Greater Lincolnshire Local Enterprise Partnership Growth Strategy

A business case for water management – Outputs to support the Growth Strategy (Full Report)

Report for Greater Lincolnshire Local Enterprise Partnership

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Executive summary

Water management has been recognised as a key barrier or enabler to green economic growth in Greater Lincolnshire. The Greater Lincolnshire Local Enterprise Partnership set-up a Water Management Task and Finish Group who commissioned this project to deliver a draft Business Case setting out the growth potential of investment in water management infrastructure and the options to deliver and fund it.

A targeted literature review identified the pressures on water management across flooding, water quality, water availability, and identified the key growth sectors. Based on this literature review and working with stakeholders the major projects proposed to address these and potential funding gaps were identified.

An analysis of beneficiaries was undertaken to identify businesses and wider stakeholders that would benefit from the proposed projects. Through a geographic information systems (GIS) mapping exercise the properties that would benefit from new schemes were then identified. The major schemes were then analysed in terms of job creation and the wider costs and benefits. Additionally partnerships funding options and alternative funding streams have also been identified.

The main schemes identified and a summary of the costs and benefits is provided below:

Project type	Projects	Total Cost	Growth fund contribution	Appraisal period (years)	PV Benefits to business	NPV (Business benefit - Growth Fund Investment)	Business benefit per £ Growth Fund Investment
FCERM	Lincshore Beach Nourishment Scheme (2015-2020) (Coastal)	£28,400,000	£11,200,000	10	£38,209,226	£27,009,226	3.4
	Horncastle (Fluvial and Surface water)	£7,000,000	TBC	100	£19,932,157	TBC	TBC
	Witham catchment (Fluvial and WFD)	£10,000,000	TBC	100	unknown	unknown	unknown
	Boston (Fluvial and Tidal)	£90,200,000	£2,000,000	100	£6,611,616	£4,611,616	3.3
	Ancholme Valley Improvements (Fluvial)	£5,000,000	Up to £5m	100	£64,464,972	£59,464,972	12.9
Non- FCERM capital investment	Fens Waterways Link Opportunities study (WFD/Waterways)	£150,000	£150,000	10	Could lead to £60m of PV benefits on implementation	Could lead to £60m of PV net benefits on implementation	n/a
	Ecosystem Services in the Fens study (WFD)	£100,000	£150,000	10			
	Spalding Waterspace Study Implementation (WFD/Waterways)	£1,200,000	£1,200,000	10			
	Water for wildlife and farming in the Fens (WFD)	£150,000	£150,000	10			
Non- capital	Fens Integrated Access Plan (Tourism)	£560,000	£560,000	10			
	Destination Fens (Tourism)	£50,000	£50,000	10	£11,750,126	£9,690,126	5.7
	TOTAL	**£142,810,000**	**£20,460,000**		**£140,968,097**	**£120,508,097**	**6.9**

This study suggests that a £20.5m Growth Fund contribution to 11 environmental infrastructure projects in Greater Lincolnshire could unlock approximately 5,440 FTE jobs in total. This equates to just £3,750 of Growth Fund monies per job. In terms of the benefits to business, this investment could unlock over £120m over 100 years (largely to the visitor-economy sector) which approximates to £7 of business benefits for every £1 contributed.

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1 Introduction

1.1 Water management pressures impacting on economic growth

Climate change and population growth are increasing pressures on the water environment and the ecosystem services this provides to society and the economy (Figure 1). These pressures can serve to limit economic growth, however taking an integrated water management approach and developing a business case in partnership with a range of stakeholders can support more integrated approaches to enable growth.

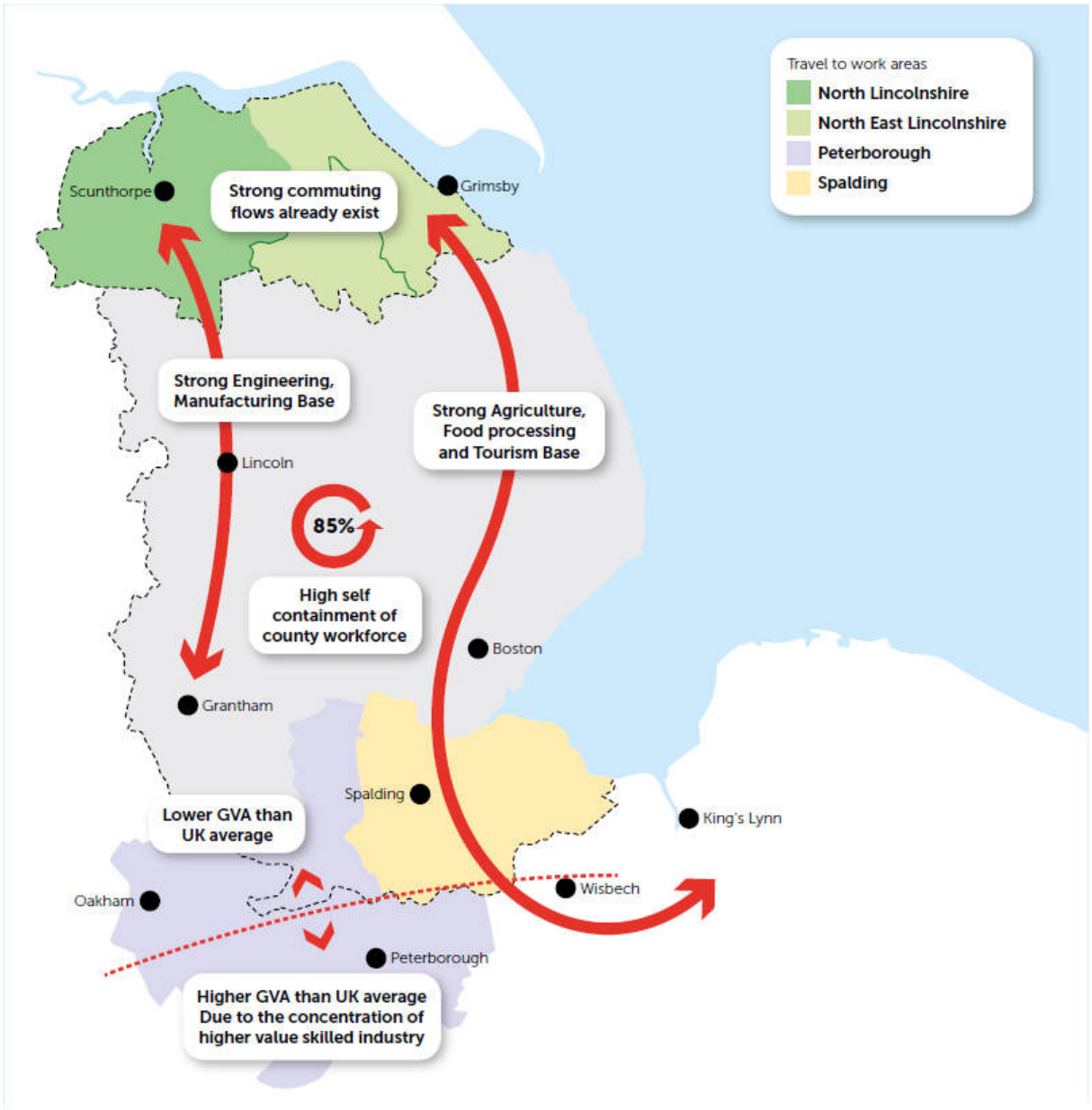
Figure 1: Water management pressures (adapted from CIRIA 2013)

1.2 Greater Lincolnshire Local Enterprise Partnership

The Greater Lincolnshire Local Enterprise Partnership (GL LEP) is a public sector led body aiming to improve infrastructure and business conditions in the Greater Lincolnshire area (Figure 2). The GL LEP includes a population of over one million and covers a wide geographic area with diverse industries including farming, ports and logistics, tourism and engineering.

The GL LEP set-up a Water Management Task and Finish Group in recognition of the important implications of flooding, water supply and water quality issues for enabling economic growth.

Figure 2: Overview of GL LEP area and key features



1.3 Project objectives

The main deliverable of this project is "a draft Business Case setting out the growth potential of investment in water management infrastructure and the options to deliver and fund it". This will meet the following project objectives set out by the Local Economic Partnership:

- To document the unique water management issues within the GL LEP 'rural economy' area
- To document and evidence the importance of agri-food, the visitor economy and ports in the GL LEP area – set in a local, 'regional' and national context – largely drawing together existing material, with minimal new research required
- To quantify, where possible, the costs and benefits of water management investments, using existing cost and benefit information from flood risk strategies and planned

schemes as outlined by the local authority and Environment Agency and the latest available water resource management plan from Anglian Water.

- To identify key growth sectors (agri- food, visitor, ports, housing) enabled by investment in flood risk and water management infrastructure
- To propose options for integrated water resource management that, in the longer term will deliver water security at farm level, and more strategically via water transfers at catchment level, across the GL LEP area.
- To assess the economic, social and environmental benefits of the provision of coastal flood defences
- To identify funding and delivery partnerships that will be required to deliver investment.

1.4 Report Structure

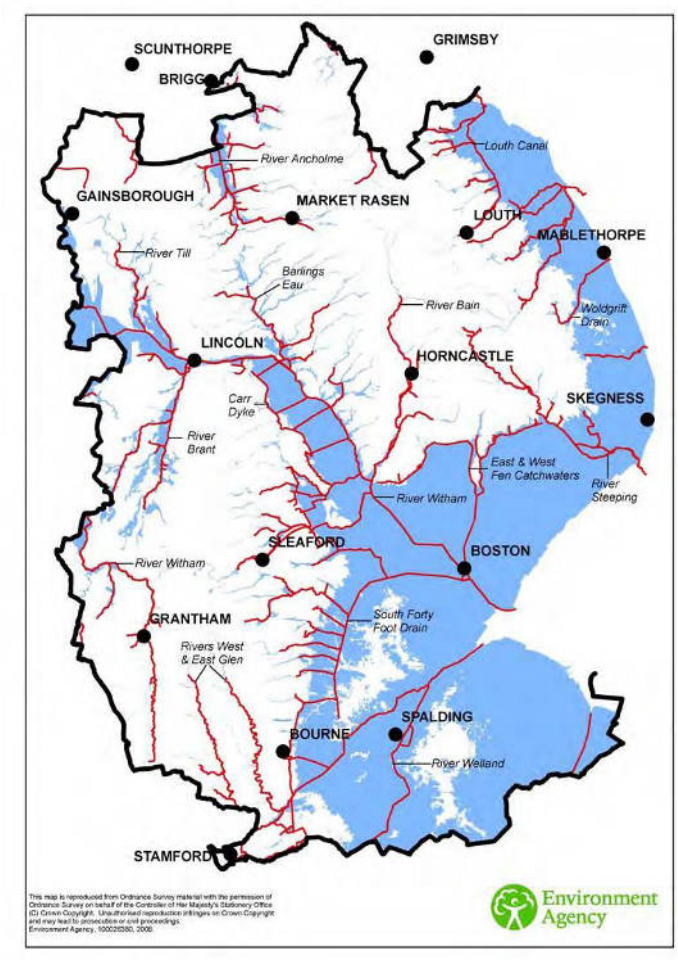
This report outlines the development of the business case for a range of water management options to enable economic growth. Chapter 2 provides a review of the literature covering flooding, water quality and the visitor economy, water availability, and key growth sectors. Chapter 3 provides a beneficiary analysis and outputs from analysis using geographic information systems mapping. An economic analysis for the business case and its impacts are detailed in Chapter 4 and 5, partnership funding options in Chapter 6 and conclusions provided in Chapter 7. An Executive Report providing a summary of the key findings has also been produced.

2 Literature Review

2.1 Flooding

Water management is intrinsically important in Greater Lincolnshire as it is an area of the country naturally susceptible to flooding. Flooding from sea water presents the greatest risk around the Eastern coastal regions owing to the low-lying land, particularly the Fenlands around the Wash and associated with the River Trent and the River Ancholme. With climate change and associated sea level rise the threat of coastal erosion and coastal flooding is set to increase. Fluvial flooding is also a feature of the region and as climate change brings a greater frequency of extreme weather events rivers are less able to dissipate excess water. With an increase in storm surge, coastal and river flooding is predicted to become an ever greater risk to the population, environment and economy in Greater Lincolnshire. Figure 3 shows the extreme flood risk from sea, tidal and river sources where there is a 1% or greater chance of flooding from rivers in any one year, or a 0.5% or greater chance of flooding from tidal/ coastal sources in any one year. The main potential sources of flood risk identified in Greater Lincolnshire are: sea and tidal estuaries/havens; rivers and watercourses; heavy rainfall; surface water run-off and over-flowing sewers; groundwater; canals; and reservoirs.

