

**Appendix (b) Section 19  
December 2013 East Coast Surge**



Boston flooding – photo taken by Lincolnshire Fire & Rescue December 2013

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## **1. Executive Summary**

On 5 December 2013, we saw the most serious tidal surge in over 60 years, with the highest water levels recorded on the Lincolnshire coast. In total, 2,400 properties were affected along the east coast of England, with 819 in the Lincolnshire Lead Local Flood Authority area. In Boston, 803 properties were affected, the other locations were Trusthorpe, Skegness and Gibraltar Point.

The incident occurred during a high spring tide period which, when combined with a surge peaking at approximately 2 metres, resulted in numerous communities at risk of flooding from the sea. The flood was between a 1 in 400 to 600 year annual exceedance for The Haven at Boston.

The surge was forecast in advance - on Sunday 1 December, 5 days before the incident, there were signals that a large surge could affect the east coast. This provided valuable time to implement pre-prepared plans and procedures. As confidence in the forecast increased, tailored actions and services were initiated, such as the provision of a Flood Advisory Service for our professional partners and the public.

The Environment Agency worked well with partners in the lead up, response and recovery phases of this incident.

It is important to recognise the performance of our defences. The extreme weather impacted the 345km of coastal and tidal assets in the Lincolnshire and Northamptonshire Area causing damage at numerous locations notably Boston. Over 99.98% of our defences held and protected communities at risk of flooding.

## **2. Purpose of document**

This document was produced by the Environment Agency to be appended to the 'Section 19 Investigation Report - Overview of coastal surge flood event during 5th, 6th & 7th December 2013'.

### 3. Extent of flooding

This section details the extent of the flooding and the associated impacts. Figure 1 below demonstrates the distribution of the flooded properties along the East Coast showing that the South Humber Bank and Boston were locations that were significantly affected.

Figure 1 – Properties flooded during December 2013 in Lincolnshire and Northamptonshire Area

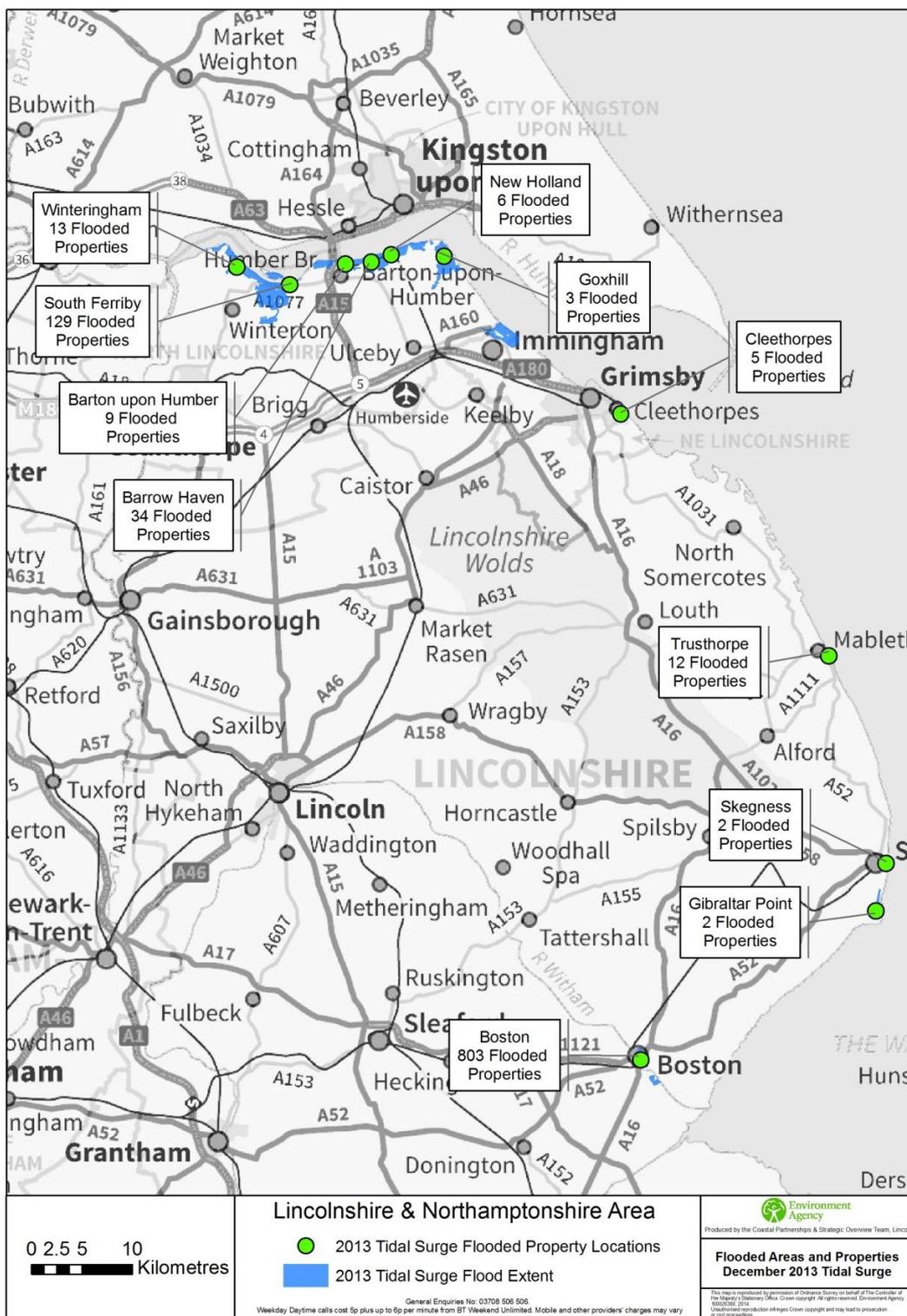


Table 1 Known impacts in the Lincolnshire LLFA area

	Residential property flooded	Commercial property flooded	Agricultural land inundated (ha)
<b>Lincolnshire Coast</b>			
Breach at Tetney Marsh	0	0	20
North Cotes	0	0	0
Mablethorpe	0	0	0
Trusthorpe	12	0	0
Skegness	0	2	0
Gibraltar Point	1	1	0
<b>The Wash</b>			
Boston	688	115	0
Friskney (Jubilee Bank)	0	0	200
<b>Total</b>	<b>701</b>	<b>118</b>	<b>220</b>

The following sections have been divided into 2 coastline reaches and provide more detail of the extent and impact of flooding

### 3.2 Lincolnshire Coast

Sea defences between Saltfleet and Gibraltar Point reduce the risk of flooding to 23,000 homes, 35,000 hectares of farmland, Europe's largest concentration of caravans and regionally important tourism. A large area of land behind the defences is below sea level.

