Flood Defences Cost Money, No Flood Defences Cost More: An economic case for the Humber and United Kingdom

Prepared on behalf of the Humber Parliamentarians, Local Authorities and the Humber Local Enterprise Partnership

THE CASE FOR INVESTMENT

Grimsby Docks 5th December 22:00

Direct Damage (£12.5bn)
Consequential Damage (£10.8bn)
Inward Investment at risk (£8.8bn)
Funding Required (£888m to £1.2bn)

At Risk

- 110,000 dwellings / 260,000 people
- 20,000 businesses
- 30,280ha of agricultural land
- 2 Hospitals
- UK’s largest port by tonnage and four other ports in Estuary
- Power Stations providing 4% of the UK’s electricity demand
- Oil and Gas Terminals landing up to 30% of UK gas demand
- Refineries providing 28% of UK capacity
- Sensitive Chemical and Pharmaceutical manufacturing sites
- Cement works and freight terminals
- 2 Waste-water Treatment Works
- UK’s largest storm water pumping station

Consequences

- £12.5bn of direct flood damage, equivalent to 85% of Regional GVA
- £10.8bn of consequential losses
- A potential £8.8bn of investment lost to the region

Expected Investment required

- £656m for defence reconstruction and rehabilitation
- £232m optimism bias and risk management
- Total investment £888m¹

¹ Of three cost options described on Pages 10 to 11
The Humber is home to 921,000 people of whom nearly 400,000 are at risk of flooding, as are key industries, 32,500 businesses and a significant agricultural sector. The Humber is one of the largest rivers, estuaries and commercial waterways in England and the rivers draining into it drain about one fifth of the entire area of the country stretching from Richmond in North Yorkshire to Birmingham and from Nottingham to Leeds.

There are some 230km of flood defences protecting the area to various standards from 20% (1 in 5) to 0.5% (1 in 200).

The area hosts some of the highest value assets and critical infrastructure in the country, including power stations and refineries, the country’s largest port complex, a petrochemicals industry worth £6bn per year as well as an SME base upon which the prosperity of the economy depends.

There are approximately 115,000ha of land at risk. Of this, 85% is farmed Grade 1 to Grade 3 agricultural land providing a significant proportion of UK grown fruit and vegetables and employing almost 6,000 people.

Despite these and other challenges the Humber Local Enterprise Partnership (LEP) and all Local Authorities consider the Humber to be on the brink of an exciting and transformational period of economic activity, driven by major investment in and around the Estuary and offshore.

The location and land resources available on both banks offer competitive opportunities for renewables, and offshore wind in particular. The Humber LEP predicts that investment linked to renewables and regeneration could result in up to £7bn of further investment across the Humber and in particular in key Economic Zones such as Greenport Hull, Paull, the Port of Grimsby and the South Humber Gateway.

The Humber recently experienced its worst tidal surge on record. The event resulted in approximately 1,100 properties being flooded along with at least 2,600ha of agricultural land in East Riding alone and 2,300ha flooded on the south bank. Direct damages are estimated to exceed £90 million, yet despite this scale of impact the event can be considered a ‘near miss’ by virtue of the fact that 90,000 homes weren’t inundated.

Humber Catchment and Humber Authorities

According to expert analysis a similar if not slightly larger surge event will occur at least once within the next 50 years, particularly with the effects of climate change which are expected to increase sea levels by almost 0.3m by 2064. Such an event has the potential to cause at least £12.5bn of direct damages to residential properties, businesses, industry and agriculture, including damages to vehicles and the impacts on health and from evacuation. This is a loss to the nation as well as to the region and local area.

Uplift factors derived from the Thames Estuary 2100 project have been applied to estimate consequential damages across the Humber floodplain in such an event. Damages of £10.6bn are estimated, which are additional to the £12.5bn direct damage from flooding.

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5 Based on investments and opportunities identified at South Humber Gateway (including AMEP and ALP), Port of Grimsby, Greenport Hull and Paull, Lincolnshire Lakes and planned C-Gen power station identified in the SEP published by Humber LEP (2014). Includes £3bn of planned investment by the Chemicals industry.
7 Based on a modelled overtopping scenario assessed with the updated Humber Strategy Model (HR Wallingford, 2014).
8 The uplift factor used has removed the effect of the financial services industry and has been scaled down by 76% in light of the ratio of Yorkshire and Humber GVA per head to that in the South East.
Cost models indicate that investment of £888m over the next 10 years, though potentially up to £1.2bn, is necessary to prevent flooding of this magnitude, which would have a devastating impact on the region. Direct damages alone represent 82.5% of the regional GVA of the Humber Authorities9, which was £15.2bn in 201210.

Such an event undoubtedly represents a major flood shock to a region becoming a major player in the future renewables market and which is looking forward to more than £8 billion of future inward investment to meet the demands of growth in the industry. The continuing risk of flooding to assets represents a significant cause for concern to investors and an additional potential loss to the region if not addressed quickly.

This Briefing Paper summarises the strategic importance of the Humber Estuary to the regional and national economy and its susceptibility to a major tidal surge. It highlights the significant scale of expected damages to the economy from a surge incident equivalent to that experienced in December 2013 but with the added influence of climate change and less favourable wind and tide conditions.

