments.

13.2 LEGISLATION, POLICY AND GUIDANCE

Statutory Authorities

13.2.1 The EA is the principal flood risk management operating authority. It has the power (but not the legal obligation) to manage flood risk from designated main rivers and the sea. These functions in relation to other

rivers (defined as ordinary watercourses) in England and Wales are undertaken by Local Authorities or Internal Drainage Boards. The EA is also responsible for increasing public awareness of flood risk, flood forecasting and warning and has a general supervisory duty for flood risk management. Since 2008, the EA also has a strategic overview role for all flood and coastal erosion risk management.

- 13.2.2 The AMEP lies within the district of the NELDB. NELDB's drainage district extends to an area of 11 250 ha which is formed predominantly of the coastal strip extending from the Humber Bridge southwards to Cleethorpes. NELDB has promulgated byelaws in accordance with Section 66 of the Land Drainage Act 1991.

Legislation

The European Directive on Urban Waste Water Treatment (91/271/EEC)

- 13.2.3 The European Directive on Urban Waste Water Treatment (91/271/EEC) lays down minimum standards for the treatment of domestic sewage and industrial waste waters. The Directive was implemented by the Urban Waste Water Treatment (England & Wales) Regulations 1994 (as amended) (UWWT Regulations).

Water Framework Directive (2000/60/EC).

- 13.2.4 This Directive covers surface water and groundwater together, as well as estuaries and coastal waters. Its overriding requirement is that Member States "aim to achieve", good surface water, (meaning both good chemical status and good ecological status), good ecological potential and good groundwater status in all waters by the end of 2015. The Directive was implemented by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003.

The Land Drainage Act 1991

- 13.2.5 The Land Drainage Act 1991 places the responsibility for the maintenance of ordinary watercourses on the adjacent landowner and provides scope for Local Authorities and Internal Drainage Boards to ensure that maintenance works are undertaken. In addition, it ensures that any channel works cannot be undertaken without prior authorisation.

The Water Resources Act 1991

- 13.2.6 The Water Resources Act 1991 as amended by the Environment Act 1995 provides for the protection of the water environment through controls on abstraction, impoundment and discharges.

The Environment Agency and Anglian Region Land Drainage and Sea Defence Byelaws

- 13.2.7 These Byelaws control activities that affect watercourses.

The Flood and Water Management Act 2010

- 13.2.8 The Flood and Water Management Act 2010 covers a range of issues including:

- encouraging sustainable drainage systems (SUDS) by requiring drainage systems to be approved against a set of National Standards;
- making local authorities responsible for adopting and maintaining SUDS; and
- cessation of the right to connect surface water to the public sewerage system.

- 13.2.9 However, only limited parts of the act are currently in force.

National Policy Statement for Ports, October 2011

- 13.2.10 The NPS for ports recognises that port development is water-compatible development and therefore acceptable in high flood risk areas.

- 13.2.11 The NPS advises applicants for projects that may be affected by, or may add to, flood risk to arrange pre-application discussions with the decision-maker and the EA, and, where relevant, other bodies such as sewerage undertakers and highway authorities. Such discussions are necessary to identify the likelihood, possible extent and nature of the flood risk, to assist in scoping the Flood Risk Assessment (FRA), and identify the information that will be required by the decision-maker to reach a decision on the application when it is submitted.

- 13.2.12 The NPS supports the incorporation of sustainable drainage systems into design.

Planning Policy Guidance/Statements

Planning Policy Guidance Note 20: Coastal Planning

- 13.2.13 In relation to coastal protection and defence, PPG20 states that the impact of defence schemes on the environment should be taken into account in reaching planning decisions.

Planning Policy Statement 25: Development and Flood Risk (2010).