Figure 3: Extreme flood risk outline from sea, tidal and river sources (Environment Agency)



2.1.1 Coastal Flood Risk

Infrastructure needs

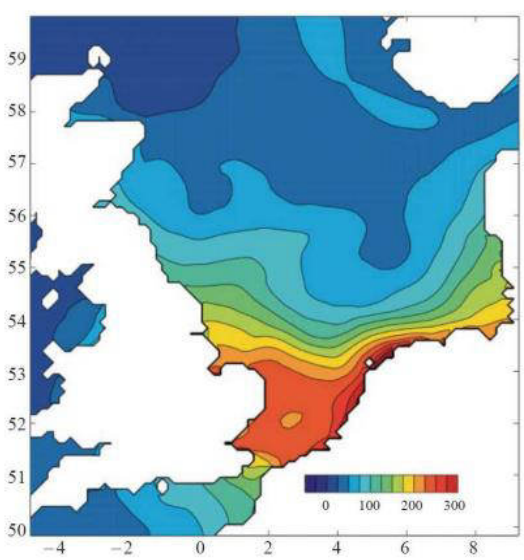
The Greater Lincolnshire coast extends more than 50 miles from the estuary of the Humber to the Wash and is bordered by the North Sea. The coastal zone is mainly flat with much reclaimed marshland to the North of the county and the salt marshes of the Fens to the South. The Greater Lincolnshire coast is of great importance to its economy, as it is home to a number of tourist hotspots and has a vibrant food manufacturing industry. There are also large areas of land dedicated to agricultural production, with approximately 30% of England's vegetable crops grown in Greater Lincolnshire. A high proportion of its most productive land is below sea level, and sea defences in South Holland, along with a desalinisation programme and drainage infrastructure, enable fertile silt land to be used for agriculture[1]. The Great flood and sea surge of 1953, where 42 people died in Greater Lincolnshire, engulfed 98,842 acres of farmland, demonstrated the mass area of land that would be lost if the flood defences were not maintained.

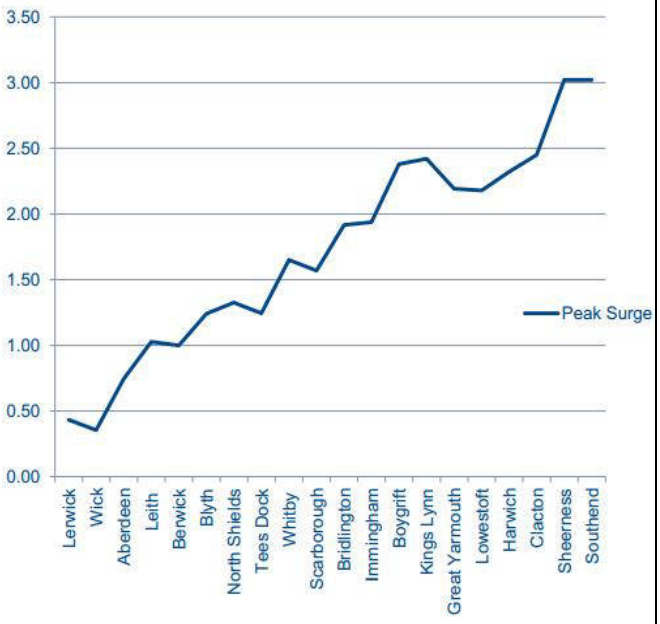
Presently the Fens and coastal flats are protected by 128km of raised sea defences which will require maintenance and investment to continue providing the same level of protection in the future[2]. The current sea defences directly protect 222,000 people or 103,000 households in Greater Lincolnshire's coastal area, 25,000 static caravans and vast expanses of agricultural land. However, the 2013 coastal surge seriously tested these as outlined in Box 1.

Box 1 – The 2013 Coastal Surge

The defences that were built following the 1953 floods were tested during a storm surge in December 2013. This was the most serious tidal surge in 60 years with major flooding occurring in Greater Lincolnshire. Over 1,400 properties were flooded, 6,800 hectares of agricultural land impacted, and major impacts occurred with closure of Immingham Port and damage to broader infrastructure

The surge levels are illustrated below.





A comparison with the 1953 flooding the Environment Agency observed less impacts, however had the wind conditions been different these could have been much greater[3].

[1] Andersons (2011) Future of Food and Farming in Lincolnshire
[2] http://www.lincolnshire.gov.uk/residents/environment-and-planning/flood-risk-management/coastal-flood-risk/112427.article
[3] http://www.coastms.co.uk/resources/695ec460-c3ab-4de3-871c-23fb5ef5200e.pdf

	1953	December 2013
Breaches	1200 different locations	Under investigation
Properties flooded	24,000	1,400 (10/12/2013)
Deaths	307	2 but not flood related
Agricultural Land	65,000 hectares	6,800 hectares
People evacuated	32,000	18,000
Infrastructure	2 Power stations 12 Gas Works 100 miles of roads 200 miles of rail	Major impacts at Immingham Port No power stations and major gas works/services affected Road and rail tbc
Flood Warnings	0	71 severe flood warnings Over 160, 000 warning messages sent directly to homes and businesses

The Flamborough Head to Gibraltar Point Shoreline Management Plan (SMP) presents the preferred options for managing flood and erosion risk along the shoreline area between Flamborough Head and Gibraltar Point[4]. The Plan identifies the current infrastructure protecting the Greater Lincolnshire region from coastal waters and includes an economic appraisal of the costs and benefits of the investment that would be required to protect coastal regions from flooding over the next 100 years, a summary of which can be found in Table 1.

The preferred policy option for the coast region from East Immingham to Cleethorpes is to 'Hold the Line' and maintain the current level of protection over the next 100 years. This area is of relatively significant economic value as it includes a number of industrial and commercial assets as well as agricultural land. A cost benefit analysis was carried out with two 'Hold the Line' options: maintaining a low standard of protection (1 in 10 Year); and maintaining a high standard of protection (1 in 100 Year). The economic analysis, centred upon estimates of avoided national damage demonstrates both these options to be economically viable (Table 1).

Defences at Humberston Fitties include groynes to stabilise the beach and sand dunes reinforced by a rock gabion (front line defence); and a flood embankment to protect against inundation (secondary defence). From the present until 2025 the front line defence will be maintained but the standard of protection is not planned to be increased to account for sea level rise. The secondary defence will be maintained and improved to support the same level of protection. Over the coming 100 years the flood embankment to protect against inundation will be maintained to secure the current level of protection. No details on the quantified costs or benefits of maintenance are available, but it was reported that holding and maintaining the secondary defence would be economically viable due to the associated large flood cell running southwards.

Further analysis is required to determine the best policy option for the front-line of defence at Humberside Fitties. South of Humberston Fitties to Theddlethorpe or St Helen the shoreline is defended mostly by earth embankments. The preferred policy option in this area is to 'Hold the Line' over the next 100 years, which includes the provision of hard defences along the 30 km stretch of shoreline. The estimates of maintenance and future construction costs to hold the line is shown in Table 1. The 'do nothing' scenario uses flood extent and identifies properties that would be inundated, and uses total property values to estimate damages from

[4] Humber Estuary Coastal Authorities Group (2009). Flamborough Head to Gibraltar Point: Appendix H – Economic Appraisal

flooding. It is estimated that from present day to 2025 15% of the total property asset value would be lost due to flooding, from 2025 to 2055 25% of the total property asset value would be lost, and from 2055 to 2105 40% of the total property asset value would be lost. Investment in defences to 'Hold the Line' will avoid these damages and avoid additional local economic shocks felt by lost business days.

Assets within the Greater Lincolnshire region that where evaluated under the SMP included the Viking Gas Terminal (Mablethorpe), located at the southern end of Skegness. This large gas terminal receives and processes gas, including offshore gas (ConocoPhillips). The coast line between Seacroft and Gibraltar Point consists of beaches and sand dunes protecting in lying land from flooding. 'Hold the Line' estimates consider the provision of hard defences along the entire 4.7km shoreline. The 'do nothing' scenario uses flood extent and identifies properties that would be inundated on the stretch of land alongside the boundary, and uses total property values to estimate damages from flooding. It is estimated that, if no infrastructure investments occurred, from the present day to 2025 15% of the total property asset value in the flood cell would be lost due to flooding, from 2025 to 2055 25% of the total property asset value would be lost, and from 2055 to 2105 as much as 40% of the total property asset value would be lost.

South of Gibraltar Point is the Wash, a square mouth coastal inlet of approximately 615km in length and the largest embayment in the United Kingdom. There are four tidal rivers that feed into the Wash and contain drainage structures at their mouths to manage the drainage ability of the rivers. The expanses of salt marsh and intertidal flat areas are an important feature of the Wash and provide a valuable resource for recreation, biodiversity and as a physical barrier. Tidal embankments are an important coastal management feature of the Wash and protect the nearby Fenland coastal plain, whilst the Wash's salt marsh and mud flat provides a natural barrier to coastal flooding. Other coastal defences at the Wash include grassed earth embankments, a maintained shingle ridge, sea walls, promenades, wave return walls and groynes. Old sea banks also provide some protection as former lines of reclamation. This area has a low population of residents but is of high agricultural importance as the Fens produces one third of the country's vegetables at a turnover of £2.5 billion.

The Wash Shoreline Management Plan 2: Gibraltar Point to Old Hunstanton (Appendix H) provides details of the assessment of the cost of managing coastal flooding across the Wash[5]. Gibraltar Point to Woferton Creek is the Lincolnshire area of the Wash that has been included in the economic analysis. The preferred option at this site from present day to 2025 is to 'Hold the Line' but over the next 100 years depending future erosions scenarios 'Holding the Line' could require managed realignment to lessen the pressure on flooding infrastructure and to compensate for habitat lost. The economic analysis for both managed realignment and for 'Holding the Line' is shown in Table 1. 'Holding the Line' will require reinforcement of the current infrastructure to maintain the current protection.

[5] http://www.eacg.org.uk/Docs/SMP4/Appendix%20H%20-%20Economics.pdf

Table 1: SMP Preferred coastal defence policy option and economic analysis (where possible)

Unit	Defences	Timeframe	Option	Capital construction costs (£)	Annual main-tenance fees (£)	PV costs (£)	Undis-counted costs	PV Damage (£)	PV benefits (£)	Benefit / Cost Ratio
East Immingham to Cleethorpes	-	-	Do Nothing	-	-	-	-	279,558,000	-	-
			Maintain Low Standard (1 in 10)			27,492,000		13,500,000	266,059,000	9.68
			Maintain High Standard (1 in 100)			57,358,000		386,000	279,317,000	4.87
Humberston Fitties	Groynes and sand dunes (front line) & a flood embankment (secondary)	Present to 2025	Front line: Maintain current defence (not accounting for sea level rise). Secondary: Maintained and improved	-	-	-	-	-	-	-
		2025 to 2055	Further policy evaluation required	-	-	-	-	-	-	-
		2055 to 2105		-	-	-	-	-	-	-
South of Humberston Fitties to Theddlethorpe St Helen	Hard defences along the entire shoreline	Present to 2105	Hold the line	81Million	£300,000	40,806,255	-	-	88,843,364	>1
Seacroft to Gibraltar Point	Hard defences along the entire shoreline	Present to 2105	Hold the line	9.9Million	£47,000	7,180,685	-	-	11,827,049	>1
Gibraltar Point to River Witham	Realign back to secondary defence line and	Present to 2105	Managed realignment	-	-	23.4 million	72.8 million	648 million (do nothing)	-	28
	Strengthening existing frontline defences		Hold the line	-	-	13.9 million	87.2 million	648 million (do nothing)	-	47

The flood risk management schemes proposed in Greater Lincolnshire for coastal erosion and sea flooding includes a number of projects across as detailed in Appendix I. These are likely to go ahead in the future and are funded or are suitable for funding from a range of different sources e.g. the Environment Agency, Local Authority or Internal Drainage Board. While these projects align to the general needs of the county, one particular coastal flood risk project is singled out as being suitable for Growth Funding. This is because it will avoid a loss of business days and output in business centres and agricultural areas and maintain the visitor economy.

Table 2: Lincshore Beach Nourishment Scheme; suitable for Growth Funding.

Project Name	Funding status	Parliamentary Constituencies	Total Project Cost	RESERVED FCRM GIA funding (£k)	INDICATIVE FCRM GIA funding (£k)				Total Contributions Confirmed
				2013/14	2014/15	2015/16	2016/17	2017/18	
Lincshore Beach Nourishment Scheme (2015-2020) (Coastal)	Proceeding 2015 if funding found	Louth and Horncastle	£28.4m			6,000	5,600	5,600	£11.2 million required

Lincshore Beach Nourishment Scheme is a programme that is currently undertaken every year and involves the maintenance of beaches to provide protection against a flooding event with a 1 in 200 (or 0.5%) annual probability. The scheme runs 30km along the coast between Saltfleet and Gibraltar Point, protecting over 20,000 houses located on the flat floodplains behind the sea defences. It is the largest beach nourishment scheme in the country, and every year the beach is surveyed and if necessary the sand is replenished. In 2013, 530,000 m3 of sand was transferred to the 20km stretch of beach[6].