The main defence mechanisms along the Lincolnshire coastal frontage are a combination of dunes, sea walls and beach re-nourishment which has been the agreed preferred option of managing coastal flood risk in Lincolnshire since 1994. The beach re-nourishment scheme, the Lincshore project, reduces flood risk along the 20 km of Lincolnshire coastline from Mablethorpe to Skegness by annual beach nourishment. The main concern is the lowering of beaches over the central 20km long section of the frontage due to the shortfall in sediment supply. The sandy beaches are underlain by clay, critical to the stability of the sea wall. While clay erodes less than sand, it cannot be replaced, so avoiding beach erosion and abrasion of the clay is critical to the long-term sustainability of the defences. Lower beach levels, associated with high surge tide levels, also make the seawalls more susceptible to wave attack and resultant overtopping.

Flood protection provided by the current defences equates to a 1 in 200 year standard of protection (or 0.5% annual chance of flooding).

The overall impacts along this part of the coast were not significant in terms of damage to property, however coastal defences were damaged. The dune system north of Mablethorpe was eroded significantly by the surge with approximately 55,000m<sup>3</sup> of material lost.

The following sections detail the key locations where properties and / or assets were affected by the incident:

### **3.2.1 Breach at Tetney Marsh**

#### **3.2.2 North Cotes**

#### **3.2.3 Mablethorpe**

#### **3.2.4 Trusthorpe (12 properties)**

#### **3.2.5 Skegness (2 commercial properties)**

#### **3.2.6 Gibraltar Point (2 properties) - Bulldog Bank**

### **3.2.1 Breach at Tetney Marsh**

Tetney Marsh lies south of the village of Humberston and the Thorpe Park caravan park and adjacent Fitties chalet park. The flood plain contains 188 residential properties, 12 commercial properties, an oil storage depot and an Anglian Water Waste Water Sewage Works.

#### Defences (maintenance and recent capital investment)

The tidal defences across the 3km Tetney Marshes frontage consist of a 2.5m high earth embankment with an extensive saltmarsh and accreting foreshore. Frequent maintenance is undertaken at an annual cost of approximately £2500/km.

#### Damage to defences

The initial surge on 5 December 2013 damaged the earth embankment and as a result of the high tide on Friday morning a breach occurred. The banks consist of local materials, mostly sand and estuary alluvium.

The eroded material from the breach was washed into the adjacent local Internal Drainage Board system at the rear of the bank. From here most of the flood water ran southwards into the Louth Canal, upstream of Tetney Haven sluice. This led to short-term and localised flooding to approximately 20 hectares of arable land, together with raised water levels in the ditch network through the caravan park. This dissipated within a few hours. The threshold of the breach was slightly below the saltmarsh foreshore and within the normal tidal range of spring tides.



Breach at Tetney Marshes.

### 3.2.2 North Cotes

North Cotes is a small village at the very southern part of the mouth of the Humber, south of Cleethorpes. It has a population of 703 and forms part of a string of marsh villages across the extensive coastal flood plain.

#### Defences (maintenance and recent capital investment)

The tidal defences between Tetney Haven and Grainthorpe Haven consist of large earth embankments up to 3.5m high. The accreting foreshore consists of established saltmarsh and very wide inter-tidal beaches.

Since 2012 much of this frontage has had the tidal defences strengthened and raised to 6.0m AOD, using locally sourced material. This was undertaken to raise the standard of protection to a 1 in 200 standard of protection (or 0.5% annual chance of flooding), with an allowance for predicted sea level rise.

#### Properties affected and damage to defences

While no properties or agricultural land were affected, the defences were damaged over a length of 400m. The majority of the damage occurred to the sandy areas along the seaward face of the defence embankment up to a maximum depth of 0.6m. It was evident the damage was limited to the areas of embankment where there was a narrower saltmarsh across the foreshore.



Damage to seaward face of embankment, primarily occurring up to the original crest level.

Where overtopping had occurred due to wave action, there was a limited amount of scour to the landward face.

### 3.2.3 Mablethorpe

Mablethorpe is a small seaside town with a population of 11,700. The town hosts many small caravan parks making tourism one of the largest industries.

#### Properties affected and damage to defences

There were no properties affected by flooding, however the dune system north of Mablethorpe suffered considerable erosion.

Current estimates of beach losses are 55,000m<sup>3</sup> between transects MB027 and MB063 (see detailed plan on page 8). This volume is based on differences from the newly formed beach profile to approximately 100m seawards, over a shoreline length of approximately 2,250m.

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Detailed plan of sand dune erosion area on the left and area used to borrow sand for the nourishment on the right.



Dunes to north of Mablethorpe- considerable amount of dune system washed away. The remains of the old fence lines can still be seen.



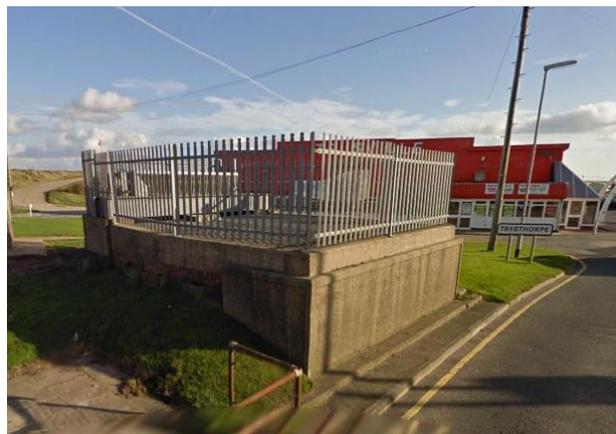
### 3.2.4 Trusthorpe

Trusthorpe is a small village in the East Lindsey District of Lincolnshire. It is situated 2 miles (3.2km) south from Mablethorpe and 12 miles (19km) north from Skegness.