The investment in flood risk management necessary to protect the Estuary against an event of this magnitude is presented and placed into context against committed long-term capital funding from Government between 2015 and 2021 and additional funding at a regional level that is in the pipeline. There is a very strong business case for investing to protect people, business and existing Regional and National critical assets and commercial activities and to support vital economic growth by unlocking new investment around the Estuary.

The Humber in Context

Location

The Humber Region is centrally located on the east coast, equidistant from London and Edinburgh.

The local authorities bordering the Estuary are varied, with East Riding the largest of the Humber Unitary Authorities in area and population. Hull is one of the most densely populated, which contrasts with North Lincolnshire and East Riding which are essentially rural with a low population density. North East Lincolnshire and Lincolnshire County Council make up the remaining authorities with a direct interest.

Key settlements include Hull, the third largest city in Yorkshire, which together with the Haltemprice villages in the East Riding has 311,000 people within the overall urban area, Grimsby, Immingham, Cleethorpes and Goole, as well as the larger urban settlements further afield such as Scunthorpe and Beverley.

The Humber has good connectivity to the rest of the UK by road and rail, and to other countries by sea and air, which is one of the area’s most important assets and a reason why businesses choose to invest here.

Industry

The Humber is referred to as the Energy Estuary, and for good reason. Up to 20% of UK natural gas demand from Norway is landed at Easington via the Langeled pipeline from where it is distributed around the UK. Three gas-powered power stations currently provide 6% of the UK’s electricity generation capacity, including the Vital CHP plant - the largest in Europe. A £1bn C-Gen Gas-fired power station is also planned.

More than 30% of the UK’s coal and an increasing amount of biomass to fuel power stations at Ferrybridge, Eggborough, Drax and Glanford Brigg passes through the Humber and Vivergo Fuels at Salt End near Hull produces 30% of the UK’s bioethanol demand for petrol11.

Furthermore, Greenport Hull, Able Marine Energy Park (AMEP) at Immingham and Port of Grimsby are gearing up to support the manufacture, operations and maintenance of windfarms in the North Sea. These sites lie within 100km of 40% of UK national offshore wind capacity1.

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9 Consisting of East Riding of Yorkshire, Kingston up Hull, North Lincolnshire and North East Lincolnshire

10 Gross Value Added – a standard measure of the value of goods and services produced in an area, industry or sector.

11 www.greenporthull.co.uk/hull-humber
The Estuary supports an extensive petrochemicals/chemicals sector worth £6bn per year, providing raw materials for much of the UK energy sector supported by the Humber Ports. Approximately 27% of UK oil refining capacity is provided by Phillips 66 and Total refineries at Immingham. There are also chemical clusters specialising in a range of sectors including petrochemical refining, personal care, pigments/colours, paint and coatings, agrochemicals, fine chemicals, and inorganic and organic commodities to name a few. Speciality niche sectors also contribute to the variety of the industry, including specialty gases, pharmaceuticals and biofuels/biomass processing\(^{12}\).

In addition to the energy and chemicals sector, the Humber is the largest trading estuary in the UK and the fourth largest in northern Europe, handling almost 80m tonnes of cargo annually.

At least 50m tonnes of cargo and 10% of all UK seaborne trade, including 30m tonnes of coal, passes through the Port of Immingham’s extensive deep-water facilities, RoRo\(^{12}\) and LoLo\(^{13}\) facilities. The nearby Port of Grimsby handles a range of cargo, including more than 550,000 cars per year, and it has an established centre for construction, support, operation and maintenance activities for wind farms on the North Sea.

The Port of Hull has extensive facilities, including container terminals at Queen Elizabeth Docks, and King George Dock, RoRo facilities and facilities for movement and storage of dry bulks, general cargo, liquids bulks and others, and includes the only passenger services in the Humber serving 1 million passengers per year. Port of Goole is the UK’s most inland port, which provides significant advantages for road, rail and canal connectivity and gives it an important role in the distribution of goods\(^{8}\).

Other industries such as engineering and manufacturing linked to Tata Steel and Guardian Industries (one of the world’s largest manufacturers of float glass and fabricated glass products), healthcare technologies with large, market-leading companies such as Smith & Nephew, Reckitt Benckiser and Croda, and a growing creative and digital services industry also contribute significantly to GVA from the area and add to the variety of strategically important sectors operating out of the Humber\(^{9}\). To maintain a competitive economy we need to be able to compete with cheaper production costs and imports from the Far East.

\(^{12}\) RoRo – Roll on Roll Off
\(^{13}\) LoLo – Lift on Lift Off
Isle of Axholme

Further up the estuary, the Isle of Axholme consists of 21,000ha of high quality agricultural land that was former marshland drained in the 17th century, much of which is at or below sea level and which supports a population of approximately 20,000 people. The Environment Agency has recently completed a study that confirms £5.1 billion of infrastructure would be impacted by a major flood event. Critical assets and key infrastructure include:

- Three motorways (M181, M180 and M18)
- National Rail Network (Cleethorpes – Doncaster)
- Robin Hood International Airport
- Keadby Power Station

Existing Flood Risk Management

The Environment Agency’s Long Term Investment Strategy\(^\text{18}\) indicates that the local authorities of Kingston upon Hull and East Riding of Yorkshire have the highest total number of properties at flood risk with more than 125,000 and 55,000 respectively.