- 13.2.14 PPS25 has the principal objective of integrating flood risk assessment with the planning process at all stages. It states that:

'Planning authorities should prepare and implement planning strategies that help to deliver sustainable development by:

- *Appraising risk*

Identifying land at risk and the degree of risk of flooding from river, sea and other sources in their areas;

Preparing Regional Flood Risk Appraisals (RFRAs) or Strategic Flood Risk Assessments (SFRAs) as appropriate, as freestanding assessments that contribute to the Sustainability Appraisal of their plans;

- *Managing risk*

Framing policies for the location of development which avoid flood risk to people and property where possible, and manage any residual risk, taking account of the impacts of climate change;

Only permitting development in areas of flood risk when there are no reasonably available sites in areas of lower flood risk and the benefits of the development outweigh the risks from flooding;

- *Reducing risk*

Safeguarding land from development that is required for current and future flood management e.g. conveyance and storage of floodwater, and flood defences.

Reducing flood risk to and from new development through location, layout and design, incorporating sustainable drainage systems (SUDS);

Using opportunities offered by new development to reduce the causes and impacts of flooding e.g. surface water management plans; making the most of the benefits of green infrastructure for flood storage, conveyance and SUDS; re-creating functional floodplain; and setting back defences.'

Planning Circulars

- 13.2.15 Guidance on the assessment of planning applications incorporating non-mains sewerage is set out in DETR Circular 03/1999. The circular

states that the first presumption ‘*must always be to provide a system of foul drainage discharging into a public sewer*’. However the Circular goes on to state that,

‘(i)f by taking into account the cost and/or practicability, it can be shown to the satisfaction of the local planning authority that connection to a public sewer is not feasible, a package treatment plant incorporating a combination of treatment processes should be considered.’

- 13.2.16 Where the developer can demonstrate that neither discharge to a public sewer nor a package treatment plant are feasible then, subject to a full assessment of various factors specified in the Circular, a septic tank may be proposed.

North Lincolnshire Local Plan Policy

- 13.2.17 **Local Plan Policy DS12** states that development will not be permitted in flood plains unless adequate protection or mitigation measures are provided.

North Lincolnshire Council Core Strategy

- 13.2.18 **Core Strategy Policy CS2 (Delivering More Sustainable Development)** states that where development does take place in the flood plain, mitigation measures should be applied to ensure that the development is safe.

- 13.2.19 **Core Strategy Policy CS12 (South Humber Bank Strategic Employment Site)** states that around 900 ha of land at the South Humber Bank Strategic Employment Site (SHBSES) will be reserved for B1, B2 and B8 port-related activities to take special advantage of its location, flat topography and adjacent deep water channel of the River Humber as an extension to Immingham Port and the Humber Sea Terminal.

- 13.2.20 **Core Strategy Policy CS19 (Flood Risk)** states that development in areas of high flood risk will only be permitted where it meets the following prerequisites:

- It can be demonstrated that the development provides wider sustainability benefits to the community and the area that outweigh flood risk;
- The development should be on previously used land. If not, there must be no reasonable alternative developable sites on previously developed land; and

- A flood risk assessment has demonstrated that the development will be safe, without increasing flood risk elsewhere by integrating water management methods into development.

Other Documents

The Humber Flood Risk Management Strategy, (EA, 2008)

- 13.2.21 This document sets out the EA's strategy for managing the risk of flooding from the Humber Estuary and takes into account climate change and consequential sea level rise. The strategy includes proposals for withdrawing maintenance to some existing defences, maintaining other defences on their existing alignment and also building some new defences behind the existing line. The latter option is referred to as managed realignment and provides new intertidal habitat to replace that being lost by rising sea levels.

13.3 ASSESSMENT METHODOLOGY AND CRITERIA

Overview

- 13.3.1 An FRA has been undertaken for the AMEP taking account of the Defra guidance, Flood Risk Assessment Guidance for New Development (DEFRA, 2006) and the specific requirements of PPS25. The FRA assesses how the proposed development will affect the site and its surroundings as well as the integrity of the Humber Estuary's flood defences.
- 13.3.2 The impact of the proposed development on the hydrological environment at the site has been evaluated to determine the likelihood of the AMEP causing impacts to the surface water environment as follows:
- impacts on land drainage and flooding; and
 - impacts associated with the pollution of surface watercourses during construction and operation.
- 13.3.3 Information sources used to complete the assessment include:
- Landmark Envirocheck Report;
 - Ordnance Survey maps;
 - topographical surveys;
 - EA flood maps;
 - data provided by the EA;

- Local Authority Strategic Flood Risk Assessments; and
- NELDB.