#### Properties affected and damages to defences

12 properties were affected by flooding in Trusthorpe. Water travelled up the surface water outfall through the non-return flap valve. The differential in water height

resulted in a large volume of water spilling out of the chamber into the surrounding area behind the defences – see photos below.



IDB chamber – photo Google

Overtopping of IDB structure behind Environment Agency defence. Looking south east across Seaholme road.

### 3.2.5 Skegness

Skegness is a seaside town and civil parish in the East Lindsey district of Lincolnshire. It is located 43 miles (69km) east of the city of Lincoln and has a resident population of 18,910. The resort is one of the better known seaside resorts in the United Kingdom.

#### Properties affected and damages to defences

The bowling alley and laser quest were flooded with up to 0.9m of sea water. The main pier remained open, however the bowling alley and laser quest fully reopened in July 2014.

During the surge, the existing stone wall at the rear of Skegness promenade, between the clock tower and pier, collapsed in a number of places by wave action upon the wall.



Photographs taken on 6 December by East Lindsey District Council

### 3.2.6 Gibraltar Point – Bulldog Bank

Gibraltar Point National Nature Reserve is an area of approximately 4.3 km<sup>2</sup> (1.7sqmi) in Lincolnshire.

The reserve is owned by Lincolnshire County Council and East Lindsey District Council and is administered by the Lincolnshire Wildlife Trust. The reserve comprises 2 parallel ridges of sand dunes—the east dunes and the west dunes—separated by approximately half a kilometre of salt marsh; and an area on the seaward side with further salt marsh and sand, shingle and muddy beaches. The reserve extends for approximately 3 miles (5 km) along the coast, from the southern end of Skegness to the northern corner of The Wash (Gibraltar Point itself is at the southernmost tip, and marks the point where the North Sea coast turns southwest towards Boston). A golf course occupies much of the west dunes (the inland side) at

the Skegness end of the area. Gibraltar Point is an area of coastal deposition—at the end of the 18th century the west dunes were by the shore, but they are now a kilometre inland.

The reserve's importance is recognised by its various designations:

SSSI (Site of Special Scientific Interest);

NNR (National Nature Reserve);

Ramsar wetland site (wetland of international importance);

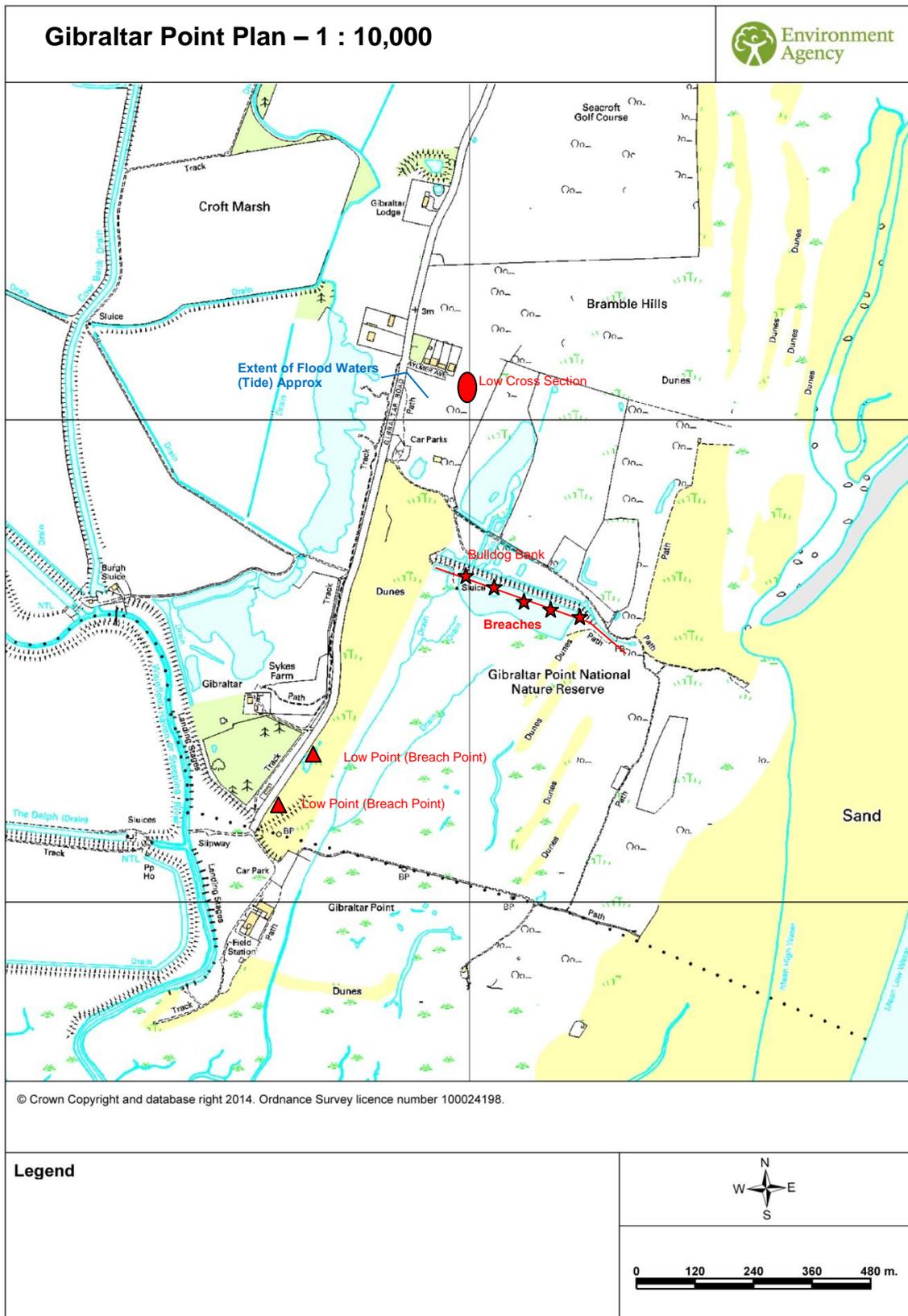
SPA (Special Protection Area).