Replenishing the sand not only supports the shore's natural flood defence capacity, but also safeguards a popular holiday destination. Managing the beach on this popular shoreline ensures that the area remains attractive to tourists who are drawn to the sandy beach and are a vital part of the local economy. The current Lincshore Scheme in place, which is funded by the Defra Flood Defence Grant in Aid, is programmed to continue until March 2015. However from 2015 the Partnership Funding mechanism will mean that substantial contributions from local sources will be required to draw down Flood Defence Grant in Aid. The scale of such contribution is not yet known, but estimates have ranged between 30% and 50% of the total cost of the scheme. A review is being carried out to establish the best option for flood risk management and a trial will take place to help assess which options offer the best long-term suitability.

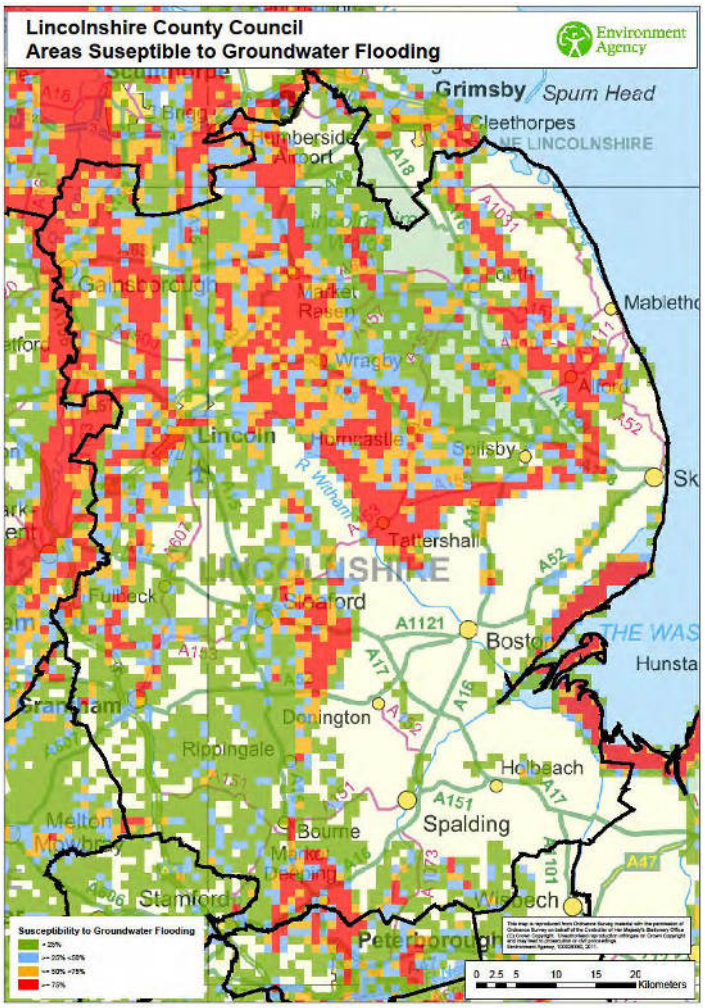
[6] http://www.royalhaskoningdhv.com/nl-nl/projects/lincshore---beach-renourishment/1450

2.1.2 Surface and ground water and flooding

Infrastructure needs

Flooding from surface water occurs when the local drainage system has reached capacity and cannot manage any additional water. Forecasting surface water flooding is challenging as its occurrence is reliant upon ground water levels, rainfall and local water management infrastructure. The Environment Agency Flood Map for Surface Water (Deep) reports 2.3 – 2.6% of properties in Greater Lincolnshire (3,230 - 4,681 properties) to be at risk from surface water flooding. The county has a history of flooding and in 2007 floods caused damage to 2000 properties throughout the county. In the past flood events from surface water have taken place in Lincoln, Louth, Horncastle, Grantham and Sleaford, whilst Sleaford and Bourne have also suffered from groundwater flooding owing to high ground water levels in the underlying aquifer[7]. Surface water flooding interacts with a number of factors including groundwater flooding. Figure 4 shows areas in the county susceptible to groundwater flooding. The Preliminary Flood Risk Assessment for the County reported that future flooding is likely to be in main from surface water run-off as a result of heavy rainfall causing surface water flooding from sewers and rivers. Longer term flooding can take place due to high groundwater levels and over full aquifers. Schemes planned to manage surface water are shown in Appendix 2.

Figure 4: Areas susceptible to groundwater flooding



[7] Preliminary Flood Risk Assessment Report - http://www.lincolnshire.gov.uk/residents/environment-and-planning/flood-risk-management/assessing-the-risk-of-surface-water-flooding-across-lincolnshire/103044.article?tab=downloads

Infrastructure funding status

The Greater Lincolnshire flooding risk management schemes programme of work for surface and ground water flooding includes a number of projects across Greater Lincolnshire as detailed in Appendix 2. Some of these are likely to go ahead in the future and are funded or are suitable for funding from a range of different sources e.g. the Environment Agency. New legislative requirements for sustainable drainage will require these approaches to be implemented in new developments, however the ownership and maintenance of these is still unclear. The case can be made on a more site specific basis for these and it may often be the case that a partnership funding approach between the developer, water company and local authority can lead to improved outcomes.

Projects to be considered for funding

While the projects in Appendix 2 align to the general needs of the county, one project, the Horncastle fluvial and surface water project, is singled out as being suitable for Growth Funding. This is because it will avoid a loss of business days and output in Horncastle. Since the project will manage both fluvial and surface water flooding it is outlined within the fluvial flooding section.

Surface water linked with sewer flooding and combined sewer overflows

Sewer flooding occurs when intense rainfall events and surface water overwhelm combined drainage systems. This also has a negative water quality impact linked to combined sewer overflows and when sewer flooding reaches water bodies. Anglian Water is the main water company serving the GL LEP region. They have identified the importance of a partnership approach to funding since the water companies have little ability to directly control sources of surface water entering combined sewers and they also rely on others for maintenance of sustainable drainage systems. Severn Trent Water also covers part of the GL LEP area.

Anglian Water has outlined in their PR14 business plan a total expenditure of £316m to support regional growth. This includes[8]:

- £117m for water service new connections, housing estate mains and intra-zone transfers of water.
- £59m for sewerage connections and requisitions.
- £112m for additional sewage treatment works capacity to meet increased demand.
- £29m to improve the existing sewerage network to avoid increased sewer flooding and combined sewer overflow events as a result of growth and new developments.

Anglian Water outlined a range of schemes, in their PR09 Business Plan to Ofwat (Table 3) that will address sewer flooding in 2009-2015. Options are currently being developed for the 2014 business plan and we contacted Anglian Water for any priority schemes. Due to the ongoing periodic review process they couldn't commit to any options for this report. The costs and benefits for sewer flooding have also been identified by Anglian Water (Table 4).

It is uncertain how much funding Anglian Water requires for these partnerships, so we have not undertaken beneficiary analysis or cost benefit analysis for these projects. There however, is room for GLLEP to investigate any returns to business from Growth Funding investments in the coming years, as future investment into these schemes have not been ruled out.

[8] www.anglianwater.co.uk%2F_assets%2Fmedia%2FICT_Final.pdf&ei=TY3eUoz6B-TK0QXz7oHQCQ&usg=AFQjCNG4E6RvjGhLBF3CjJ5-DxpBLc-6JA&sig2=YEL8sdBoblc6XriBJbap-g&bvm=bv.59568121,d.d2k&cad=rja

Table 3: Schemes to address sewer flooding, 2009 - 2015

Outputs		Cost allocation		
		Enhanced Service	Base	Supply Demand
Removals from internal register - known problems	213 properties	£69.9m	-	-
Removals from external register - known problems	295 areas	£2.8m	-	-
Mitigation - internal register - known problems	100 properties	£0.5m	-	-
Mitigation - external register - known problems	100 areas	£0.5m	-	-
Mitigation - internal register - new additions	110 properties	-	-	£0.6m
Total		**£73.8m**	**£0.0m**	**£0.6m**

Table 4: Sewer flooding benefit values

Service measure / severity	Descriptor	Private benefit (£k/property/annum)	Societal benefit (£k/property/annum)
Internal sewer flooding - inside	Reduction by one in properties affected each year	£68k	£10k
Internal sewer flooding - under floor	Reduction by one in properties affected each year	£58k	£8k
Internal sewer flooding - uninhabited cellar	Reduction by one in properties affected each year	£58k	£8k
Loss of facilities - all durations	Reduction by one in properties affected each year	£12k	£2k
External sewer flooding - all properties and curtilages	Reduction by one in properties affected each year	£52k	£4k
External sewer flooding - agricultural land	Reduction by one in numbers affected each year	£37k	£3k
External sewer flooding - open areas	Reduction by one in numbers affected each year	£48k	£4k
External sewer flooding - amenity areas	Reduction by one in numbers affected each year	£89k	£8k
External sewer flooding - unknown (any area except domestic premises)	Reduction by one in numbers affected each year	£40k	£4k
External sewer flooding - highways	Reduction by one in numbers affected each yea	-	£6k

2.1.3 Fluvial flooding

Infrastructure needs

Greater Lincolnshire has a vast network of rivers, canals and managed drainage networks. The county's highly productive agricultural land is supported in cultivation by an extensive artificial drainage system. The Internal Drainage Boards maintain 3,800 miles of watercourses and 286 pumping stations across the Fens. Pumps are required to circulate the water around as much of the land is below the level of the rivers that discharge to the sea. The Environment Agency manages 1,024km of rivers with raised embankments in Greater Lincolnshire.

The Preliminary Flood Risk Assessment did not consider canals and reservoirs a significant risk as a flood source. The interaction of fluvial, coastal, surface and groundwater sources was identified as potentially affecting flooding in the future and could take place anywhere behind raised fluvial and coastal flood defences. Sea level rise will increase the risk of flooding in the county. Drainage systems that have been modified to manage current water levels could be developed to help adapt to climate change. A rise in sea water could impact on rivers inland as a result of interactions with drains, sewers and smaller watercourses. The PFRA highlighted the need for sustainable drainage to support adaptation to climate change and a need for local studies to establish the likely effects of climate change impacts on Greater Lincolnshire's water.

Infrastructure funding status

There are a number of river programmes scheduled proposed in Greater Lincolnshire to address river flooding as shown in Table 5.

Projects to be considered for funding

While the projects outlined in Appendix 3 (full list collated during literature review) align to the general needs of the county, a number of projects are suitable for Growth Funding, as shown in Table 5. This is because investing will avoid a loss of business days and output in centres such as Boston, protect important agricultural land and/or encourage tourism growth. Many of these projects are collaborative projects in that as well as reducing fluvial flood risk they enhance river environments and wildlife which improves the attractiveness of a town to work in. Note that the Horncastle project alleviates both surface water and fluvial flooding.

Table 5: Fluvial projects; suitable for Growth Funding.

Project Name	Funding status	Parliamentary Constituencies	Total Project Cost	RESERVED FCRM GIA funding (£k)	INDICATIVE FCRM GIA funding (£k)				Total Contributions Confirmed
				2013/14	2014/15	2015/16	2016/17	2017/18	
Horncastle (Fluvial and Surface water)	Not proceeding before 2014	Louth and Horncastle	£7m	-	1300	-	-	-	Lincolnshire County Council £2.3 million East Lindsey District Council £0.5 million Internal Drainage Board precept £0.3 million Local Levy £2.6 million.
Witham catchment (Fluvial and WFD)	Not proceeding before 2015		£10m indicative	-	-	TBC	-	-	None as yet. Up to £1m required
Boston (Fluvial and Tidal)	Not proceeding before 2017	Boston and Skegness	£90.2m	-			77,200		£11 million confirmed from Lincolnshire County Council. £2 million required to progress or £7.2 million to fast track.
Ancholme Valley Improvements (Fluvial)	Not proceeding before 2015	Brigg and Goole	£5m						None as yet Up to £5m required

Horncastle (Fluvial and Surface water)

Located in the Lincolnshire Wolds, Horncastle is a market town of 6,000 people, and is vulnerable to both fluvial and surface water flooding. Significant fluvial floods took place in 1920, 1960, 1981, 1993 and 2007 and the last surface water flood was in 2012. The town has a 1 in 10 chance of flooding in any one year, and options are currently being considered as to the best approach to reduce this risk. There are two main rivers in the town, the Bain and the Waring, and the most popular flood risk option includes developing an upstream wash land storage area on the river Bain. Individual property protection is a likely option for the river Waring. Investing in flood protection for the river Waring and Bain will reduce the risk of flooding for 100 properties, which in turn will reduce cost and disruption caused to the community as a result of flooding. The surface water flooding work that has been proposed is hoped to reduce the risk of flooding to 28 properties from a 5% (1 in 20) chance of flooding in any year to less than 1.3% (1 in 75) chance of flooding in any year. Protecting against both fluvial and surface water flooding will enable growth and economic development in the town. This is the second part of a scheme that will see significant investment in flood retention basins to protect the town of Louth from fluvial flooding.