Construction Phase

13.3.4 The main impacts to be addressed during the construction phase are:

- ensuring that continuity of tidal defences is maintained;
- ensuring that the operation of the Killingholme Marshes Drainage System and tidal outfall is maintained;
- release of sediment into the sea and inland watercourses;
- release of polluting substances into the sea and inland watercourses; and
- disturbance to wildlife.

13.3.5 Whilst some impacts on sediment and wildlife matters are included in this chapter, they are predominantly addressed in *Chapters 9 to 11*.

Operational Phase

13.3.6 The main impacts to be addressed during the operational phase are:

- ensuring that continuity of tidal defences is maintained;
- ensuring that the operation of the Killingholme Marshes Drainage System and tidal outfall is maintained; and
- release of polluting substances into the sea and inland watercourses.

Sensitive Receptors

13.3.7 Sensitive receptors are:

- the ground, the sea, and inland watercourses;
- the installations, facilities and people on the AMEP; and
- nearby residential property, installations and operations.

Significance Criteria

13.3.8 The likely significant effects for assessment of drainage and flood risk are:

- change in fluvial or tidal flood risk;
- change in flood hazard;
- change in flood defence standard of protection;
- the surface water drainage systems;
- the foul water drainage arrangements;
- water quality; and
- wildlife populations.

13.3.9 The potential impacts before and after mitigation along with residual impacts have been assessed using the criteria outlined in *Table 13.1*.

Table 13.1 *Significance Criteria for Drainage and Flood Risk*

Significance of Impact		Description
Negligible		No appreciable impact on humans, aquatic flora and fauna, or surface water resources. Any minor effects are reversible.
Minor	Adverse	Minor detrimental effect on local watercourses. Minor increased risk of local flooding adjacent to the site. Minor local-scale reduction in surface water quality, reversible with time. Reversible detrimental effects on aquatic flora and fauna.
	Beneficial	Minor reduction in risk to humans, animals or plant health. Minor localised improvement to the quality of surface water resources or minor reduction in flood risk.
Moderate	Adverse	Moderate detrimental effect on local watercourses. Moderate increased risk of flooding or change to flow characteristics of watercourses. Moderate reduction in surface water quality, reversible with time. Moderate effects on aquatic flora and fauna.
	Beneficial	Moderate reduction in risk to humans, animals or plant health. Moderate localised improvement to the quality of surface water resources or moderate reduction in flood risk.
Major	Adverse	Major detrimental effect on local watercourses. Major increased risk of flooding or change to flow characteristics of watercourses. Permanent reduction in surface water quality. Permanent effects on aquatic flora and fauna.
	Beneficial	Major reduction in risk to humans, animals or plant health. Major regional improvement to the quality of surface water resources. Major reduction in local flood risk.

13.4 CONSULTATIONS

- 13.4.1 The Scoping Opinion and response to the statutory consultation undertaken to comply with the requirements of the Planning Act 2008, included various comments relating to drainage and flood risk; these are outlined in *Annex 2.2* together with explanations of how these matters have been addressed.

13.5 BASELINE AND DEVELOPMENT IMPACTS

- 13.5.1 The flood risk assessment and drainage strategy for the AMEP is reproduced in *Annex 13.1*. The salient points are summarised in this section.