#### Properties affected and damages to defences

Gibraltar Point Coastal Reserve – Lincolnshire Wildlife Trust Reserve, cafe flooded and sea water entered reserve.

#### Bulldog Bank:

On 5 December, the water level came over the primary tidal defence, Bulldog Bank, which runs east to west across the Lincolnshire Wildlife Trust site at Gibraltar Point. This bank separates the freshwater part of the site on the north from the saline marshland side to the south (see site layout on page 12). The flood waters inundated the visitor centre and the attached annex property, occupied by the Wildlife Warden. These properties are located on the tidal side of the flood defences. There are a number of other properties on the inland side of the defences that could be affected by the flood waters. Access routes to houses became inundated and parts of the golf course to the north of the wildlife reserve suffered from flooding.



The flood waters encroached (see plan above) into the nature reserve (marshland) area and began to overtop Bulldog Bank sea defence. This caused erosion across the top of the bank and subsequent breaches occurring.

This inundated the freshwater section of the nature reserve causing saline damage to the area. The water continued northwards to the east of Gibraltar Road onto Seacroft Golf Course, flooding the fairways and greens between the raised/landscaped banks towards the Club House.

The tidal waters also flowed through a number of low points of the sand bank alongside Gibraltar Road towards the southern end (near Sykes Farm). The flow of flood water then traversed along Gibraltar Road northwards, mainly along the highway as this is at a lower level and the roadside dykes. The water also spread out westwards behind Sykes Farm (lower land). The extent of the flooding northwards along the road was to the junction of Aylmer Avenue and to the high point in Gibraltar Road.

As far as we are aware, no properties to the north of the visitor centre (sea defence bank) were flooded, however access was cut off for a short period due to flooding of the highway (one property owner had to be rescued).

The Wildlife Trust Visitor Centre was flooded along with the annexed warden's property, however these were on the tidal side of the defences and therefore did not have any sea bank protection.

Additionally the water seeped under the flood barrier across the road at the visitor centre car park entrance.



Bulldog Bank breach – Photo Taken by C J Helicopters

### 3.3 The Wash

The Wash is a large coastal inlet, with a surface area around 615 km<sup>2</sup>, which opens out in to the North Sea. It has 4 tidal rivers, the Witham, Welland, Nene and Great Ouse, which all drain into The Wash.

Raised earth embankments separate The Wash from the coastal floodplain. These flood defences provide protection to a significant area of low-lying high quality agricultural land (grade 1 & 2) and a number of coastal settlements, which include Boston, Spalding, Holbeach, Long Sutton, Sutton Bridge, King's Lynn and Hunstanton.

The edge of The Wash is characterised by salt marsh and mud flat. This relatively high foreshore plays an essential role as a natural flood defence by absorbing incoming wave energy and therefore reducing wave attack on the sea banks.

The main strategic sea defences around The Wash did not breach with the exception of 1 privately owned and maintained frontline (non-strategic) known locally as Jubilee Bank, which breached in 2 locations, flooding 200 hectares of land.

### Defences

Most of the raised flood defences in The Wash are grassed earth embankments, known as sea banks. The large expanse natural salt marsh and mud flat in front of these earth embankments absorbs wave attack and forms part of the overall sea defence in reducing coastal erosion, protecting the low-lying floodplain area behind the sea banks.

At a number of places behind these main frontline defences, the remnants of secondary and tertiary lines of defences exist in the form of old sea banks. These old banks provide evidence of the stages of land claim that have been carried out over many centuries. Most of which have no formal flood defence status.

The following sections detail the key locations where properties and / or assets were affected by the incident:

#### **3.3.1 The Haven - Boston (approx 800 properties)**

#### **3.3.2 Friskney - Jubilee Bank**

#### **3.3.1 The Haven - Boston**

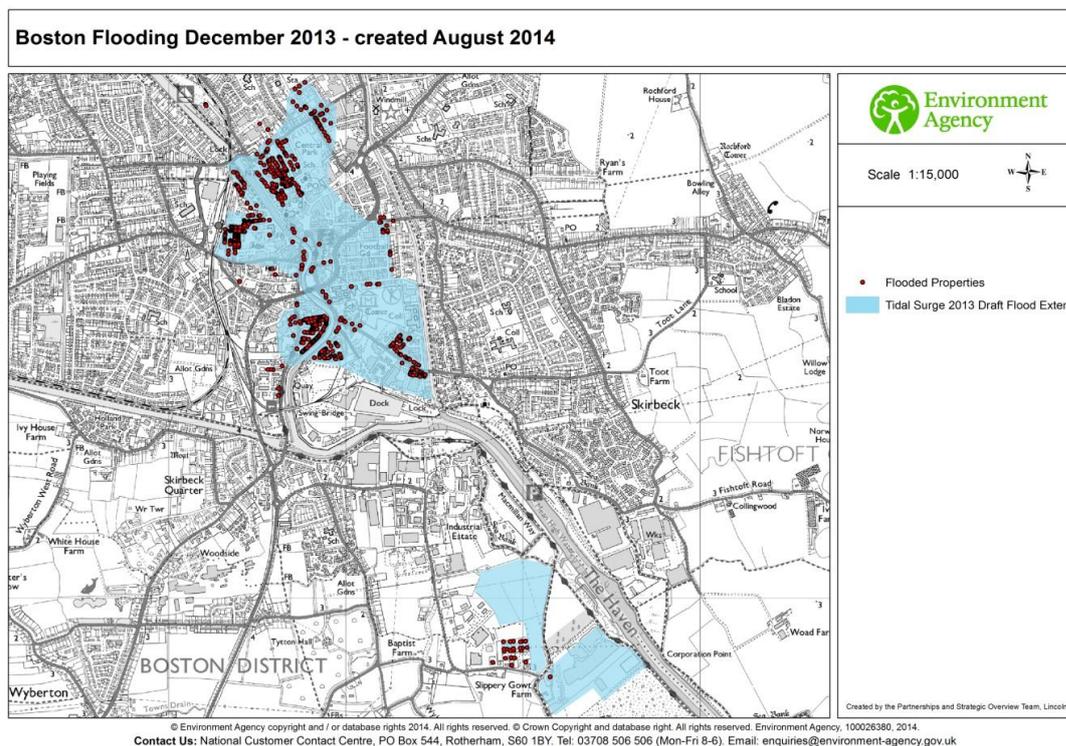
The market town of Boston lies within the River Witham catchment on the tidal reach called The Haven. It is 10 km inland of The Wash, in the heart of the low lying fens, much of which is at or below mean high water spring tide levels. Boston Borough has a population of around 65,000 and has a higher number of properties at significant risk of flooding than any other local authority area in England and Wales (around 25,000, approximately two thirds of the Borough's properties).