Witham catchment (Fluvial and WFD)

The Witham catchment contains large areas of high grade agricultural land as well as a number of key growth areas such as Grantham, Lincoln and Sleaford. Peak flows in the river Witham can result in water breaching the flood defences. The 'Witham Opportunities Study' is being currently carried out to identify potential partnership opportunities to deliver flood risk management and wider social and environmental benefits for the Witham. There are a number of management options that could be implemented in the Witham catchments including the following locations:

- Washingborough Fen
- Wllingham Fen
- Flood storage at Barlings Eau
- Lower Witham single water level
- Whisby Nature Park and gravel pits
- Metheringham habitat creation
- Beckingham Stapleford flood storage
- Cowbridge Drain
- River Bain

The opportunities put forward aim to deliver benefits to local economies, people and the environment.

Boston (Fluvial and Tidal)

Boston lies within the Witham Catchment and was identified in the Environment Agency's National Flood Risk Assessment (NaFRA) to be within the top four areas for the greatest number of properties at moderate or significant chance of flooding. There are five phases of work to address flood risk to the town, including a multi-functional barrier within the tidal Witham Haven to provide protection against a tidal surge with a 0.33% (1 in 300) annual chance of occurring and to enable safe navigation through the town centre thus delivering a key part of the Fens Waterways Link (see below).

Ancholme Valley Improvements (Fluvial)

The Ancholme Valley, drained by the river Ancholme, lies predominantly below sea level and is home to the small market town of Brigg. Both agricultural land and residential areas have been flooded in the past, including significant flood events that occurred in 1973, 1978, 1981, 1993 and 2000. The preferred options identified in the past have included flood storage upstream of Brigg or raising the flood banks in Brigg, which would reduce the risk of flooding to 840 properties.

2.2 Water quality and the visitor economy

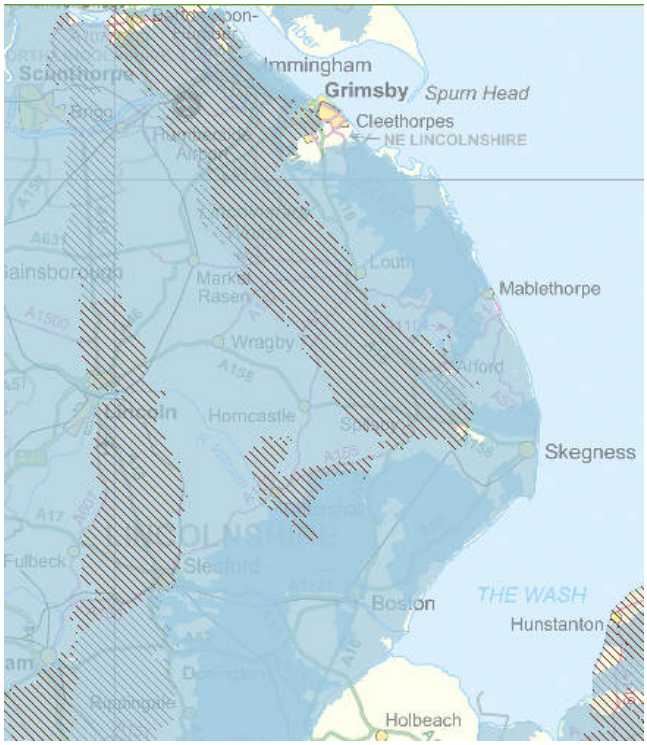
Infrastructure needs

Good water quality reduces the cost of drinking water treatment and improves the water environment for recreational users, visitors, residents and the local wildlife. There are documented links between water quality and public health, and between river restoration and local development and wellbeing. A location by a good quality water environment elicits higher property prices and therefore increases in council tax revenues.

The Water Framework Directive sets out that by 2015 all water bodies must achieve 'good' status and for surface water 'good' status includes the water bodies overall status including an ecological and chemical element. The Lincolnshire River Basin District (RBD) falls mostly into the Anglian River Basin District (RBD) (82.4%) and partly into the Humber RBD (17.6%).

Greater Lincolnshire has several major aquifers and a large proportion of the county is included in groundwater vulnerable zone with a major aquifer running alongside the coast between the Humber estuary and Skegness, and another aquifer running north to south through central Lincolnshire. Most of Greater Lincolnshire is designated as surface water Nitrate Vulnerable Zone (NVZ) areas and parts are designated as groundwater NVZ areas as shown in Figure 5[9]. As such farmers must adhere to rules that address nitrates loss from agriculture[10]. Greater Lincolnshire's growing agricultural industry faces restrictions in fertiliser usage as a method of improving the quality of groundwater which has the potential to increase production costs and reduce profit margins for those involved in the sector[11].

Figure 5: A section of Greater Lincolnshire's surface water NVZ areas (blue) and ground water NVZ areas (black)



Furthermore, there are over 90 fishing sites in Greater Lincolnshire recorded by the Go Fish website and over 1,500 rod licences are sold in some postcode districts. This supports

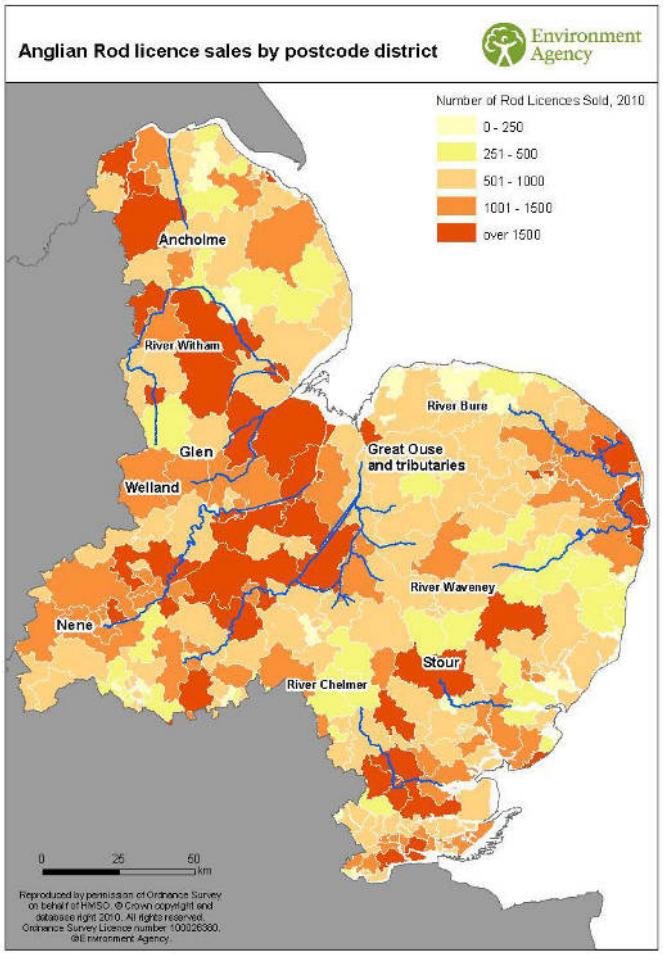
[9] http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=nvz&layerGroups=default&lang=_e&ep=map&scale=4&x=526275.8125&y=366100.8125#x=514965&y=373840&lg=1,&scale=4

[10] Joint Lincolnshire Flood Risk and Drainage Management Strategy: Appendix 4 – Updated Environmental Baseline Information

[11] Andersons (2011) Future of Food and Farming in Lincolnshire

Greater Lincolnshire's visitor economy as angling is an all year round, recreational sport which accommodates both day trips and longer visits.

Figure 6: Anglian rod licence sales by postcode district (Environment Agency, 2010)



Infrastructure funding status

Currently the measures for improving the water environments to good status and their associated costs and benefits are being developed by the Environment Agency in conjunction with the water companies. These will be outlined in the draft River Basin Management Plans, published in the summer of 2014.

At present funding requirements for all of the water quality investments relative to River Basin Management Planning are unknown, but we are aware that there will be a need for partnership funding to ensure delivery.

Meanwhile, the Environment Agency has highlighted a number of projects which will contribute to economic growth. These are as follows[12]:

[12] EDRF Project Pro-forma, GLLEP Project Pro-forma

Table 6; Water quality programmes

Project Name	Funding status	Total Project Cost	RESERVED FCRM GIA funding (£k)	INDICATIVE FCRM GIA funding (£k)				Total Contributions Confirmed
			2013/14	2014/15	2015/16	2016/17	2017/18	
Fens Waterways Link (WFD/Waterways)	Not proceeding before 2017	£150,000					TBC	None as yet. Up to £150k required
Ecosystem Services in the Fens study (WFD)	Not proceeding before 2014	£100,000	-		-	-	-	None as yet. Up to £100k required
Spalding Waterspace Study Implementation (WFD/Waterways)	Not proceeding before 2016	£1,200,000						None as yet. Up to £1.2m required
Water for wildlife and farming in the Fens (WFD)	Not proceeding before 2014	£150,000						None as yet up to £150k required
Destination Fens (Tourism)	Not proceeding before 2014	£50,000						None as yet. Up to£50k required
Fens Integrated Access Plan (Tourism)	Not proceeding before 2014	£560,000	-		-	-	-	None as yet. Up to £560k required

Water for Wildlife and Farming in the Fens

Agricultural crops in the Fens rely heavily on spray irrigation in the summer. The availability of water for this purpose is a challenge that is likely to increase in the future and water storage reservoirs will be required. To protect against habitat and biodiversity loss there is pressure from nature conservation organisations to create new wetlands for local wildlife. The project aims to address conflicts over water in the fens by investigating the potential for cross-sector partnerships in developing multifunctional storage wetlands that can support a wide range of biodiversity and act as a source of water for summer abstractions. The delivery partners would be: Environment Agency; Natural England; Conservation NGOs; NFU; and Academic Institutions.

Fens Waterways Link Opportunity Study

The Fens Waterways Link aims to connect up to 240km of waterway in the East of England. As the biggest waterway enhancement scheme in Europe, the Fens Waterways Link not only has the potential to improve water supply and flood defence but also stands to benefit the local economy though increased tourism and recreation. The scheme would link up a number of the region's towns and cities and create new routes for recreational boating and develop transport corridors for people and freight, helping to stimulate local business and provide a number of community benefits such as new employment opportunities. The likely funding partners for this project are: Lincolnshire County Council; Local Authorities; the Environment Agency; and Greater Lincolnshire LEP. The opportunity study is an early requirement before investment, of around £100m, would take place in future years.

Ecosystem Services in the Fens

This project aims to evaluate and quantify the ecosystem goods and services that could benefit the Fens through the creation and recreation of wetlands. Reducing the risk of flooding to the local areas and improving water storage for abstraction are examples of some ecosystem services that would be included. The likely delivery partners for this project are: Environment Agency; Natural England; Greater Lincolnshire LEP, Conservation NGOs; NFU; and Academic Institutions.

Spalding Waterspace Study Implementation

The Spalding Waterspace Study was published in 2010 by the South Holland District Council (SHDC) and the Lincolnshire Waterways Partnership (LWP). It aimed to support partner organisations involved in delivering river projects along the river Welland and Glen, which would contribute to the regeneration of the Spalding region. The next study will provide a policy framework to promote sustainable development along these rivers and to provide funding outputs of the 2010 Spalding Waterspace Study and to develop some of these outputs to implementation stage. The likely funding partners for this project are: the Environment Agency; South Holland District Council; Greater Lincolnshire LEP; Lincolnshire County Council; Lincolnshire Waterways Partnership and Local Businesses.

Destination Fens

Destination Fens is a tourism strategy to encourage visitors into areas of the Fens which are largely not seen as a place to visit. The study aims to promote some the regions' rich history and to attract visitors to some of the Fen's lesser known features, including water management infrastructure such as the Denver sluice. Outputs of the project would include a strategy for increasing tourism using in the Fens and an interactive website where visitors can plan to visit local attractions. This project is in its early stages but the delivery partners are likely to be: Environment Agency; Greater Lincolnshire LEP, Natural England; District

and County Councils; Conservation NGOs; Agricultural sector including IDBs; English Heritage; and Academic Institutions.

Fens Integrated Access Plan

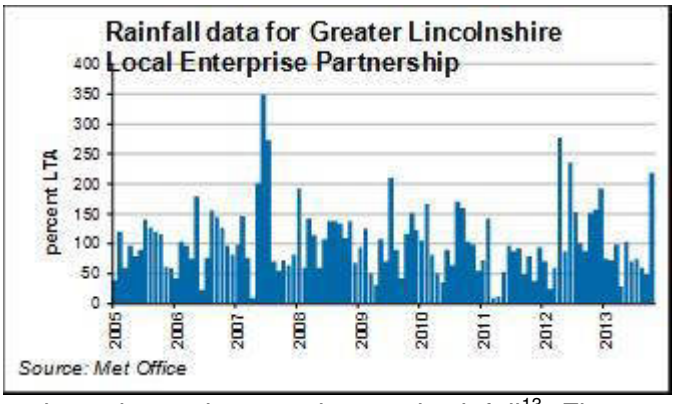
The Fens Integrated Access Plan supports the Destination Fens strategy and focuses on improving access to a number of Fenland attractions using footpaths, waterways, cycle-ways and hopper-buses. The objective is to increase tourism in the region and stimulate the local economy. Outputs will include a delivery plan and the delivery of access improvements. The project is still in its early stages and funding opportunities are being explored. The likely delivery partners for this project are: Environment Agency; Greater Lincolnshire LEP, Natural England; District and County Councils; Conservation NGOs; Agricultural sector including IDBs; English Heritage; and Academic Institutions.