Coastal Flood Defences

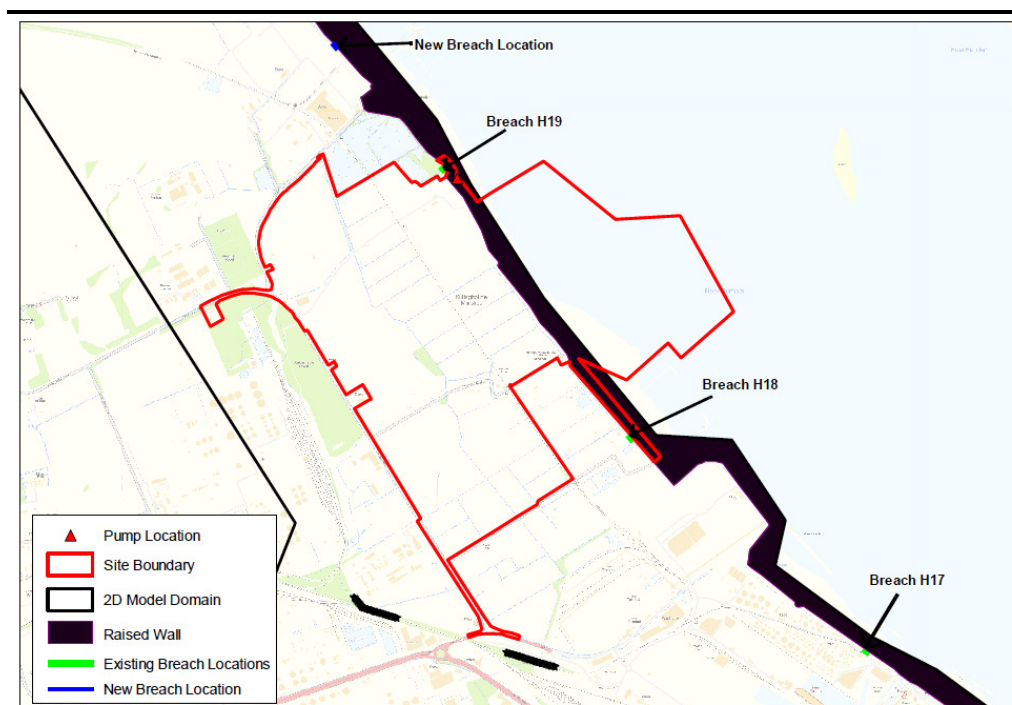
- 13.5.2 Almost the whole of AMEP is shown within Flood Zone 3 on the EA's Flood Map. The site is low-lying and it is located immediately behind continuous tidal flood defences. The site is at risk of tidal flooding in the event of breach or overtopping of the tidal defences. The only significant recorded tidal flooding of the site occurred in 1953, when major flooding occurred at numerous locations on the east coast of England.
- 13.5.3 There are tidal flood defences in place along the entire south bank of the Humber Estuary. The existing defences at the proposed development site consist of an earth embankment topped by a concrete ave return wall and these are currently maintained by the EA. The EA has confirmed that the existing defences are in a good to fair condition and currently provide a standard of protection that varies between 1:50 years to 1:150 years (2 percent to 0.66 percent annual exceedance probability).
- 13.5.4 The new quay will replace a section of the existing tidal defences and the effective defence level of the new quay will be slightly higher in order to incorporate an increase for climate change. Modelling has been undertaken to assess the potential impacts of the quay on the risk of overtopping of adjacent defences. The quay has been designed to minimise such impacts, and mitigation measures (deposition of rock armour on the seaward face of affected defences) are proposed to combat the residual impacts. The quay will be a very substantial installation and it will be virtually impossible for it to be breached.
- 13.5.5 In consultation with the EA, the design of the new quay takes into account current predictions in respect of climate change as set out in

PPS 25. PPS 25 includes an allowance of 1.11 m for sea level rise from 2014 to 2114 and for a 10 percent increase in wave heights over the same period.