#### Defences (maintenance and recent capital investment)

The tidal defences from The Wash are raised earth embankments ranging between 6.20m - 6.70m AOD and offer a 1 in 200 standard of protection (or 0.5% annual chance of flooding). The tidal defences through the town consist of masonry brickwork, sheet piles with some earth embankments at around 6.0m AOD offering a 1 in 50 standard of protection (or 2% annual chance of flooding).

### Properties affected

Within the Boston area, 803 properties were affected by flooding - 688 residential properties and 115 commercial properties



On the evening of 5 December 2013, at approximately 6.30pm, water levels exceeded 5m in the Haven and the positive pressure on the flood defences resulted in seepage at various locations through the town between Black Sluice Pumping Station and Grand Sluice. As the tide continued to rise above 6m, around 7pm, the majority of the flood defences throughout the town over-topped and continued to do so until levels started to recede an hour later. The large volume of water resulting from seeping and over topping of defences inundated the areas shown in the flood extent map above.

In total 803 properties were affected by flooding including Boston College, Boston Grammar School, leisure centre, bus station, Boston Stump (pictured on page 16) and Black Sluice Pumping Station.



The walls of The Stump (right hand picture) recorded the height of the 1953 flood. The water marks from the December surge are well above these.



Boston, Lincolnshire – 6 December 2013



Boston flooding – photo taken by Lincolnshire Fire & Rescue



James Street, Boston



Skirbeck Road, Boston - photo taken by Lincolnshire F&R

### Damages to defences

The surge damaged the defences in the St Ann's and White Horse Lane area of the town, Bath Gardens, Slippery Gowt, the Black Sluice Pumping Station wall and Jakeman's Slip.

### St Ann's / White Horse

This section of The Haven has an existing sheet piled wall to retain the channel, this was in the process of being replaced with a new line being driven directly in front of the existing line. The height of the retaining wall is approx 4.80m AOD, with a landward flood wall set back from the retaining wall, at a height of 6.00m AOD, (height of flood wall above ground is approximately 1.00m). A grassed earth bank rises up to the base of the flood wall. As the tide reached a maximum height of 6.08m AOD, the pressure from the tide initially forced water through the grassed embankment through and around the flood wall foundations, the defences were eventually overtopped leading to properties being flooded.

### Bath Gardens

The tidal surge on 5 December 2013 exceeded defence heights at its peak through the town, leading to major defence seepage and overtopping. This led to a partial collapse of a 10m section of a flood defence brick wall structure at Bath Gardens. This contributed to the flooding of properties on the left bank.

### Slippery Gowt

Slippery Gowt is a locally known area located immediately downstream of Boston on the right hand bank.

The primary defence is an earth embankment first built in the 1930's. The Boston Barrier Scheme had identified that improvement works were required.

During the surge, the primary defence line (earth embankment) was breached to a width of 30m to 40m, flooding the landfill lagoons behind. Flood waters overtopped at a couple of low spots and through an open culvert in the old sea bank. This flooded neighbouring farmland and properties, mainly commercial, on the Haven Business Park off Marsh Lane.



Slippery Gowt - picture taken on 6 December 2013.

### Black Sluice Pumping Station wall

The tidal surge on 5 December 2013 exceeded defence heights at its peak through the town leading to major defence seepage and overtopping of the wall running along London Road in front of the Pumping Station.

Flood water filled up the basement and first floor submerging 5 diesel pumps and the main control cabinet. This caused temporary loss of the electricity supply and damage to the diesel pumps and gearing.

### Jakeman's Slip



Bank slippage - Boston

This area, just downstream of Grand Sluice on the left bank of The Haven did not show signs of movement following the 5 December tidal surge. The first signs of movement followed the New Year high tide

### Roads

A number of major roads were flooded resulting in them being closed during the evening of 5 December. By the morning flood waters had receded and the Highways Agency were able to inspect the road surface for damage.

### Port of Boston

There were a number of locations throughout the town where defences, including the port frontage, were lower than the maximum tide level. As a result the port suffered widespread flooding with depths ranging between 0.3m and 0.5m depending on ground levels. We have no further information on impacts to the port following the tidal surge.

## **3.3.2 Friskney - Jubilee Bank**

### Defences (maintenance and recent capital investment)

There are 3 lines of sea defence along this section of The Wash frontage. There is a former landward 1800's bank, in front of that there is a 1947 strategic sea defence line, which the Environment Agency maintain and in front of that there is a 1977 private earth embankment line known as 'Jubilee Bank'. Jubilee Bank runs from Horseshoe Point in a north easterly direction along the Wrangle Flats.

The approved Shoreline Management Plan for The Wash sets out the policy on how defences should be managed over the plan period with private owners permitted to manage private defences with no public investment.

### Properties affected and damages to defences

The tidal surge on 5 December 2013 caused the 1977 private line to breach in 2 separate locations (approx breach width 30-40m each) resulting in approximately 200 ha (500 acres) of grade 1 farmland being inundated in the flood cell between the

strategic 1947 line and the private 1977 Jubilee Bank line. The landowner used 1 tonne filled bags to provide a temporary defence line to prevent further sea water from entering the site. Due to land levels the water was unable to fully drain away by gravity and required pumping out. The picture below was taken on 6 December 2013, and highlights the extent of the impact.



## 4. Recovery

Following the major east coast surge on the 5 December 2013, a Recovery Manager was appointed at both the Regional and Area offices to co-ordinate activities. Considerable damage had been done to numerous defences along the coast and priority actions were underway from an early stage.