For more context on these studies, please contact the Environment Agency.

2.3 Water availability

Infrastructure needs

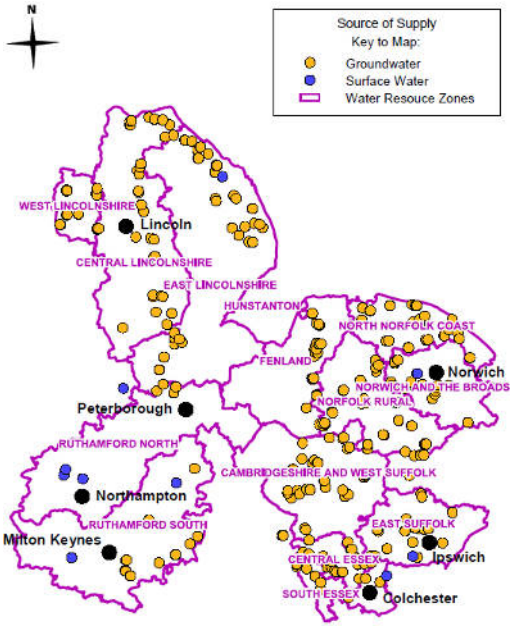
Figure 7: Monthly mean rainfall for GL LEP



Since water is a major input into production and its supply is statutory to maintain employee health, key to economic growth in any region is the availability and supply of clean water for both domestic and commercial use. Rainfall in Eastern England is low compared to the rest of the country although the number of annual thunderstorms contributes significantly to the regions total annual rainfall[13]. Figure 7 illustrates the monthly variability in rainfall within the region. Intense periods of high rainfall followed by long dry spells leave Lincolnshire susceptible to both flooding and drought. Investment in infrastructure must consider both these climate extremes to ensure future water availability is secured.

Anglian Water is responsible for the supply of water to most areas in Greater Lincolnshire, except areas of North Lincolnshire, alongside the Humber Estuary, which is supplied by Severn Trent Water. Figure 8 shows the location of Anglian Water's water sources that supply the area. Greater Lincolnshire is mainly supplied by groundwater sources, a number of which are in coastal regions between the Humber and Skegness, including one surface water source[14].

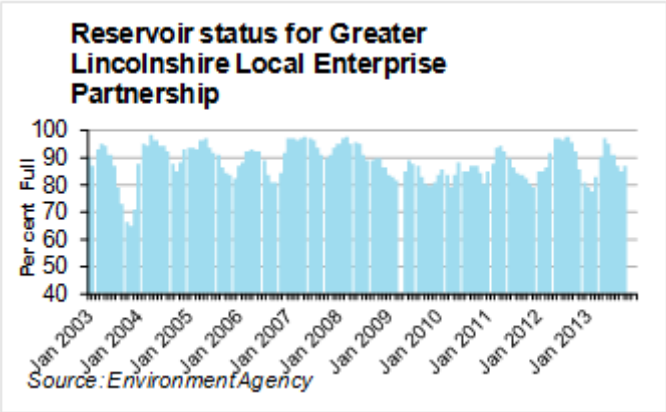
Figure 8: Anglian Water's water sources (draft 2014 Water Resources Management Plan)



Agriculture is a major consumer of water in the region and there are over 600 agricultural spray irrigation licences supporting high value arable food production businesses. Over 250 of these include a storage reservoir. A reduction in summer water abstraction needed for irrigating crops has been identified as a threat to the areas growing agricultural sector[15]. Demand for water abstraction varies considerably according to the season and climate. Annual variation as well as seasonal is common and over the summer of 2011 5 million cubic metres was abstracted for spray irrigation, whilst in 2012 this fell to 2 million cubic metres. Greater Lincolnshire has limited capacity to increase abstraction from surface water and groundwater sources and recently storage reservoirs have become increasingly popular as users are able to capture excess water during high flow periods and rely upon this water during dry spells. Some users will benefit from the Trent Witham Ancholme River Transfer Scheme which in times of low flow is turned on to pump water between the River Trent at Torksey to Fosdyke Canal and River Witham. This ensures that in times of water scarcity there is enough available water to meet the needs of Greater Lincolnshire's crops along with that of other industries[16]. During the drought of 2011/12 The Environment Agency worked with a number of reservoir users who were struggling to fill their reservoirs during the 'normal'

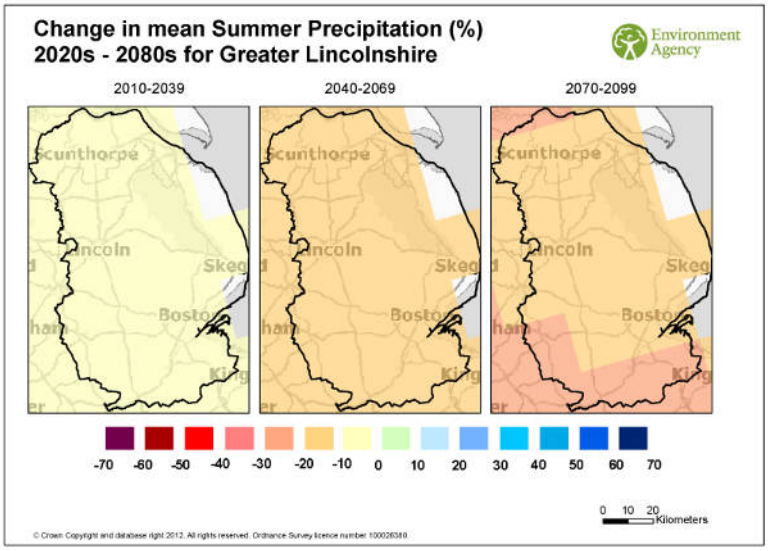
[13] http://www.metoffice.gov.uk/climate/uk/ee/print.html
[14] http://www.anglianwater.co.uk/environment/water-resources/resource-management/
[15] Andersons (2011) Future of Food and Farming in Lincolnshire
[16] http://www.environment-agency.gov.uk/news/146308.aspx

Figure 9: Mean percentage full for two reservoirs in the GL LEP region (Anglian region only). Last updated 18/11/13



wet winter. Over twenty licence holders were permitted to abstract water outside of their normal authorised abstraction period during the wet April/May period at the end of the drought. Figure 9 shows the mean percentage of the two reservoirs serving Greater Lincolnshire (Anglian region only). From 2003 and 2013 reservoir levels have never been full and at times have dropped to below 70% with most summers being below 90% full. Flooding from reservoirs is therefore less likely compared to flooding from other sources. Considering the 30% decrease in summer precipitation that is expected by 2040 (Figure 10), future investment will be needed to ensure reservoir levels remain high enough to support abstraction without negatively impacting on the environment.

Figure 10: Maps showing the projected change in summer and winter precipitation



Greater Lincolnshire relies heavily on the use of pumping infrastructure to move water around the region to help prevent both flooding and drought. In 2012, 99 million cubic metres of water which equates to 30% of annual rainfall was pumped out to sea. Between July 2012 and June 2013, 63 pumps were relied upon to move 77.4 million cubic metres, which would be enough water to meet the domestic needs of 1.4 million people for a whole year (150 litres of water per day) or over 1500 modest agricultural storage reservoirs. This suggests that there are sufficient quantities of water in the region as a whole to meet the needs of the local economy and environment.

Water infrastructure is therefore required to ensure that such water can be made accessible to the industries and communities that would benefit from it. Every five years water companies publish a Water Resource Management Plan (WRMP) detailing how they plan to deliver a reliable water supply over the next 25 years. The 2014 Anglian Water Draft Resource Management Plan reports that over the next 25 years Greater Lincolnshire is overall not expected to experience a deficit in supply of water unlike surrounding regions.

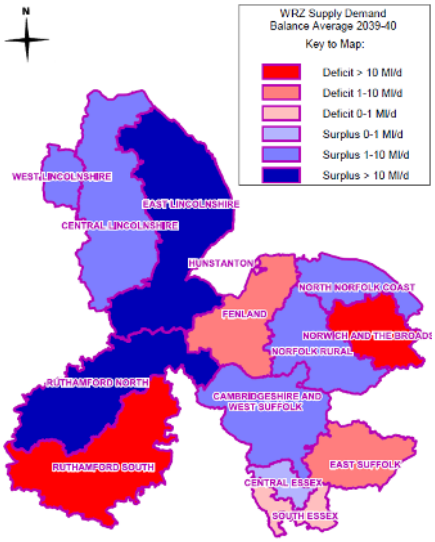
The key points for each of the water Resource Zones (RZs) in Greater Lincolnshire are summarised in Table 7. Poor quality groundwater is shown to be a problem in East Lincolnshire as it reduced deployable output by 24 Ml/d as chalk groundwater is contaminated by nitrate and as such it is not available for public use[17].

Table 7: Water Resource Zone Summaries (AW 2014 Draft WRMP)

Resource Zone (RZ)	Key Points
West Lincolnshire	• No deficits are forecast • No significant climate change or levels of service sensitivities have been identified • No Confirmed or Likely sustainability reductions are required • The worst case sustainability reduction is approximately 24 Ml/d. A reduction of this magnitude would drive significant supply-demand investment • Supply-demand risk is minimal.
Central Lincolnshire	• No deficits are forecast • No significant climate change or levels of service sensitivities have been identified • Two water treatment works have been targeted for Likely 2a and Likely 2b sustainability reductions. • The deployable output at risk is equivalent to 6.6 Ml/d at average and 7.5 Ml/d at peak • The worst case sustainability reduction risk is equivalent to an additional 49 Ml/d. A deficit of this magnitude would drive significant supply-demand investment. • Associated supply-demand risk is minimal.
East Lincolnshire	• No deficits are forecast • No Confirmed or Likely sustainability reductions are required • The worst case sustainability reduction is approximately 57 Ml/d. A reduction of this magnitude would drive significant supply-demand investment • No significant baseline climate change or levels of service sensitivities have been identified. • In the worst case, climate change may reduce average daily source-works output by 2 Ml/d. This would affect abstraction from the Louth Canal • Deployable output has been reduced to take account of the effect of poor quality groundwater • The associated supply-demand risk is minimal.

[17] Anglian Water (2013) Water Resources Management Plan – Draft Report http://www.anglianwater.co.uk/environment/water-resources/resource-management/

Figure 11: Baseline average supply demand balance 2039/40 water in the AW region



Overall Greater Lincolnshire (in the Anglian Water region) is not expected to experience water shortages as a whole (Figure 11) in fact the East, Central and West Lincolnshire regions are predicted to have a surplus in the supply demand balance in 2039/40[18]. This factor, alongside higher than average sunlight hours, gives Greater Lincolnshire its unique selling point as an agricultural centre for the UK.

It is possible that localised deficits could arise. The Anglian Water WRMP 2010 forecasted that in 2036-37 certain planning zones within the water resource zones will experience deficits which are illustrated in Table 8 along with the preferred water management options[19].

Anglian Water's Draft 2014 WRMP supply-demand investment programme focuses investment between 2015 and 2020 in the areas outside of Greater Lincolnshire in future water deficit regions including the neighbouring Norfolk Fenland and Hunstanton. One of the main risks that water companies have to plan for is climate change and under a worst case scenario the 2014 Draft WRMP forecasts that East Lincolnshire will have 1-5% of deployable output affected as a result of climate change. Surrounding regions including Ruthamford and the Norfolk Fenland is forecasted to have >10% of deployable output affected. The East of England's population is expected to grow 20% between 2015 and 2014. Greater Lincolnshire itself has not been identified as a growth hotspot over the 25-year forecast although growth hotspots nearby to Greater Lincolnshire's borders include dwellings such as Peterborough and Corby.

Table 8: Localised forecasted deficit in 2036-37

Planning zone with forecast deficit in 2036/7	Preferred Water Management Option	Period
Barrow	Intra water RZ transfers	AMP5
Grimsby	Active leakage control, Enhanced metering, Elsham Non-Potable Extn Phase 1, Elsham Non-Potable Extn Phase 2, Pyewipe wastewater reuse, Humber South Bank Desalination, Intra WRZ transfers	AMP5/6 +
Scunthorpe South	Additional metering, Active leakage control, Water efficiency measures, Intra WRZ transfers	AMP5
Branston	Active leakage control, Intra WRZ transfers, Enhanced metering	AMP9/5-8

[18] Anglian Water (2013) Draft Water Resources Management Plan 2014 http://www.anglianwater.co.uk/environment/water-resources/resource-management/
[19] Anglian Water (2010) Water Resources Management Plan - Main Report http://www.anglianwater.co.uk/environment/water-resources/resource-management/

Lincoln	Active leakage control, Pressure reduction, Enhanced metering, New Lincoln WTW	AMP5
Sleaford	Pressure reduction, Enhanced metering, Intra WRZ transfer	AMP5/8
Louth	Pressure reduction, Enhanced metering, Intra WRZ transfer	AMP5
Boston	Enhanced metering, Covenham WTW transfers	AMP5
Bourne	Intra WRZ transfer, Pressure reduction, Enhanced metering	AMP5/6

Infrastructure funding status

The cost of implementing the local drinking water supply-demand deficit options has not been captured in this report and it is assumed that the cost will be absorbed by the bill payer.