To manage the tidal and tidally influenced flood risk around the Humber Estuary, the Environment Agency, with Local Authorities and private land owners, maintain a portfolio of 229.5km of flood defences.

A significant proportion of these defences were constructed after the last major tidal surge, which took place in January 1953, killing 326 people in the UK. The Humber Flood Risk Management Strategy indicates that the current standard of protection provided by the Humber Estuary flood defences varies between 20% (1 in 5 years) and 0.5% (1 in 200 years) and that many have a residual lifespan of less than 10 years. Approximately 14% of the floodplain is protected by defences with a lifespan of less than 10 years, and only 25% have a lifespan of more than 20 years\(^\text{2}\).

December 2013 Tidal Surge

On the evening of 5th December a tidal surge that had been tracking around Scotland and down the east coast of England reached the Humber Estuary. The surge resulted in a high tide earlier than expected and some 1.93m higher than predicted, producing an observed high tide at Hull Barrier of 5.81m above Ordnance Datum (AOD)\(^\text{19}\), which was higher even than the level of the 1953 surge.

Around the Estuary as a whole, approximately 40km of flood defences were overtopped. This resulted in significant landward damage of soft flood defences caused by erosion and the collapse and breach of the defences in a number of locations. During the post-event repair of defences it became obvious that the defences in many locations are not as robust in their construction as might be assumed.

The East Riding experienced significant consequences to rural areas, including considerable flooding and damage to the network of minor roads in the floodplain, which rendered the area difficult to evacuate and disorientating even for residents when roads were impassable and because of the dark, as typified by the image below from Saltmarshe.

Estuary wide there was in the region of 7,000ha of land flooded, affecting agriculture, livestock and poultry. The impact on agricultural productivity is yet to be understood, as the growing season has only recently commenced in earnest and harvesting is yet to take place.

Saltmarshe

Hull on the other hand suffered rapid flooding of urban areas with streets quickly inundated and in some cases to significant depths. The images below are 4 minutes apart showing the rapid inundation of Porter Street, north of the English Street area and the A63 near Hull City Centre.

Porter Street, Hull City Centre

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\(^{19}\) Environment Agency (2014) Fact Sheet 13: The Tidal surge of December 5th 2013, NE Hydrology Team
At Tetney there was overtopping and breach of flood defences whilst nearby Cleethorpes seafront was overtopped and Grimsby experienced overtopping of the Mitre Gates which provide access into Grimsby Docks. On the Lower River Trent there was also overtopping of flood defences at Keadby and Burringham.

Elsewhere, places like the Port of Immingham and industries at South Ferriby were also affected.

It can be concluded from a wide variety of sources that the tidal surge of December 2013 was indeed a significant and damaging event across the whole Estuary. Damages from a small number of sources total at least £90 million and the sum total of all damages to people, property, business and the environment is expected to be significantly larger.

Had the surge peaked only two hours later then there could have been a significantly greater impact. The peak tide level could have been up to 40cm higher resulting in a higher rate of flow over the defences with considerably wider ranging and significant impacts from inundation and breach of defences\(^6\). Furthermore, had there been an easterly wind or had the Trent and Ouse had higher rates of flow, then the impacts could also have been more acute on both sides of the Estuary and could have reached further upstream.

From observations on the day, it is understood that water levels were near to the top of defences protecting the 17,600 people who live in Goole. In Hull, had the volume of water flooding the centre of Hull been larger, there would have been flow into the lower lying, residential areas within the City and fatalities would have occurred.

### A Larger but Conceivable Event

Experts involved in the development of the emerging update to the 2008 Humber Flood Risk Management Strategy, due for publication in 2015, have assessed the consequences of a larger but still conceivable event to that which took place in December of last year.

With an allowance for climate change over the next 50 years, and with slightly more onerous astronomical tide, wind and wave conditions, the extent of flooding and impacts on the Estuary have been assessed and are summarised below.

### People and Property

130,000 properties are at risk within the predicted tidal flood extent consisting of:

- 110,000 dwellings
- 20,000 businesses
- 30,280ha of agricultural land
- 142 nurseries/schools/colleges/university
- Hull Royal Infirmary and Goole & District Hospitals
- 30 emergency service assets
- 5 National Grid Substation assets
- 27 water and waste-water assets
- 696 electricity sub-stations
- 1,295km of roads, including 23.7km of motorway and 98km of A-Road
- 46.8km of railway line

In relation to the dwellings affected, this equates to approximately 260,000 people, of whom a similar proportion (50%) will be located within the 20% most deprived areas within the UK based on the Governments Indices of Multiple Deprivation (IMD)\(^{16,17}\).
Predicted Flood Extent relative to Key Assets at Risk

Key Assets

Of the key assets identified within the Humber Estuary, only 5 lie outside of the area predicted to be inundated. The assets at risk include three power stations (Salt End, Immingham and South Humber Bank), various petrochemical and gas terminal and transfer facilities, chemical facilities and transport assets, Hull Waste-water Treatment Works and the key urban areas of Hull, Grimsby, Cleethorpes and Goole. Of strategic importance are the Humber Ports which account for 98% of imported and exported goods coming into the area and account for 15% of seaborne trade.