Total Environment Agency spend for Lincolnshire LRF following the tidal surge was £8.1M, split as follows:

- Boston £2.9M (13/14 £1.8M and 14/15 £1.1M)
- Lincolnshire East Coast and Wash £5.2M (13/14 £3.4M and 14/15 £1.8M)

### 4.1 Lincolnshire Coast

#### 4.1.1 Emergency and urgent repair works

##### Tetney Marsh breach

The repair of this breach was a priority as the bank reduced flood risk to 188 residential and 12 commercial properties, an oil storage depot and an Anglian Water Waste Water Sewage Works.

As a precautionary measure ahead of the predicted tides on 15 December, a small earth bund, within the breach, was constructed on 14 December to give some protection in the event that there was another tidal surge. Work to affect a full repair started on 16 December and was completed on 23 December in time for predicted high tides around New Year.

The repair work involved the transportation of approximately 3000 tonnes of material by road and then to site by tracked dumper along 2km of existing raised flood bank to the breach. The work was undertaken using a local Environment Agency Framework.



Breach on morning 06.12.13



Tetney Marsh breach repairs – 20.12.13

The total cost of the repair work was £145,000.

### North Cotes

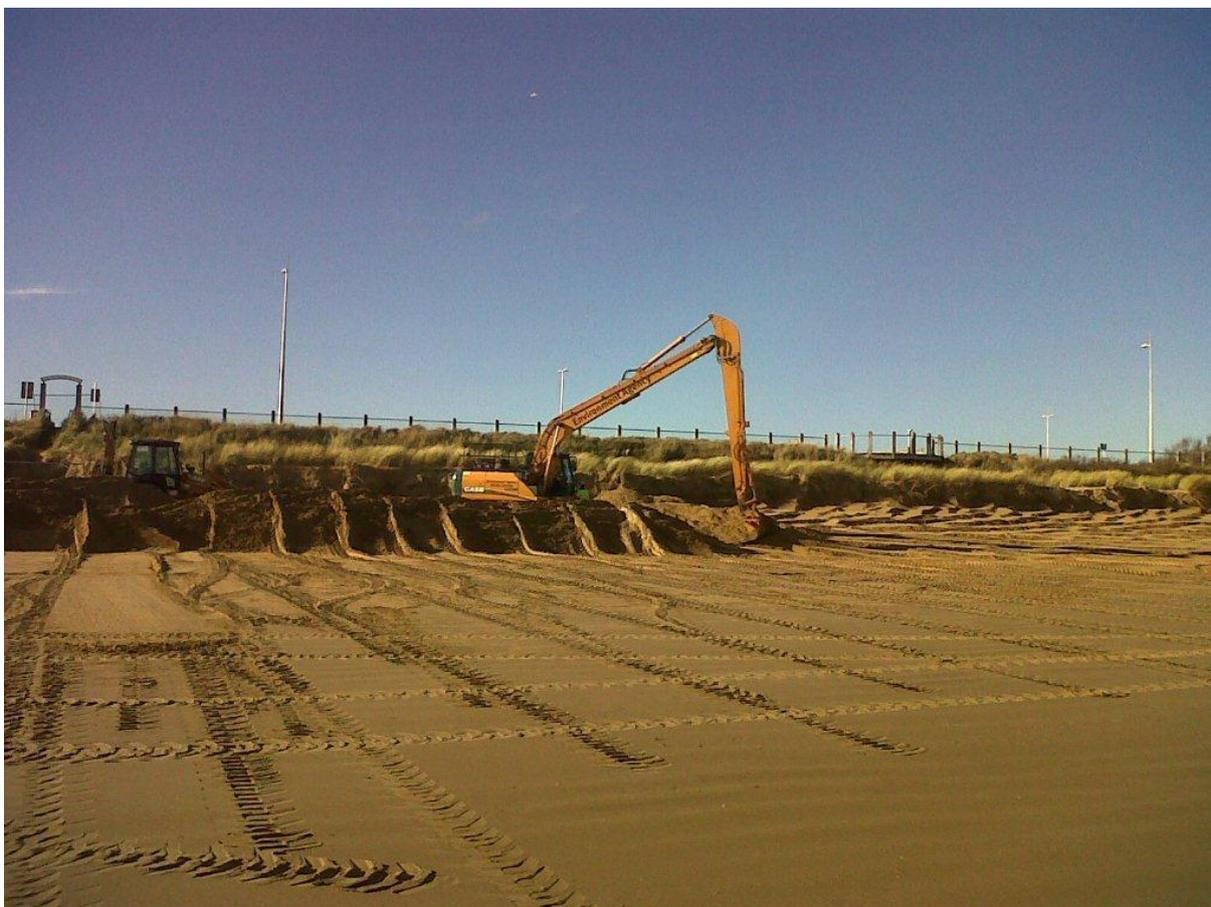


Limited repair works completed by Birse in Feb 2014

We carried out initial repairs to this damaged section to ensure that the residual flood risk remains low. A further programme of works to complete a full repair will begin in August with an estimated cost of £110k.

### Mablethorpe

On the 6 December, the Environment Agency's emergency work force was on site to reinforce the areas most of risk, in particular the north end of Mablethorpe North Car Park and dune system (see photo below).



Following significant sand dune erosion north of Mablethorpe after the storm surge, emergency beach recharge and dune management has been undertaken to maintain the beach/dune system between Mablethorpe outfall and the southern limits of designated conservation sites. The works were completed in April 2014.



Mablethorpe emergency works



Mablethorpe emergency works

The emergency works consisted of replacing 55,000m<sup>3</sup> of material that was lost. £4.05 million was allocated to repair the damages in this area caused by the surge.

### Skegness

During the surge incident the existing stone wall at the rear of Skegness promenade between the Clock tower and Pier was effectively destroyed in a number of places by wave action upon the wall.

Temporary defences were put in place by the Environment Agency's emergency work force to prevent further flooding in the short-term. Discussions are currently under way with East Lindsey District Council to agree Partnership Funding for a permanent solution.

This work to construct a permanent flood wall will be undertaken as part of a local regeneration scheme in October.



Damage to the flood wall

### **4.1.2 Residual flood risk measures**

This section provides detail on the areas where works were not deemed as emergency but were required in order to re-instate the standard of protection.