A Ricardo-AEA report for the Environment Agency included Table 9 that outlines potential hot spots for water availability related to the Food and Drink Industry. The Grimsby, Ancholme and Louth catchments in Greater Lincolnshire are highlighted as having short term issues relating to water availability. Based on a sample of Federation House Commitment sites a saving of around 12% on 2011 water use could be achieved through a range of water efficiency measures[20]. To support this industry a region-wide water efficiency programme could be proposed for funding. Unfortunately, no such programme is yet in place and therefore this concept is not included in the beneficiary analysis and cost benefit analysis.

Table 9: Water availability and vulnerability for the Food and Drink sector

Freshwater availability	Vulnerable Region	Specific catchment
Short term (next four years)	Eastern England	Cam & Ely Ouse (Cambridgeshire) Broadland Rivers (Norfolk) Combine Essex (Essex) East Suffolk (Suffolk) Upper Lee (Bedfordshire, Hertfordshire, Essex) Colne (Hertfordshire)
	Midlands	Grimbsby, Ancholme & Louth (Lincolnshire) Dove (Derbyshire) Idle and Tome (Nottinghamshire) Lower Trent and Erewash (Nottinghamshire) Welland (Leicestershire, Rutland)
	South West England	Hampshire & Avon (West Hampshire, South Wiltshire) Kennet & Pang (North Wiltshire) Upper Thames (South Gloucestershire, West Oxfordshire)
Medium term (four to ten years)	Midlands	Nene Catchment (Northamptonshire) Middle Severn Catchment (Worcestershire) Avon Catchment (Warwickshire)
Long term (more than ten years from now)	South Wales	Whole Region
	Midlands	Whole Region
	South West England	Whole Region

Meanwhile, the availability of water for summer spray irrigation of agricultural crops must be managed so that the growth of the agricultural sector will not put pressure on future drinking water supply and biodiversity in the Fens. Previously the Demonstration Fens project successfully worked with farmers to implement adaptive water efficiency measures.

Further work could be undertaken to improve resilience. A number of new winter storage reservoirs are needed to meet current and future demand. The 'Water for Wildlife and Farming in the Fens' project will explore developing new 'storage wetlands' that can deliver significant areas of habitat and tolerate high levels of summer abstraction without compromising biodiversity interest. This project is of interest for Growth Funding investment.

[20] http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/LIT_8767_4d1fe5.pdf

Table 10: Water resources improvement projects

Project Name	Funding status	Total Project Cost	RESERVED FCRM GIA funding (£k)	INDICATIVE FCRM GIA funding (£k)				Total Contributions Confirmed
			2013/14	2014/15	2015/16	2016/17	2017/18	
Water for wildlife and farming in the Fens (Water resources/WFD)	Not proceeding before 2014	£150,000	-	-	-	-	-	None as yet up to £150k required

2.4 Key growth sectors

2.4.1 Agri-food

Food and farming provides 13% of the country's Gross Value Added (GVA) income[21]. In 2007, 252,400 ha of land in Greater Lincolnshire was dedicated to agriculture, which accounts for 2.7% of agricultural land in England[22]. The county is the biggest producer of cereals and vegetables in England and agriculture in the region contributes more than £5 billion GVA to the UK's economy annually. Agriculture is a major employer in Greater Lincolnshire with over 1 in 10 people employed in food or farming contributing to 13% of the county's GVA of more than £1 billion a year[23]. It is estimated that approximately 32,000 people are employed in the food and farming sector in the region. In particular, in some areas these sectors are economically even more important such as the South Holland area where 1 in 4 people are employed food and farming accounting for approximately one third of GVA. The county plays a major role in the production of the UK's fresh produce and is the single largest producer by county. The main crops grown include: bulbs and flowers; vegetables grown outdoors; cereals; and sugar beet. The county's land used for crop production makes up over 10% of that used across the whole of England. Agriculture is a hugely important industry to Greater Lincolnshire and there is potential for this sector to grow despite facing a number of threats. A recent report looking into the future of food and agriculture in Greater Lincolnshire identified the lack of secure water for abstraction and the need to improve water quality by reducing inputs of fertilisers to be amongst the main threats to production and restrictions that the industry needs to prepare for[24].

2.4.2 Agri-food and manufacturing

Food manufacturing which includes primary production, food processing, wholesale, retail and packaging is a major industry within Greater Lincolnshire and provides employment to 73,000 people. The UK's food security relies upon Greater Lincolnshire's food manufacturing industry. This includes 70% of the country's fish that is processed within the region, along with 1/8th of wider food and drink processing[25]. To feed the UK's growing population growth within Greater Lincolnshire's food manufacturing industry is important. Like other areas of the UK manufacturing has been declining in Greater Lincolnshire, although there are a number of other growing manufacturing industries in the region including: primary engineering; chemicals; metals; and polymers. Including agri-food manufacturing, manufacturing as a whole accounts for 16% of jobs.

2.4.3 Ports

The ports of Grimsby and Immingham are the busiest in the UK and 13th busiest in Europe, transporting 54,029 tonnes of cargo annually[26]. Bulk materials and cars make up a large proportion of the cargo transported, whilst the smaller ports of Boston and Sutton Bridge focus on other cargos such as timber and grain. Greater Lincolnshire's ports allow food and other goods to be transported around the UK quickly. Along with the Humberside Airport which supports large quantities of seafood freight the sector provides 18,000 jobs and generates £700 million annually. Greater Lincolnshire's ports are strongly linked with the local agri-food industry and number of other local sectors. There are a number of wind farms along the east coast and the ports of Immingham and Grimsby make the area a location of choice for a number of blue-chip energy firms such as E. ON and Dong involved in the

[21] Andersons (2011) Future of Food and Farming in Lincolnshire
[22] Atkins (2009) Lincolnshire Coastal Study. Task 1 Report: Evidence Base http://www.lincolnshire.gov.uk/residents/environment-and-planning/environment/lincolnshire-coastal-study/task-1-evidence-base/74062.article?tab=downloads
[23] Cambridge Econometrics, Local Economy Forecasting Model (LEFM) 2006
[24] Andersons (2011) Future of Food and Farming in Lincolnshire
[25] The Greater Lincolnshire Enterprise Partnership (2014) Strategic Economic Plan
[26] AAPA World Port Rankings 2010 http://aapa.files.cms-plus.com/Statistics/WORLD%20PORT%20RANKINGS%202010.pdf

offshore wind industry. In the near future Siemens could be investing approximately £300 million in an offshore project within the region.

2.4.4 Tourism

Greater Lincolnshire's rich variety in both landscape and culture makes the area an attractive destination for visitors. The visitor economy is estimated to be worth approximately £1 billion and provide 39,000 jobs. Visitors are attracted to the coast with the coastal towns of Skegness and Cleethorpes being popular destinations, while Butlins in Skegness is the UK's 4th most popular tourist resort. Other popular tourist regions in Greater Lincolnshire include the Fens, the Vales and the Wolds, all of which are known for their beautiful countryside. The tourism industry in Lincolnshire is growing and between 2011 and 2012 the number of tourists attracted to the region increased form 17 million to 17.4 million.

3 Beneficiary Analysis

3.1 Overview of beneficiaries

Eleven environmental infrastructure projects have been identified in Greater Lincolnshire as having particular added value to over 9,000 businesses in the regions' economy.

These include flood risk schemes which aim to avoid business damages and disruption, and multidisciplinary tourism, water quality and water resource improvement projects which aim to maintain the quality and quantity of water required by the agricultural sector, increase visitor numbers to feed a buoyant visitor economy and improve attractiveness as a place to work. The total cost of all projects outlined below is an estimated £142m, while the estimated contributions required are around £20.5m. This equates to a contribution representing around £2,300 per business benefiting.

The potential investment projects we have undertaken beneficiary analysis for include:

- Lincshore Beach Nourishment Scheme (2015-2020) (coastal flood risk)
- Horncastle (fluvial and surface water flood risk)
- Witham catchment (Fluvial and WFD)
- Boston (fluvial and tidal flood risk)
- Ancholme Valley Improvements (Fluvial)
- Fens waterway link opportunities study (WFD/Visitor Economy)
- The Fens and Spalding projects, including:
    - Ecosystem Services in the Fens study (WFD)
    - Spalding Waterspace Study Implementation (WFD/Waterways)
    - Fens Integrated Access Plan (Tourism)
    - Destination Fens (Tourism)
    - Water for wildlife and farming in the Fens (WFD/Water Resources)

In this chapter the results from a mapping exercise to identify beneficiaries of each project or group of projects is presented. It should be noted that this exercise would benefit further from better modelling of risk, as the historic flood risk maps do not take in account the impacts of climate change and development pressures on the flood plain. Thus, a somewhat high level estimate of beneficiaries is presented.

The Fens and Spalding projects cover a very similar area and thus, to ease the beneficiary analysis they have been considered together. As the Fens cross over LEP borders we have assumed that the Fens projects identified here will concentrate on the wider Spalding area.

By using Geographical Information Systems (GIS), we have estimated that each project will benefit the following number of businesses Tables 11, 12 and 13):

Table 11: Business beneficiaries in Greater Lincolnshire per investment

	Lincshore beach nourishment	**Horncastle**	**Witham catchment**	**Boston**	**Ancholme Valley**	**Waterway link**	**Spalding and Fens**
	Flood Risk	*Flood Risk*	*Flood Risk*	*Flood Risk*	*Flood Risk*	*Water Quality/tourism*	*Water Quality/ Water Resources/ Tourism*
Sector							
Agri_food	88	8	1407	10	38	552	211
Health_and_Care	44	5	1144	2	28	259	72
Manufacturing_Engineering	46	7	1641	6	44	510	135
Ports_Logistics	7	2	1469	3	37	377	197
Renewables	1	2	94	0	3	38	9
Visitor_Economy	336	13	2065	9	54	518	165
Other	822	150	14231	69	414	4534	1422
Total	1344	187	22051	99	618	6788	2211

Table 12: Breakdown of property types which would benefit from investment

Project	Properties	businesses	residential
Boston	777	99	678
Horncastle	758	187	571
Lincshore	21136	1344	19792
Spalding and the Fens	20883	2211	18672
Fen Waterway Link	76648	6788	69860
Witham	299504	22051	277453
Ancholme Valley (3km)	5059	618	4441

The total number of beneficiaries has been totalled below. Conservatively, around 104,000 properties look to benefit from the eleven investments. This includes over 9000 businesses.

Table 13: Total beneficiaries benefiting from investment

Project	Properties	businesses	residential
Boston	777	99	678
Horncastle	758	187	571
Lincshore	21136	1344	19792
Fen Waterway Link	76648	6788	69860
Ancholme Valley (3km)	5059	618	4441
	104378	9036	95342

Since there is overlap between the projects (i.e. Southern section of the Waterway Link meets Spalding and the Fens and the Witham catchment project covers a wide area including the River Bain which runs through Horncastle) it would not be suitable to total the beneficiaries by adding up all business numbers. Thus, to avoid double counting, the Witham and Spalding and the Fens property counts have been removed from the total.