- 13.5.6 An assessment of the overtopping characteristics of the proposed quay has been undertaken in accordance with the EurOtop Manual (HR Wallingford, 2007). Overtopping calculations require an initial assessment of the wave heights that will occur in combination with still water levels at a specific location; this is generically termed a 'joint probability analysis'. Such an analysis for the Humber Estuary was commissioned by the EA and includes an assessment for the foreshore at South Killingholme (ABP Mer, 2007). Using this EA data, and the EurOtop methodology, the maximum overtopping rate at the new quay face is calculated to be 91.8 l/s/m in the 200-year event in 2114. Further details are given in *Annex 8.1*.
- 13.5.7 An overtopping assessment has also been undertaken of the existing flood defences to the north and south of the proposed development. To the south of the development, the wave climate is not adversely affected by the proposals. However to the north of the quay, wave reflection on the ebb tide causes a small increase in wave height over a length of approximately 60 m. Following discussions with the EA, it was agreed that overtopping of these existing defences should not exceed 2 l/s/m in the 200 year event in 2033 which is the end of their current management plan for flood defences along the Estuary. In order to limit overtopping to this amount, rock armour will be placed over the seaward face of the existing defences over the length that will be adversely affected.
- 13.5.8 Construction of the new quay will interrupt access to the retained lengths of EA defences to the north and south. An access route will be provided to the southern retained defences via the extension to Station Road within the AMEP. A turnaround facility will be provided within AMEP at the southern end of the northern retained defences.
- 13.5.9 As noted above, the low-lying land behind the tidal defences is located within Flood Zone 3 and it is inevitably at risk of flooding in the event of breach or overtopping of the tidal defences. Some raising of site levels is proposed: firstly the placement of approximately 1 m depth of compacted stone to form yard areas suitable for the heavy plant, and secondly to form a 1:100 slope from the elevated quay down to the manufacturing yards. The proposed raising of ground levels will tend to reduce flood risks on the site by reducing the potential depth of floodwaters in the event of a breach.

13.5.10 Tidal breach modelling has been undertaken to identify the impact of the development on the extent, depth and speed of inundation on the site and its surroundings. Breaches were modelled to the north and south of the new development as shown in *Figure 13.1*.

Figure 13.1 *Modelled Location of Breaches in the Flood Defence*



Source: *Annex 13.1*

13.5.11 The modelling is reported in detail in the FRA which outlines the impact of a 50 m breach at two alternative locations through which seawater is free to pass for a period of 72 hours. Briefly, the modelling confirms that the raised site levels tend to obstruct the route of floodwaters, thus increasing flood risk on land near a breach (outside the site flood depths are predicted to increase by a maximum of 0.35 m adjacent to a breach). However, flood depths in the affected areas would be over 2 m without the development.

13.5.12 In broad terms the modelling shows that peak water levels within the flood plain increase adjacent to the development once the development is complete. In the case of a breach to the south of the development, the flood extent and flood depths increase at the coal and ore terminal to the south and at Hazel Dene, a residential property on Marsh Lane. At these locations water depths increase by around 350 mm in 2114 as a consequence of the development, from around 2.35 m to 2.7 m. At Hazel Dene the upper floors of the property will still provide a safe refuge however.

13.5.13 In the event of a breach to the north of the site, the flood extent remains largely unchanged but flood levels increase adjacent to the development by around 300 mm in 2014.

13.5.14 *Table 13.1* details the peak flood levels adjacent to the development at the present day and after taking into account 100 years of climate change. Existing ground levels on Killingholme Marsh are around 2.5 mAOD.

Table 13.1 *Flood Levels Adjacent to the Development*

Breach Location	Year	Peak Water Level without development (mAOD)	Peak Water Level Post Development (mAOD)
1km north of H19	2014	3.8	4.1
	2114	4.9	5.1
H18	2014	4.2	4.6
	2114	5.5	5.8

13.5.15 Within the development site, indicative flood depths and velocities are summarised in *Table 13.2* for both the development year and following 100 years of climate change.

Table 13.2 *Flood Levels at Building on Plot T1 (FFL=3.7 mAOD)*

Breach Location	Year	Max Flood Depth (m)	Max Velocity (m/s)
1km north of H19	2014	0.2	0.1
	2114	1.2	0.6
H18	2014	0.9	0.3
	2114	2.1	0.7

Surface Water Drainage

13.5.16 The site is currently drained by a network of open watercourses (the Killingholme Marshes Drainage System under the control of the NELDB) that currently discharges into the Humber Estuary via a flapped gravity outfall on the coast in the middle of the AMEP frontage.

13.5.17 Areas of land adjacent to the inland watercourses are at risk of fluvial flooding, particularly during periods of high tide when the existing flapped gravity outfall is tide-locked.