#### The coastline between Mablethorpe and Skegness.

The annual beach nourishment campaign (Lincshore) ran between April and June 2014, replenishing the material lost over the last year. Over a 20 km stretch, there were 6 areas being re-nourished in this year's campaign:

- Area 1 – Mablethorpe, Trusthorpe and Sutton on Sea
- Area 2 – Boygriff
- Area 3 – Huttoft and Moggs Eye
- Area 4 – Wolla Bank and Chapel Six Marshes

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- Area 5 – Trunch Lane
- Area 6 – Ingoldmells

Below is a map of these areas.

The estimated quantity of materials required to nourish all areas is 520,000m<sup>3</sup>



Photos of the beach re-nourishment



Before nourishment works in early 1990's



Following re-nourishment works -2009

The present campaign, between 2010 and 2014, cost £36m (approx £7m/year).

Gibraltar Point – Bulldog Bank

This area was not identified as a priority for emergency works.

The Environment Agency is currently looking into the future of the Bulldog Bank sea defence. The published Shoreline Management Plan (SMP) shows the policy for this frontage, in the short to medium term, to be 'Hold the line' subject to funding and approvals.

If we are unable to secure funding for a repair we will need to consider alternative options. This may include seeking contributions towards the repair of the bank or re-alignment. We are aware Natural England has expressed a desire to set back the bank, allowing a more natural tidal creek system to form. We will continue to engage with them to agree the most appropriate way forward.

We will consult all interested parties, including Natural England, local councils, the Lincolnshire Wildlife Trust and the local residents and businesses if there is a change from the agreed SMP policy.



Breach point in Bulldog Bank Sluice

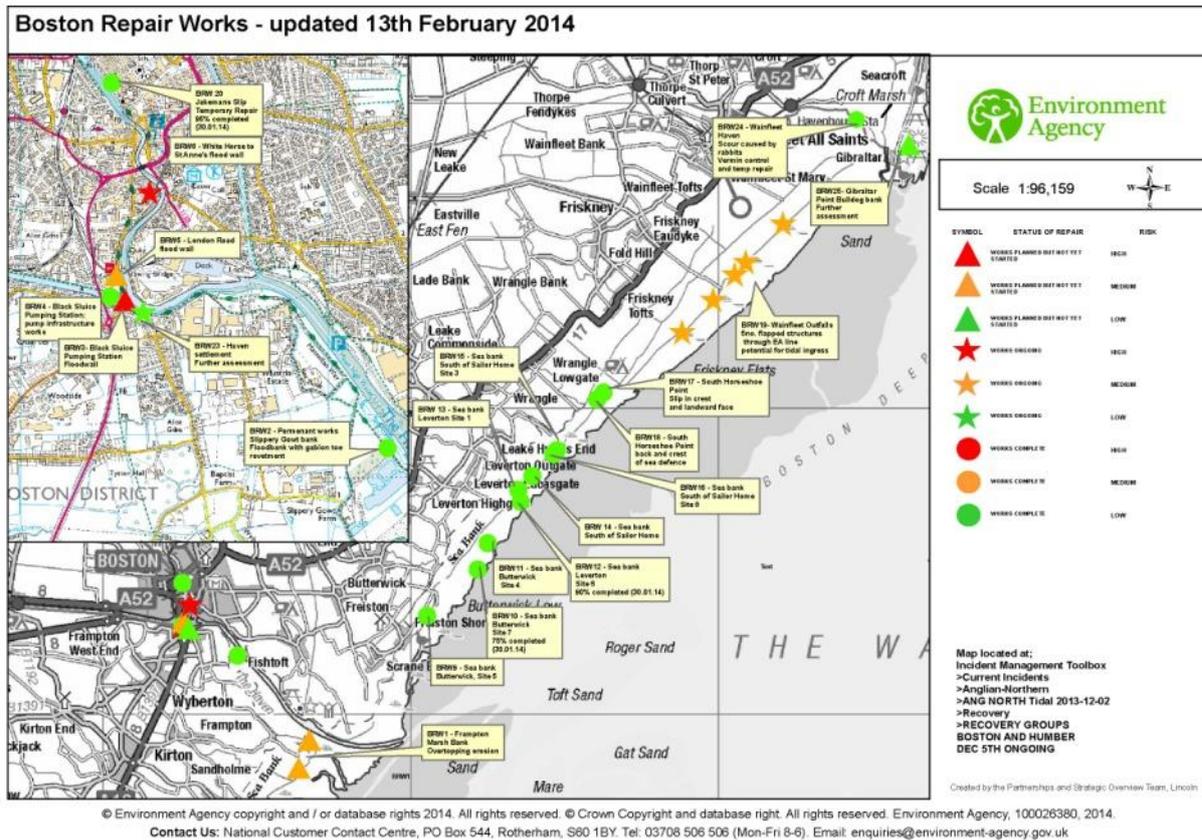


Secondary bank with sluice

## 4.2 The Wash

### 4.2.1 Emergency and urgent repair works

We produced a map for all sites within the Boston area and Wash frontages that were affected by the tidal surge. All sites were inspected immediately after 5 December and a priority order for repairs was identified.



Flood Warning thresholds were adjusted and remained in place until April 2014, when the flood defences were fully repaired. We maintained a constant dialogue with partners at the Recovery Group chaired by Boston Borough Council and provided them with ongoing assessments of flood risk.

We are currently preparing the Transport and Works Act Order for the Boston Barrier Scheme. We will submit this to the Secretary of State for the Environment during autumn 2015. Subject to approval, we plan to start construction on site during summer 2017. The barrier will take to 2.5 years to complete.

#### Slippery Gowt

Following the 40m wide breach at Slippery Gowt, an immediate temporary repair was completed during December to secure the defence. We used 300 tonnes of stone with 3m sheet piles driven along the front face. The contractor worked 14 hour days, using floodlights to allow them to work in darkness, to ensure the works were completed as quickly as possible (cost to date £140K). A permanent repair to improve defence stability will be undertaken in October and November 2014.



### Bath Gardens (South Terrace)



The tidal surge led to partial failure of a 10m section of a brick flood wall at Bath Gardens. Sand bags were used, not only to temporarily secure the opening, but also afterwards to protect the new brickwork against subsequent New Year high tides (cost to date £130K).