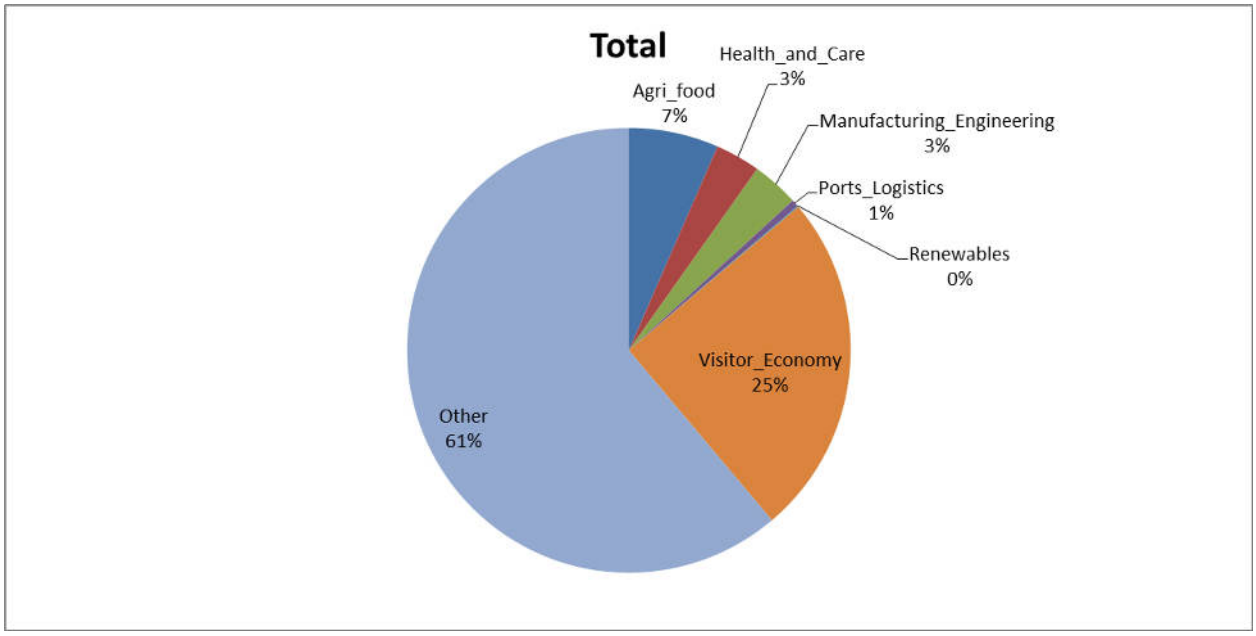
The following section outlines the beneficiaries for each of the investment projects proposed.

3.2 Lincshore Beach Nourishment Scheme (2015-2020) (coastal flood risk)

The Lincshore Beach Nourishment Scheme will continue to protect 1,344 business properties from coastal flooding. Figure 13 shows the clusters of businesses which are located in areas which have been subject to historic flooding. Naturally, the clusters of visitor economy and port businesses are situated adjacent to the coast. The coast both provides business and can distrupt it.

By nourishing the beach along the coast line, these businesses can avoid damages from flooding. The businesses which will continue to be protected from flood risk as a result of scheme investment will include 88 business properties registered as agri-food, 7 as ports and logistics, 336 as visitor economy, 44 as health and care, 46 as manufacturing and engineering, 1 as renewables and 822 as 'other' (Figure 12). It is assumed that 'other' includes retail and office properties.

Figure 12: Lincshore beach nourishment beneficiaries by business type



Business disruption is also sensitive to the ability of staff to make the journey to work. There are around 19,792 residential properties located in areas which have been subject to historic flooding from 1953 and represents a conservative estimate of beneficiearies (Figure 14). By reducing the risk to flooding to these properties there will be an avoidance of lost working days.

Figure 13: Businesses benefiting from Lincshore Beach Nourishment Scheme

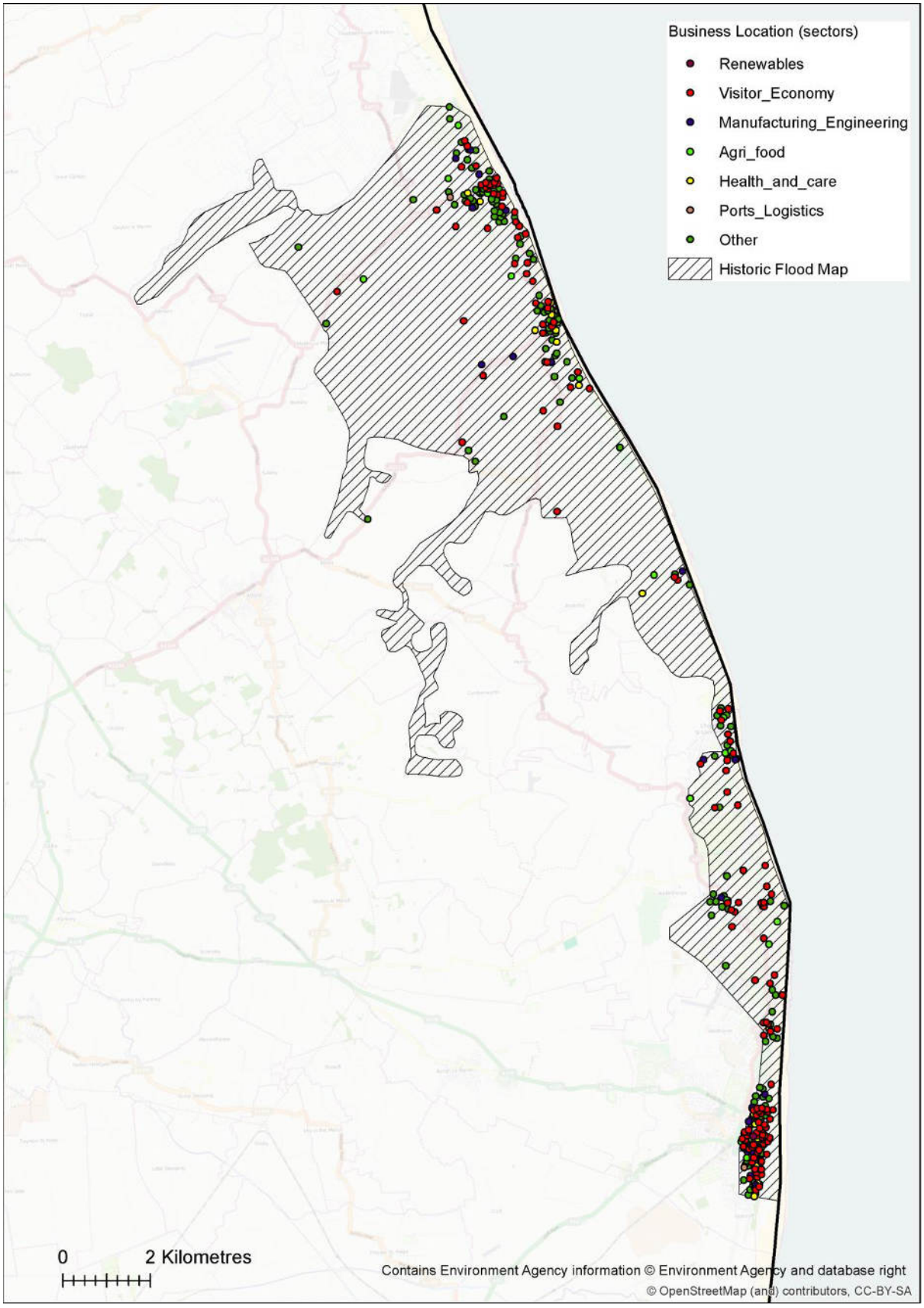
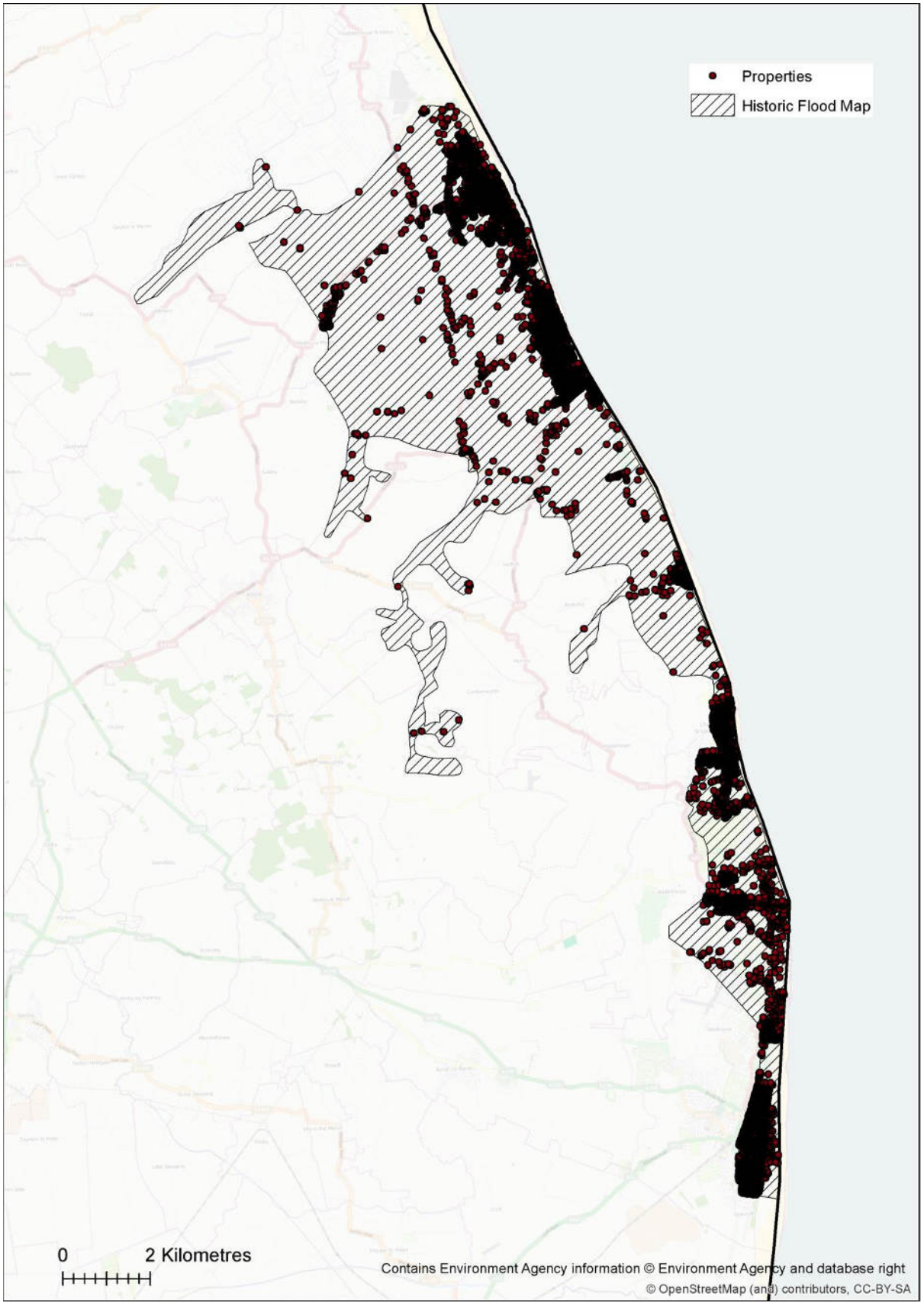


Figure 14: All properties benefiting from Lincshore Beach Nourishment Scheme



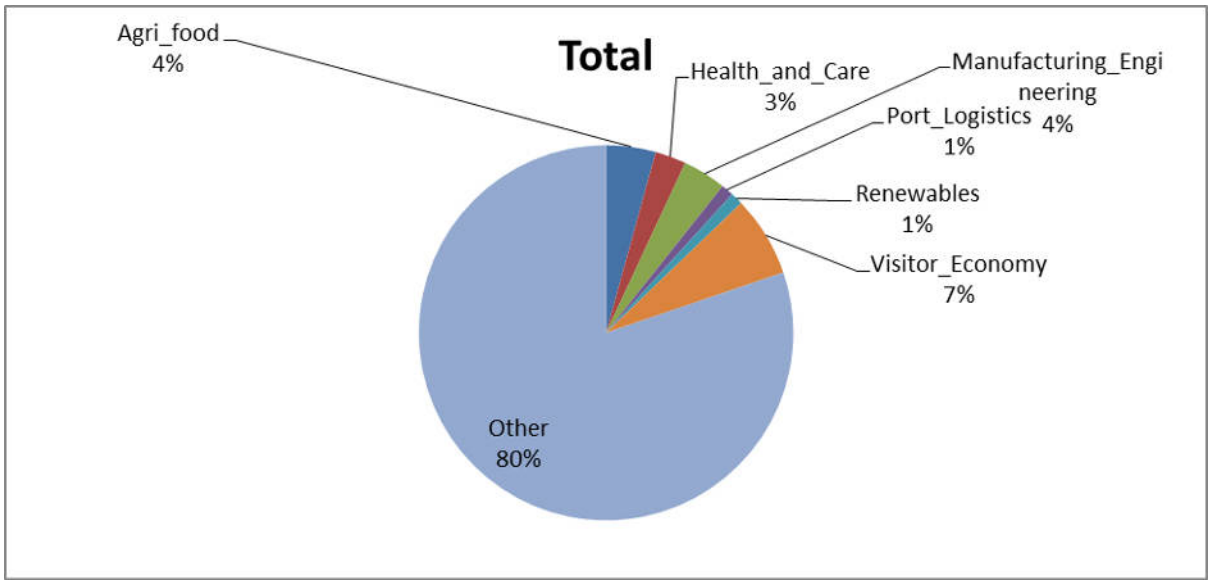
3.3 Horncastle (fluvial and surface water flood risk)

The Environment Agency states that the Horncastle Flood Risk Management Scheme will reduce the risk of fluvial flooding to 100 properties from a significant or very significant to a moderate risk. The scheme will also reduce the risk of surface water flooding to 28 properties from >5% (1 in 20) chance of flooding in any year to <1.3% (1 in 75).