Direct Damages

The information available from modelling of this event allows an estimate of the direct damages to be made, including the direct damage from flooding to dwellings, non-residential properties (i.e. businesses) and to agriculture.

The direct, tangible damages are estimated to be as follows\(^\text{20}\) amounting to a total direct damage of approximately £12.0 billion:

- Dwellings: £8,684 million
- Non-residential: £3,295 million
- Agriculture: £22 million

In addition there could be an additional £96m of damage to vehicles and up to £443m of cost to the nation as a result of evacuation and from impacts on health\(^\text{21}\). Taking these values, the total direct damages would amount to just over £12.5 billion:

- Total Direct Damages: £12,541 million

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Consequential Damages

Consequential damages include losses such as loss of income, disruption to business, loss of customers to competitors and disruption of supply chain, and they are not typically taken into account because it is assumed that these losses are transferred elsewhere within the national economy and are not therefore a loss to the nation.

At the local and regional scale however they can be significant. In some cases, such as impacts to refineries and power generation, it could be argued that some consequential losses represent a national impact because they won’t immediately be transferred elsewhere within the UK or may be transferred out of the country.

Impact on the costs of insurance is also a key consideration that can be clearly evidenced from recent floods in the Humber area. The majority of Kingston upon Hull is within the flood plain, as indicated on the Environment Agency flood maps and this has an impact on the availability of insurance for the residents and businesses of Hull. Discussion between Hull City Council and the ABI has established that without future investment in the Humber defences it is unlikely that the availability of flood insurance can be continued.

The consequential impact on businesses caused by flooding has a negative impact on the economy causing businesses to relocate, new developments to stall and increased demand on government, both local and national to provide assistance and funding to those affected. The businesses most affected by this issue are the small business units, which within Hull make up 37.8% of the businesses within the city; this is above the national level of 23.7%22. Hull City Council has direct experience of the difficulties and financial pressures of insuring for flood risk with many of the Council’s assets becoming difficult to insure.

The scale of consequential losses is often difficult to quantify, particularly when looking at a large area such as this, however, in the Humber Estuary for the event assessed they have been estimated in the following way:

1. A ratio, from work undertaken for the TE2100 project relating total damage to property damage, was adapted to remove the effect of London’s financial services and to scale down the ratio to account for the lower GVA per head for the Humber area23.

2. The final ratio was applied to property damage from the event in the Humber to produce a total damage estimate. The property damage was then subtracted to provide an estimate of consequential damage.

The final adopted uplift factor to estimate total damages in the Humber Estuary from property damage was 1.89. This uplift factor results in an estimate of consequential damage of £10.8bn which is in addition to the £12.5bn direct damage from flooding.

- Direct Damage: £12,541 million
- Consequential Damage: £10,781 million
- Total Damage: £23,322 million

Qualifying the Indirect Damages

Consequential losses of £10.78 billion are significant and require some qualification and justification. The following highlights a select number of consequential impacts from flooding in the Humber Estuary which supports the scale of consequential losses identified.

- The supply of crude oil to the Phillips 66 site comes in at Tetney via tanker into a storage tank farm that only has finite number of day’s storage capacity. It is then transferred to the refinery via underground pipeline, however the pipeline is not entirely below ground and therefore some sections are at risk from a surge event. The consequences of impacts to the storage facility and the pipeline are potentially significant, however, knock on impacts to UK refinery capacity could be catastrophic nationally.

- Up to 20% of UK natural gas and 30% of total UK demand for gas can pass through Easington Gas Terminal. The Gas Transfer stations passing gas beneath the Humber are both at risk from a tidal surge. A previous estimate of the damage to the pipeline was capped at the value of relaying the pipeline, estimated to be in the region of £198 million24.

- Estimates put the value of infrastructure in the Immingham area alone (power stations, refineries etc) at a minimum of £5 billion. North East Lincolnshire Council estimate potential flood damages to be in the region of £1bn to the refineries.

- Facilities at Salt End (Chemical works, Power Station and three National Grid Sub-stations) would have similar impacts, in the region of at least £1 billion.

- The Port of Immingham holds and processes 30% of UK coal demand. Flooding of coal stockpiles would result in a need for their disposal leaving power stations like Drax, responsible for 7% to 8% of the UK’s electricity demand, with only days worth of supply.

22 Inter Departmental Business Register - ONS
23 Communication from Environment Agency to Dr John Chatterton, April 2009
24 Arup (2009) Meeting Memo, Sunk Island Study
• The Port of Immingham also holds and processes a significant and growing demand for biofuels/biomass. An impact on biomass infrastructure would have a significant effect on biomass electricity generation - the stockpiles themselves would be destroyed requiring appropriate disposal and the ‘Just In Time’ supply chain would be more sensitive to a hiatus of supply in the event of a flood.

• Flooding of the road network within and surrounding the Estuary would significantly hamper the distribution of petrol and fuels across the UK, resulting in shortages within a very short space of time. Impacts on the rail network would prevent the transport of coal and biomass to power stations, adding to the impacts of flooding to the Humber Ports.