13.5.18 The site lies within the catchment of the Killingholme Marshes drainage system. NELDB has a proposed scheme for improving the drainage of the Killingholme Marshes system, comprising the installation of a

pumping station at the existing tidal outfall and associated channel widening (designed to cater for unrestricted surface water discharges from all potential development sites in the catchment area and ensure that the 100-year plus climate change flows will be contained within the channels of the watercourses). The proposed NELDB improvement scheme is specifically designed for the 1 percent (100-year) AEP event. An adaptive approach to climate change is promoted in NELDB's strategy to allow for flexibility in the development timings, and the take-up of contributing area. If significant use of permeable surfacing can be made there may not be a need for additional measures. NELDB envisages that corridors for flood mitigation may need to be provided alongside watercourses where additional flood storage might be provided in the future. The existing tidal outfall and the site of the proposed pumping station are located within the footprint of the proposed quay. The pumping station therefore needs to be relocated to accommodate the development. A feasibility study has been undertaken which presents various options for relocating the proposed NELDB pumping station. In accordance with the recommendations of that study the pumping station will be located to the south of the site. The surface water drainage proposals for the AMEP are otherwise compliant with NELDB's requirements.

- 13.5.19 The construction of a new outfall into the Humber Estuary will lead to the creation of a new channel across exiting intertidal mudflat. The new outfall will have an invert level of approximately 0 mAOD and will discharge up to 12.8 m³/s in the 1: 100 year storm event. This new outfall will create a new channel through the intertidal mudflats. The size of channel created has been assessed and is estimated that a 6 m wide channel would be created covering a plan area of 1 ha over the intertidal area. Further details are included in *Annex 8.3*

Foul Drainage

- 13.5.20 There are no public sewers within or adjacent to the site and a new foul drainage connection will have to be made direct to the South Killingholme Waste Water Treatment Works (WWTW). A network of foul pumping stations is envisaged serving all parts of the AMEP (except the small Customs House near the quay, which will be served by a private foul treatment package plant with a direct discharge to the sea). Anglian Water will upgrade of the WWTW to receive new foul drainage from the site.

Construction Phase

- 13.6.1 The modification of watercourse channels and the creation of new watercourse channels may result in disturbance to water voles and other wildlife. It may also cause disturbance to the bed and banks of the watercourses, possibly leading to the release of sediments. The worst-case potential impacts of such incidents on the sea and the inland watercourses may be Major Adverse.
- 13.6.2 During construction of the development, there is a general risk of polluted runoff entering the sea and the inland watercourses (eg soil and sediment being washed away from areas where topsoil stripping and excavation is in progress; and fuel, cement and concrete being washed away). The worst-case potential impacts of such pollution incidents on the sea and the inland watercourses may be Major Adverse.

Operational Phase

- 13.6.3 The construction of the quay will replace a length of existing tidal defences (which may be breached or overtopped in an extreme event). The quay will be a very substantial installation and it will be virtually impossible for it to be breached. Thus the quay will provide a localised improvement in the tidal flood defences. The standard of protection provided by the existing adjacent tidal defences will not be reduced.
- 13.6.4 Implementation of an engineered surface water drainage system will significantly reduce fluvial flood risks to the site resulting in a Major Beneficial impact.
- 13.6.5 The creation of a new outfall will result in the creation of a new channel across the intertidal habitat which will cause a change in the ecological functionality of that habitat locally.
- 13.6.6 The raising of ground levels within the application site will give rise increased flooding depths adjacent to the development. it will not however change the hazard rating of the affected areas as existing flood depths and velocities are significant.
- 13.6.7 Foul water will be discharged to the South Killingholme WWTW: Anglian Water will carry out a feasibility study of the required upgrade of South Killingholme WWTW and subsequently carry out the necessary improvement works. Any potential environmental effects of the discharge from the WWTW on the receiving water body will be

controlled by other consents to be obtained by Anglian Water as part of their upgrading of the WWTW.

- 13.6.8 The release of polluting substances into the sea and inland watercourses (eg spillages of fuel and oil) may result in Major Adverse impacts.