### Black Sluice Pumping Station

The tidal surge caused seepage and overtopping of the wall running along London Road in front of the pumping station. As an immediate precautionary measure to stabilise the wall and to prevent further seepage on subsequent predicted high tides, we used large sand bags with polythene sheeting along the back face. Following a structural survey the sand bags remained in place until the wall was fully repaired, at the end of March 2014.

Flood water entered the pumping station and filled up the basement and first floor submerging 5 diesel pumps and the main control cabinet. This caused temporary loss of the electricity supply and saline intrusion to the diesel pumps and gearing. While the pumps could have been repaired over time, a decision was taken with partners (the Black Sluice Strategy had already identified the number of pumps required to operate the catchment could be reduced) to only recover 2 of the pumps. These were back in full working order by the end of December 2013 (cost to date £300K).

### Jakeman's Slip

This area, just downstream of Grand Sluice on the left bank of The Haven started to show signs of movement following the New Year high tide and required 300 tonne of stone to be placed along the toe of the bank to prevent further slippage. This work was completed by the end of March 2014.



### Area between St Ann's Wharf and White Horse Lane (including Oxford Street and Pulvertoft Lane)

Due to the impact of the high tide levels along this section of The Haven, movement of the flood wall was evident in a number of locations and a structural survey was undertaken. The flood wall was repaired along Oxford Street with a new 30m flood wall constructed at White Horse Lane. During these repair works, 1 tonne polythene sand bags were used to support and protect the existing structures from further damage during the New Year high tides. Whilst the new wall was being constructed, demountable defences were put in place to reduce the immediate risk of flooding to 150 properties in the White Horse Lane area in Boston (cost to date £1.3M).



Demountable defences, White Horse Lane

White Horse Lane

### Jubilee Bank

The 2 separate breaches (each approx 30-40m wide) in the Jubilee Bank were not repaired as the land owners have decided to construct a new earth embankment (approx 300m) diagonally across the bottom corner. The work to secure their land will be completed by autumn 2014 (cost unknown).

### Wash Frontages

During the event, the frontage did experience some overtopping in a number of isolated locations, mainly resulting in crest and rear-face soil erosion. These have all been repaired to their original condition.

## **4.2.2 Residual flood risk measures**

### Boston Combined Strategy (approved 2008)

The aim of The Boston Combined Strategy (BCS) is to reduce tidal flood risk on The Haven for the town and wider communities, and provide waterways regeneration. The strategy comprises 5 phases of work, as follows:-

1. New lock structure which facilitates navigation between the tidal Haven and South Forty Foot Drain (Black Sluice Lock). This work was completed March 2009
2. To improve the condition of Environment Agency assets within the Haven, through Boston town centre. This work was completed summer 2014.
3. Design and construct a multi-functional barrier within the Tidal River Haven with associated works: dual function for tidal surge and waterways regeneration.
4. Provision of new enhanced waterways facilities such as moorings, along the waterfront
5. Raising embankment levels downstream of barrier at an appropriate future time.

The Boston Combined Strategy seeks to reduce tidal flood risk on The Haven for the town and wider community from a 1 in 50 standard of protection (or 2% annual chance of flooding) to a 1 in 300 standard of protection (0.33% annual chance of flooding) over the 100 year lifetime of the strategy; providing an improved standard of tidal flood protection to over 15,000 residential properties and 900 commercial properties.

### The Wash

The Wash Banks performance review, completed 2010, did not identify assets requiring immediate attention, with the exception of an area south of Horseshoe Point where bank-raising was required. This work has been identified within our Medium Term Plan for completion.

## **4.4 Community engagement activity**

In the immediate aftermath of the flooding, the focus was on Boston, with staff in the town centre visiting affected businesses and reassuring residents on the Friday and Saturday, particularly along Wormgate and Red Lion Street. Four events were quickly arranged for the following week through our existing partnership working with Boston Borough Council (BBC), Boston Market, Craft Market and Asda, giving people the opportunity to come and speak directly to officers. A further two days of leaflet dropping on 18/19 Dec meant we could talk to people between White Horse Lane and St Ann's Lane, as temporary defences were put up ahead of the next spring tides.

At least 225 out of 921 new Floodline Warnings Direct (FWD) registrations within the BBC area for December can be directly attributed to this initial engagement activity. Virtually all businesses on Wormgate, and St Botolph's church, are now signed up, along with many in the main market place. Most are also helping to promote FWD via leaflets. 4 people came forward as potential new flood wardens (none existed in the town itself previously). Links were made with local councillors, who expressed interest in disseminating flood plans and promoting FWD. There was collaboration with other partners too e.g. Asda and Lincolnshire Police, plus initial links made with local community groups e.g. U3A and Alzheimer's Society.

Contact has been made with those councillors in wards directly affected by flooding – Central, Witham, Skirbeck, Pilgrim and North - to explore how they can be supported further and make their communities more resilient. This has led to opportunities to attend the Boston Community Forum, which in turn has led to additional contacts being made with existing community groups e.g. the Latvian community group 'Stronger Together' and Boston Christian Fellowship.

The Boston Mayflower Housing Association, who own 4,800 homes in Boston Borough is carrying out a number of activities on our behalf to help promote flood resilience

A meeting took place in January to discuss a localised community emergency and flood plan (CEFP) following an approach from the South Ward councillor to the Joint Emergency Management Service (JEMS). This plan could include flood wardens and the creation of localised networks to share information. It is envisaged that this could be used to provide a template/guidance to roll out to the remaining nine ward councillors within the town to help build resilience for the future.

We identified the issue of communication with non-English speaking parts of the community. It is envisaged that these communities could form a local network of 'flood champions' that could cascade messages from FWD during expected flooding in the future e.g. by phone, or door-knocking. It could be possible to identify people for each

ward who can lead on raising awareness of flood risk and who could ‘buddy up’ with those who speak different languages. This could then form part of the CEFP.

The council tax leaflet in Boston included a flyer with photos of easy DIY steps people can take to reduce the impact of flooding on homes and it is in English, Polish, Russian and Portuguese. It has been produced by BBC with the support of partners.

Work continues to share information about flood risk and the Boston Barrier with interested community groups and councillors in wards affected