• It is possible that impacts to all power stations within the Estuary flood zone would seriously deplete power generation with demand outstripping supply leaving a shortfall, which the Grid could not immediately recover. Such a scenario could invoke strict rota quotas for the whole of the UK for many months.

• A TE2100 consequential damage assessment of the Port of Tilbury identified potential damages of £1.3 billion25. Tilbury handles only 24% of the tonnage handled by Immingham alone, suggesting far greater damages from flooding to Immingham not to mention Port of Hull, Port of Grimsby and Port of Goole adding to the total damage (likely to be in excess of £4bn).

Future Inward Investment

To compound the impacts of a significant flood event in the Estuary, there is a real risk of jeopardising future inward investment in the region from inaction on flood risk management.

The aspirations of the region and economic growth are intrinsically linked to the development of renewable energy capacity within the North Sea and the infrastructure required supporting that development, which the Estuary is almost uniquely placed to exploit. Improvement of flood defence and resilience will secure the Humber’s position as the UK’s Energy Estuary and benefit the whole of the UK economy.

There is already some concern amongst industries based within the Port of Immingham estate about the level of support being provided by Government to Associated British Ports (ABP). These companies will be reviewing their Business Plans and capital investment strategies in light of the current resilience of the infrastructure in and around the Port and Estuary to tidal flooding. Major international companies will be considering whether the Humber Estuary remains a viable location for their operations in light of the potential damages faced and HM Treasury could also face a loss of excise duty should that occur.

The recent arrival of Dong Energy to the Port of Grimsby has resulted in investment commitments of £11 million, creating at least 100 new jobs and highlighting the type of investment expected.

<table>
<thead>
<tr>
<th>Consequential Impacts</th>
<th>Value (£bn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Re-laying Easington gas pipeline</td>
<td>£0.2</td>
</tr>
<tr>
<td>Flood damage to Immingham refineries</td>
<td>£1.0</td>
</tr>
<tr>
<td>Extrapolated flood damage to Salt End Power Station, chemical works and sub-stations</td>
<td>£1.0</td>
</tr>
<tr>
<td>Damage to Humber Ports and stored goods</td>
<td>Incalculable, in excess of £4bn</td>
</tr>
<tr>
<td>Impact to Humber Refinery from disruption and damage to Tetney oil storage and pipeline</td>
<td>Significant</td>
</tr>
<tr>
<td>Impact on UK economy from impacts to road and rail network causing disruption to distribution of refinery products, coal/biomass and port cargo</td>
<td>Catastrophic</td>
</tr>
<tr>
<td>Impact on UK economy from reduction in national electricity generating capacity</td>
<td>Catastrophic</td>
</tr>
</tbody>
</table>

25 Chatterton, J. (2008) TE2100 Assessment: Assessment of Damages to properties in the Thames Estuary of Likely high Consequence from Tidal Flooding
The construction of the £23 million Grimsby Dock’s Flood Risk Management Scheme undoubtedly contributed towards this commitment and highlights the importance of investment in flood risk resilience in unlocking new opportunities for development and growth.

The Government’s own Long Term Investment Strategy highlights the importance of this function in its funding of flood alleviation schemes in places like Clacton and Holland on Sea, Exeter, Leeds and the Lower Don in Sheffield amongst others.

To support investment in business and industry, considerable housing development is required across the Estuary. Within Hull for example it has long been recognised that jobs are essential to improve the city’s housing market, this is reflected in the objective of the City plan to create 7,500 jobs. The western employment corridor within the city is therefore critical to support the renewal of the housing market in Newington and St Andrews which has secured £9.8million through the Regional Growth Fund to provide a quality housing offer. Investment in flood defences is therefore of strategic importance to the city of Hull and its future growth.

Elsewhere in Hull more than £1.9bn of future investment is planned. Investments include £1.4bn in new offshore wind energy manufacturing and servicing capability at Green Port (Alexandra Dock) alongside other energy, industry and manufacturing investments, £270m in public infrastructure, such as road improvements and rail electrification, and a further £220m in housing.

To summarise, there is significant future investment planned within the Humber that is likely to exceed the £8.5bn identified here and excluding the benefit to regional and national GVA that would follow. The potential loss of this investment and revenues should be considered an additional consequence of failing to invest in flood risk management alongside the direct and indirect damages presented on the previous page.

**Predicted Flood Extent relative to selected areas of Future Investment in the Estuary**
Regional Impact in Context

The damages associated with a larger, conceivable event in the Humber Estuary have significant consequences on the regional if not national economy.

The ONS indicates that the GVA of the Humber Authorities was £15.2bn in 2012. Direct damages (£12bn) alone represent 82.5% of this regional GVA. A surge of this magnitude arguably represents a major flood shock to a region that could be a major player in the future renewables market and one that is looking forward to significant investment to meet the demands of growth in the industry.

Necessary Flood Defence Investment

Estimates have been made to quantify the investment in flood defence infrastructure necessary to ensure residents are safe from flooding, to enable existing businesses to develop and to secure the growth in the area by providing the right infrastructure to support and encourage inward investment.

Three cost models have been developed to produce a credible range of estimates for which funding is sought.