13.7 *MITIGATION MEASURES*

Construction Phase

- 13.7.1 During the construction phase, the following Pollution Prevention Guidelines (as published by the EA) will be implemented to mitigate the potential impacts of pollution incidents:

- PPG1 – General Guide to the Prevention of Pollution Mitigation Measures;
- PPG5 – Works or Maintenance in or Near Water;
- PPG6 – Working at Construction and Demolition Sites; and
- PPG21 – Pollution Incident Response Planning.

- 13.7.2 Among the measures which can be implemented are:

- minimising pollution risk - eg drip trays on mechanical equipment such as pumps and generators, fail-safe bunded storage of fuel and cement and other materials to prevent spillage to groundwater, watercourses or the sea;
- any over-pumping around works in watercourse channels will be carried out with a suitably-sized pump, in order that excessive flows are not generated and disturbance of the bed material is minimized;
- where possible, watercourse bank reinstatement works will be carried out by vehicles operating from the bank rather than the watercourse channel;
- for work on, over or adjacent to the watercourses, a maximum of one third of the watercourse will be bunded at any time, and the bunds will have a minimal height above normal water level, and should either wash out or create minimal obstruction during flood conditions;

- construction materials will be prevented from entering watercourses or the sea and blocking either the channels or culverts and bridges; and,
- care will be taken with all works involving concrete and cement. Suitable provision will be made for the washing-out of concrete mixing plant or ready-mix concrete lorries, and such washings will not be allowed to flow into watercourses or the sea.

13.7.3 Temporary lagoons may be required to allow any sediment carried by surface water runoff to settle out and be trapped on site, prior to the runoff discharging to inland watercourses or the sea.

13.7.4 Specific consents for temporary works will probably be required from:

- the EA (in relation to works adjacent to existing tidal defences);
- NELDB (in relation to works affecting their watercourses); and
- the Marine Management Organisation (MMO) (in relation to works in the Humber Estuary).

Operational Phase

13.7.5 During the operational phase, the following Pollution Prevention Guidelines (as published by the EA) will be implemented to mitigate the potential impacts of pollution incidents:

- PPG1 – General Guide to the Prevention of Pollution Mitigation Measures;
- PPG2 – Above Ground Oil Storage Tanks;
- PPG3 – Use and Design of Oil Separators in Surface Water Drainage Systems;
- PPG5 – Works or Maintenance in or Near Water;
- PPG7 – Refuelling Facilities;
- PPG13 – Vehicle Washing and Cleaning; and
- PPG21 – Pollution Incident Response Planning.

13.7.6 Among the measures which will be implemented are:

- fail-safe bunded storage of fuel and other substances to prevent spillage to groundwater, watercourses and the sea;
- provision of oil interceptors in paved areas; and
- installation of penstocks on outfalls to watercourses and the sea to contain any pollution incidents (where there is an identified risk).

13.7.7 The primary proposed flood risk mitigation measure is the implementation of a robust Flood Warning and Evacuation Plan for the site with its key objective being to evacuate the site before flooding occurs. Any people on the site will make their way off site or to the safe refuges on the upper floors of the buildings and await rescue by the emergency services. The Flood Warning and Evacuation Plan will not have any particular environmental impacts.

13.8 *RESIDUAL IMPACTS*

13.8.1 Potential residual impacts are:

- flood risk due to breach or overtopping of tidal defences (to be mitigated by implementation of a robust Flood Warning and Evacuation Plan);
- flood risk due to failure of the proposed NELDB pumping station (residual impacts are likely to be Minor Adverse and will be mitigated by the use of multiple pumps, alarms, etc);
- flood risk due to failure of the proposed foul pumping stations (residual impacts are likely to be Minor Adverse and will be mitigated by the use of standby pumps, alarms and flow storage facilities); and
- the accidental release of polluting substances into the sea and inland watercourses (control measures will be implemented to mitigate the impacts of pollution incidents).

13.9 *CUMULATIVE IMPACTS*

Construction Phase

- 13.9.1 There will be no adverse cumulative impacts in combination with other adjacent developments (including the Compensation Site) during the Construction Phase.

Operational Phase

- 13.9.2 There will be no adverse cumulative impacts in combination with other adjacent developments (including the Compensation Site) during the Operational Phase.