Cost model 1 uses cost information for earthworks and hard defences from similar completed schemes within the Estuary, as well as detailed estimates of defence costs from planned and ongoing schemes. Items such as design and supervision, contractor and Environment Agency costs are included, along with land purchase/compensation and geotechnical and environmental investigation.

An uplift for managed realignment to offset the loss of intertidal habitats, which is a statutory obligation on the Environment Agency is also included, particularly as this often results in limited working periods, specific ways of working as well as mitigation/compensation measures, all of which increases costs.

The adopted model assumes that 75% of defences need to be completely rebuilt and the remainder can be remediated and topped up at approximately half the unit cost. It is also assumed that 75% of the works can be considered standard civil engineering with the remainder non-standard. Optimism bias is also included in the model at a reduced rate of 21% for the standard engineering works and 31% for the remainder, assuming a reduction in project risks brought about by assessing contributory factors and through effective Project Management as per HM Treasury Supplementary Green Book Guidance. It is further assumed that these measures will be implemented and effective.

The total expected flood defence investment required, defined by the Green Book recommended method for risk mitigation, equals £888m, as shown in the table overleaf.
<table>
<thead>
<tr>
<th>Element</th>
<th>Model One (£m)</th>
<th>Model Two (£m)</th>
<th>Model Three (£m)</th>
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</thead>
<tbody>
<tr>
<td>Reconstruction of defences</td>
<td>563</td>
<td>563</td>
<td>750</td>
</tr>
<tr>
<td>Rehabilitation of defences</td>
<td>94</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td><strong>SUB-TOTAL</strong></td>
<td>656</td>
<td>656</td>
<td>750</td>
</tr>
<tr>
<td>Standard Civil Engineering Works</td>
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<tr>
<td>Optimism bias</td>
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<td>217</td>
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<tr>
<td>Non-standard Civil Engineering Works</td>
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<td></td>
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<tr>
<td>Optimism bias</td>
<td>51</td>
<td>108</td>
<td>450</td>
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<tr>
<td>Optimism bias risk mitigation</td>
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<tr>
<td><strong>SUBTOTAL</strong></td>
<td>888</td>
<td>981</td>
<td>1,200</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>888</td>
<td>981</td>
<td>1,200</td>
</tr>
</tbody>
</table>

A slightly more conservative cost model, which is essentially identical but includes an upper limit optimism bias of 44% and 66% as per the Green Book and therefore no risk mitigation costs, results in an estimated investment requirement of £981m.

A final cost model assumes that 100% of defences require a high degree of intervention, especially in adapting to climate change, with a range of engineering conditions anticipated. Optimism bias is based on standard FDGiA rates of 60%, resulting in a cost estimate of £1.2bn.

The Humber LEP and Humber local authorities are keen to see the investment in flood defence infrastructure commence as quickly as possible with an ambitious investment programme of between £888m and £1.2bn over the next 10 years.

This additional investment will support and enhance the delivery of £200m as of yet unsecured investment in flood defences to 2032 as part of the Humber Flood Risk Management Strategy, which was approved in 2007. It is also understood that there is an Environment Agency commitment to provide £4.1m of funding towards a £13m scheme to protect the South Humber refineries, ports and energy infrastructure. Private investment of £15m is secured towards a £32m flood defence scheme along the tidal River Trent that will facilitate investment at the Lincolnshire Lakes site, near Scunthorpe. Match funding is required for the development to proceed. Further schemes to protect properties, industry and infrastructure along the South Humber bank and £5.1bn of assets in the Isle of Axholme area are also being considered, subject to bid submissions and funding rules.

Further, there is a potential, currently unsecured, structural investment from ERDF funding amounting to some £200m nationally, of which in the region of £14.5m is expected to be directed towards the Humber and which could leverage a further 2,250 jobs and OVA contributions of £120m amongst other things. Bids for funding under the Local Growth Fund amounting to £131m are also expected with some flexibility on how it is spent. Nine schemes are identified targeted at flood risk management and seeking to protect the environment and resource efficiency and to promote climate change adaptation, risk prevention and management.

The Government is committed to funding up to £2.3bn of national flood defence works over the next 6 years, in order to protect people and property and to secure investment opportunities at a range of locations. The UK’s second largest Estuary containing one of the UK’s most at-risk cities, the UK’s largest port by tonnage and arguably one of the UK’s most important areas for energy production needs a greater commitment from Government to secure the future of the region.

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29 Thematic Objective 5 and 6 of the European Union Strategic Investment Fund Implementation Plan (2014)
Appendix A:
December 2013 Surge

Case Study: East Riding

Records from East Riding of Yorkshire Council show that the event flooded 471 properties, of which 341 were residential and the remainder businesses. The surge overtopped and breached defences in Welwick (above) and overtopped defences at Paull, Hessle, North Ferriby, Faxfleet, Blacktoft, Yokefleet, Saltmarshe and Sandhall on the north bank as well as Reedness on the south bank of the tidal Ouse. Spurn Point was over-washed and the point cut off for months, with implications to ABP’s Vessel Traffic Services and the RNLI station.

There were direct costs to ERYC of £1.04 million, including:

- £221,000 from Council Tax relief
- £52,000 from business rates relief
- £75,000 from post-event assistance
- £415,000 from repair of roads
- £279,000 from repair of flood defences

In addition there was disruption of Northern Power Grid assets, damage to Yorkshire Water Pumping Stations at Hessle, Paull and Easington and the closure of and damage to Network Rail lines estimated to be in the order of £100,000. The above excludes damages to properties which are estimated to be in the region of £13.4 million.

Case Study: English Street, Hull

Kingston upon Hull City Council has confirmed that approximately 151 businesses were affected in the English Street area of the city, which lies between Albert Dock to the south and the A63 to the north. To the east lies the mouth of the River Hull, the River Hull Barrier and the popular tourist destination of The Deep. The flood defence level at Albert Dock, to the south of English Street, are low at 5.04m AOD, which is approximately 0.77m lower than the highest recorded tide level during the incident.

Flood flows passed from Albert Docks into English Street, Jackson Street and Lister Street area where the majority of commercial properties and small businesses suffered flooding. Flow was quick and levels were as deep as 1.5m in places. Interviews and CCTV footage have confirmed issues of floating cars, floating heavy debris and pedestrians taking refuge from the rapid flowing water.

Significant clean up and recovery works took place throughout this area and associated damages and costs will be extreme. Initial estimates put the damage to commercial properties in this area, which include some significant industries, as £50 million excluding consequential damages such as loss of trade.

Surrounding areas, such as Wellington Street, were affected by the surcharging of sewers caused by the ingress of tidal water in the English Street area. The City Centre, Hessle Road and Strickland Street with 149 residential properties all affected by the overland flow of tidal flooding from the English Street area. Some other areas were affected by minor overtopping.
Case Study: Cement Works, South Feriby

The Cemex cement production plant at South Feriby on the south bank of the Humber Estuary produces over 800,000 tonnes of cement per year. The site provides employment for 150 permanent staff and contributes around £10m annually to the local economy.

Tidal flooding on 5th December caused very extensive damage to all aspects of the plant, with water depth generally 1.5m and much deeper in some of the low lying parts of the site. Many of the site’s buildings have had to be replaced and the electrical system in particular was badly damaged by the salt water, although structural damage was limited.

Repairs and refurbishment of the plant has involved all of the company’s own staff, supplemented with 100’s of additional specialist contractors from many countries.

Limited production began again in April, and full production is envisaged in the coming months, once new equipment has been safely commissioned.

The costs of repairs and from the loss of production have yet to be confirmed but are expected to be in the 10’s of millions.

Case Study: Port of Immingham

The Port of Immingham is operated by ABP, which is the UK’s largest and leading ports group. The port and associated supply industries have expanded in recent years and the port currently handles 10% of the UK’s seaborne trade amounting to 50 million tonnes annually, including around 30 million tonnes of coal and petroleum products.

The port has extensive deep-water facilities and the infrastructure to handle a variety of different cargo streams, including dry bulks, containers, RORO, forest products, general cargoes, liquid bulks and break bulks. For this reason and because of its close location to power stations the port is nationally significant for the ‘ESI’ (Electricity Supply Industry) both because of the coal it handles and its growing volumes of biomass, which are forwarded by rail to power stations located mainly in the Aire and Trent Valleys.

The port also performs a vital role in the supply chain surrounding the two refineries adjacent to the port owned by Phillips 66 and Total, which together represent around 28% of the UK’s refining capacity.

The flood level at the Port of Immingham has been confirmed as 5.31m by the Environment Agency and the current resilience level is 4.7m AOD. The port’s greatest asset, the main lock pit, was the principal point of entry for flood water, as it forms a channel through which the surge tide entered the enclosed dock. Water levels within the dock rose because of this inundation to a point where adjacent quaysides were significantly overtopped, with some locations seeing several feet of water. Riverside defences also proved to be inadequate. Damages to the port included:

- Damage to buildings, cargoes and equipment.
- Transmission infrastructure - 40 substations within the port estate supplying electricity to ABP’s facilities as well as their customers’ operations. The subsequent power supply disruption had a damaging effect upon all port operations.
- Transport infrastructure - points and signalling on critical railway lines serving the Humber International Terminal were affected. Network Rail and ABP engineers worked assiduously at restoring rail connectivity to this facility, which is the entry point for a significant amount of coal burnt in UK power stations. Crucially none of the power stations suffered a significant disruption in the supply of coal to their sites, with buffer stocks actually at the power station allowing for a small hiatus in supply.

Direct damages to ABP are estimated at £10 million to £15 million, however, losses to the Port Businesses are even more significant, with repercussions nationally.
Appendix B: Future Investment Case Studies

Case Study: ABP’s Humber Ports Investment

ABP recently committed to investing well over £100m to handle wood pellet shipments at its Humber Ports of Immingham, Hull and Goole to support Drax Power’s conversion to a low carbon electricity producer through replacing coal with sustainable biomass. The project will generate approximately 100 jobs at ABP’s Humber Ports during the construction phase and over 100 permanent positions will be supported once the facilities become fully operational over the next few years. The Drax Power Station at Selby is the UK’s largest single producer of electricity, meeting approximately seven per cent of the UK’s electricity needs. Drax plans to convert three of its existing coal-fired generating units to burn sustainable biomass which will result in its output being predominantly from renewable resources within the next few years.

At the Humber International Terminal (HIT) at its Port of Immingham, ABP will create a dedicated import facility, the Immingham Renewable Fuels Terminal, to handle Panamax-size bulk carriers which will service up to three million tonnes of wood pellets a year. The investment will require new quayside discharge plant with associated equipment to convey the biomass from the ships to new silos capable of storing up to 100,000 tonnes. From these silos, cargo will be conveyed to a new a train loading facility which will service the specialist rail wagons transporting the biomass to the power station at Selby. The project also includes a significant upgrade in rail infrastructure at HIT to facilitate the servicing of this new trade.

ABP is currently investing in an additional 100,000 tonnes of capacity at the Humber International Terminal (HIT) including dedicated handling equipment and storage facilities in order to handle up to one million tonnes of biomass each year to be supplied to Drax by rail. An investment of £17million required for improvements to the frontages of the port is required. Further inland at its port of Goole, only seven miles from Drax, investment in warehousing is also being made as a result of increased imports of biomass through the port.

Case Study: Grimsby EZ

The Grimsby Dock’s Flood Risk Management Scheme reduces the flood risk to local businesses and up to 14,000 properties in the borough, reflecting the council’s commitment to development and growth by enabling the local area to fully realise its potential. The scheme will also bring major improvements to the docks infrastructure and ensure that they are a key place for investment.

The scheme sees the Enterprise Zone included as additional contributions to ensure that this site is able to be opened up for further development. The improvements gained by the flood improvement works will over future years enable significant growth in the port and town of Grimsby which is estimated to be in excess of £1bn. The scheme is part of an overall ambition to improve growth in the area by providing the right infrastructure to support and encourage inward investment in the area, to enable existing businesses to develop, and to ensure residents are safe from flooding.

- £23m investment in 3.5km of flood defences
- £200m of investment secured already, including an £11m commitment from Dong Energy
- At least £1bn investment expected over future years

Considered on of the most successful flood improvement scheme with effective partnership working from EA, ABP and LA. With significant contributions from the public and private sector to the scheme.
Case Study:
Able Marine Energy Park

Able Marine Energy Park (AMEP) is a simple concept based on industrial logic that will meet the needs of the emerging renewable energy sectors.

AMEP offers 1,389m of new, heavy-duty deep water quays and 367 hectares of developable land. It is designed specifically for the marine renewables sector providing a multi-user facility for the manufacture, storage, assembly and deployment of next generation offshore wind turbines and their associated supply chain - all in the heart of the largest offshore wind market in the world.

AMEP will provide direct investment of £450m and it is anticipated that there will be additional indirect investments from supply chain and associated businesses totalling £1bn. Up to 4,100 new jobs will be created, with potentially 10,000 across the region.

Direct on-site GVA is expected to equal £265m annually with net additional GVA regionally estimated at £378m, plus a further £186m of additional business activity within the region. Total additional GVA is therefore expected to equal £692m.

Case Study:
Able Logistics Park

The Able Logistics Park (ALP) has full planning permission for 498ha of Business Park, warehouse, hotel, manufacturing, storage and logistics development with a direct investment of £120m and providing an additional 5,300 jobs. It is the largest employment site in the north of England and is immediately adjacent to the proposed AMEP site.

The development of ALP will complement tenants on AMEP, potentially enabling a ‘just in time’ approach minimising inventories, sustaining and maximising efficiencies and workflow concepts. ALP also offers the perfect proposition for port-centric logistics operations across other sectors. The area’s high density of flexible port terminals combined with its already strong supply chain network means cargo can be unloaded, stored and distributed from ALP and be speedily dispatched to its end destination.

The port has direct rail access and is connected to more major motorways than any other UK region (M18, M1, M62, M180) meaning that customers can access key conurbations more quickly. With a population of 1.8million within a 60 minute drive and the ability to connect with areas such as Sheffield, Leeds, Hull, Newcastle, Manchester and the Midlands, ALP offers a prime location central to the UK.
Case Study:
Green Port Hull and Paull EZ

The vision for ABP’s Green Port Hull project is to create a world class renewable energy hub. By capitalising on Hull’s location close to the major Round 3 wind farm zones, and with a portfolio of 500ha of deliverable development land around the port and its hinterland, all investor requirements can be catered for; from major manufacturing facilities, business parks, research and development and operations and maintenance developments servicing the renewable energy sector.

Green Port Hull will involve the regeneration of Alexandra Dock, an existing port complex that is directly adjacent to a natural deep-water channel that is perfectly positioned for the receipt of import cargo, component manufacture and the dispatch of the turbines for installation at the wind farms out at sea. The development will comprise of a facility for the assembly of wind turbine equipment, together with component storage areas, offices and car parking, in addition, a new 600m riverside berth will be constructed for the export of wind turbine components.

The Green Port Growth Programme expects to:

- Increase GVA by £300m
- Up-skill and train up to 1,900 local people
- Develop over 90ha of brownfield land and bring forward 70 ha of greenfield sites
- Secure £280m of large inward investment
- Assist up to 650 local businesses to diversify and enter the supply chains of major renewables investors and their suppliers
- Establish Hull as a Centre for RDI for the renewables industry
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