Since the Environment Agency modelling was unavailable to us at the time, we undertook beneficiary analysis to understand the potential beneficiaries using the historic flood risk maps. Our study suggested that the Horncastle fluvial and surface water flood risk project will reduce risk for up to 187 local businesses and a significant amount of agricultural land; around 85% of the 2.75km² area within the historic flood risk boundary (Figures 15 and 16).

Our analysis suggests that the scheme will result in the protection of businesses including 8 business properties registered as agri-food, 2 as ports and logistics, 13 as visitor economy, 5 as health and care, 7 as manufacturing and engineering, 2 as renewables and 150 as 'other'. The scheme will maintain the livlihood of businesses which saw flooding in 2007, 2007 and 2012.

Figure 15: Horncastle beneficiaries by business type



Our analysis also identified that up to 571 residential properties could also see a reduced risk of flooding, resulting in less affects on employees and less lost working days (Figure 17).

Figure 16: Businesses who have a history of flooding benefiting from Horncastle Flood Risk Scheme

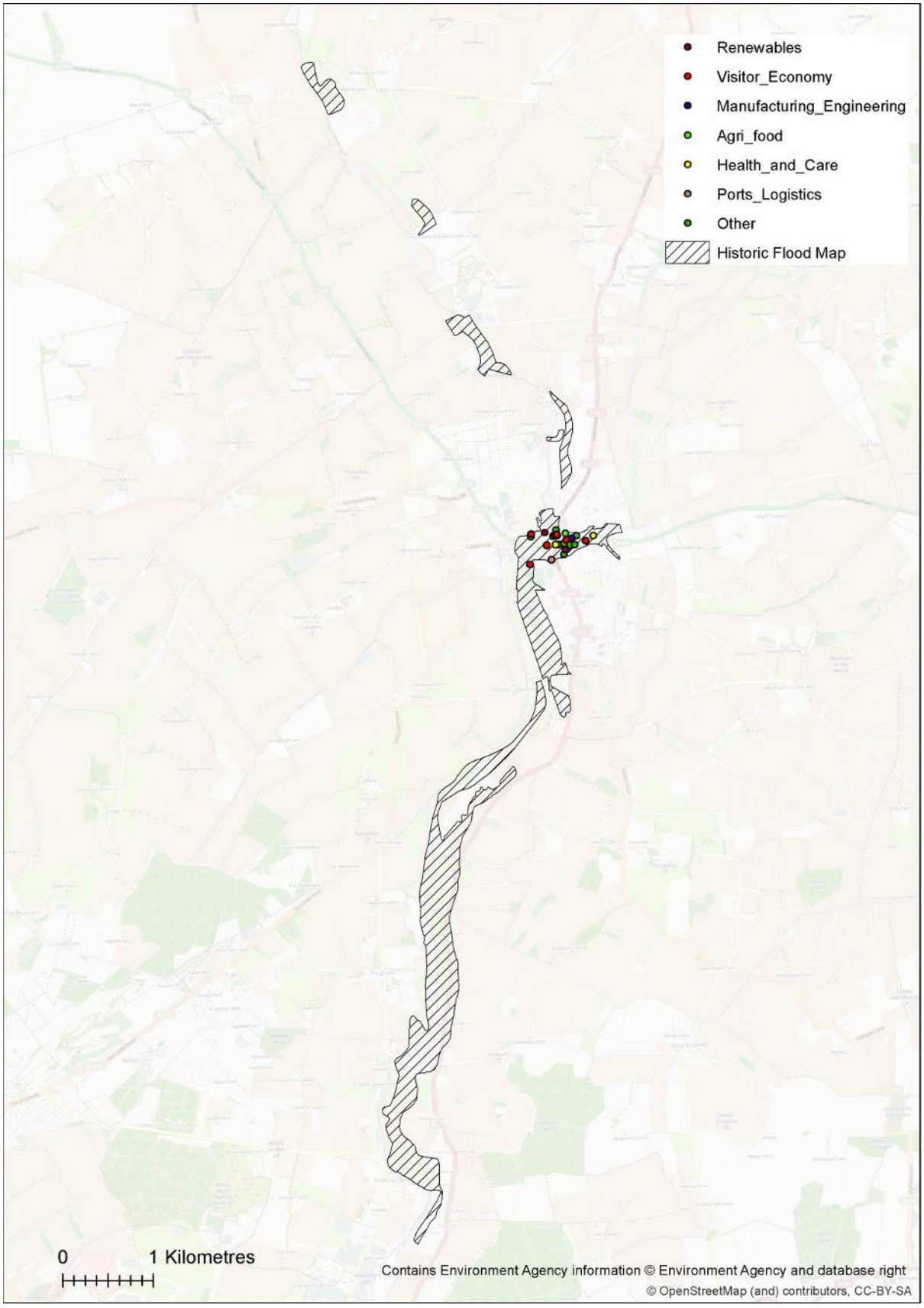
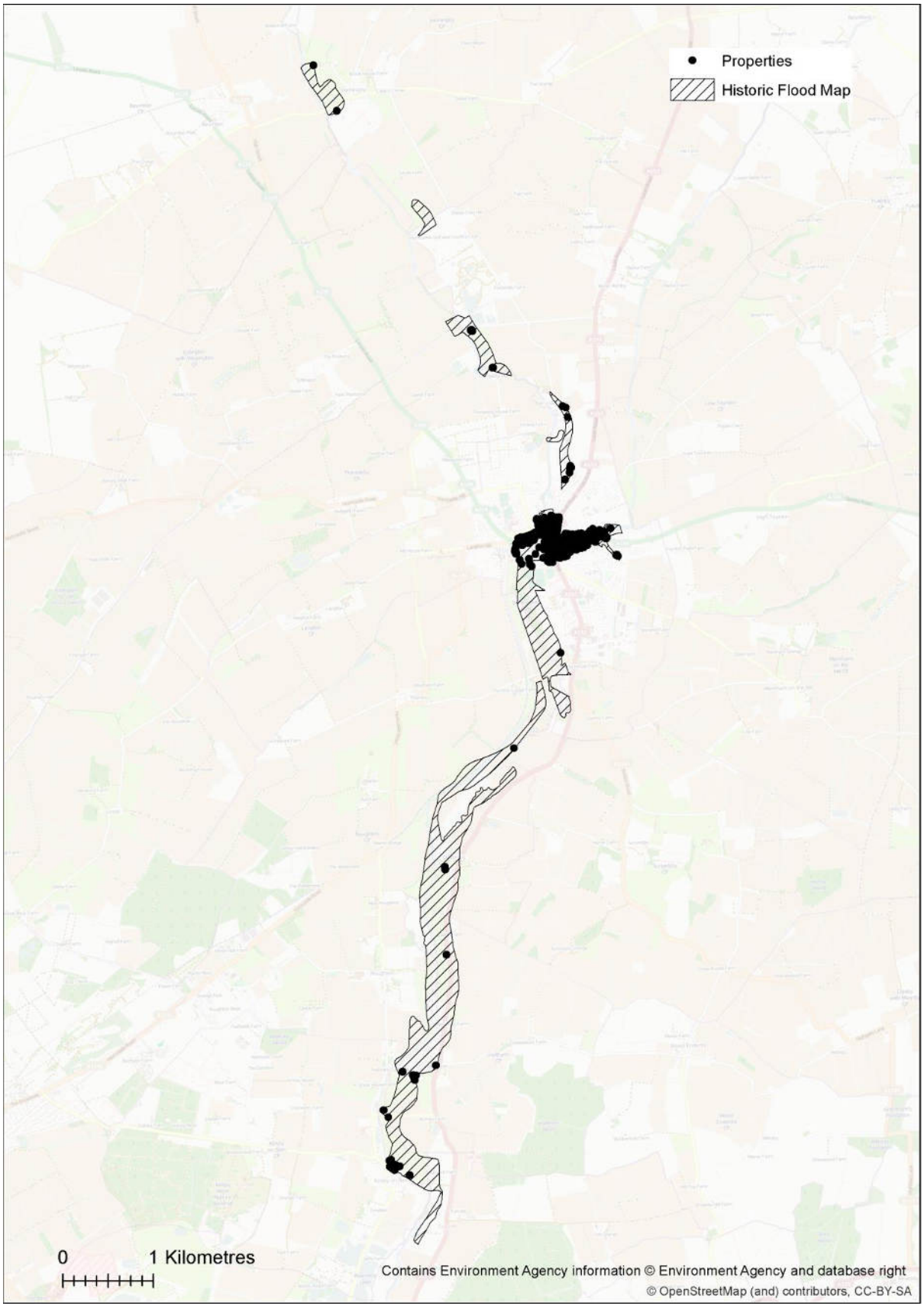


Figure 17: All properties that have a history of flooding benefiting from Horncastle Flood Risk Scheme



3.4 Witham catchment (Fluvial and WFD)

Flows in the River Witham and its tributaries result in 'bank full' conditions on average every three years. Such high water levels can lead to overtopping of flood embankments and the potential for the defences to breach. Without effective man made river defences and land drainage much of the area would be marshland, leading to the loss of rural communities and a breakdown of the sustainability of the existing catchment economy.

The 'Witham Opportunities Study' aims to identify potential partnership opportunities at an early stage to deliver flood risk management and wider social and environmental benefits for the Witham. It is expected that opportunities developed via a full strategy would be delivered as subsequent projects within the catchment post 2015.

The current project has identified the following project opportunities with stakeholders that could be delivered within the Witham catchment:

- Washingborough Fen
- Wllingham Fen
- Flood storage at Barlings Eau
- Lower Witham single water level
- Whisby Nature Park and gravel pits
- Metheringham habitat creation
- Beckingham Stapleford flood storage
- Cowbridge Drain
- River Bain

Much of the catchment comprises high grade agricultural land at risk of flooding; 6% of businesses registered in the area are in the Agri-Food sector. There are also a number of key growth areas within the Witham Catchment (e.g. Grantham, Lincoln and Sleaford).

The project is at a relatively early stage and partnership working will determine the next step for investment and define the beneficiaries. Because these projects will effect not only those who live adjacent to the works, but visitors and commuters too, a summary of the make up of the Witham catchment is provided in order to understand the maximum extent of beneficiaries which this scheme may effect.

The Witham catchment is made up of 1,407 business properties registered as agri-food, 1,469 as ports and logistics, 2,065 as visitor economy, 1,144 as health and care, 1,641 as manufacturing and engineering, 94 as renewables and 14,231 as 'other'. There are also 277,453 residential properties within the Witham catchment (Figures 18, 19 and 20).

Figure 18: Potential Witham beneficiaries by business type

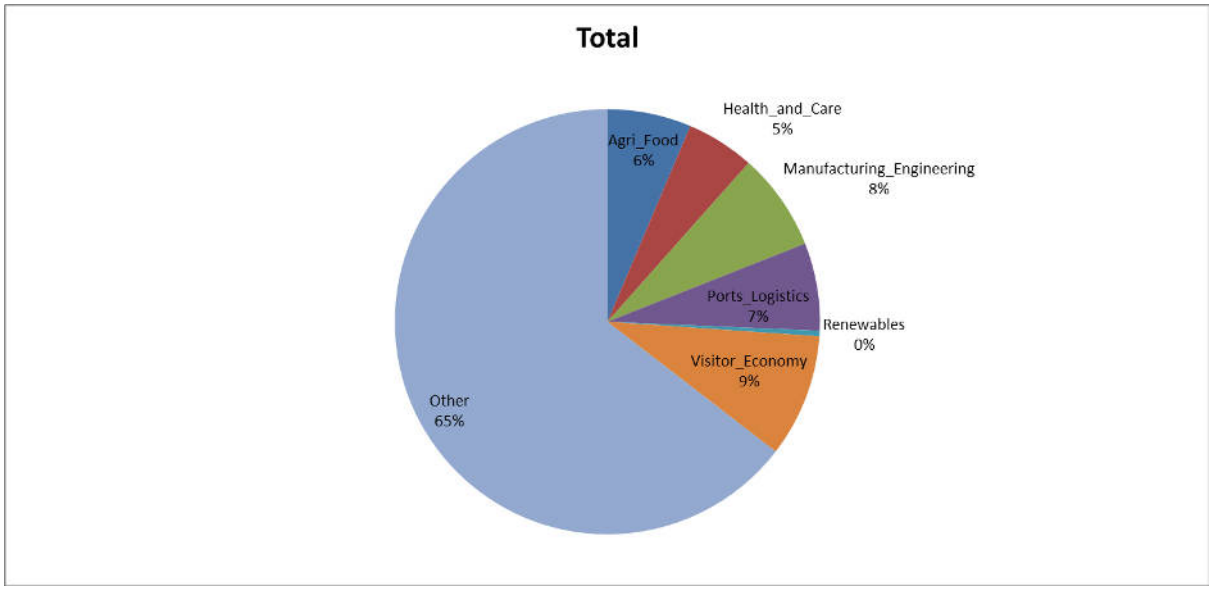


Figure 19: Businesses within the Witham

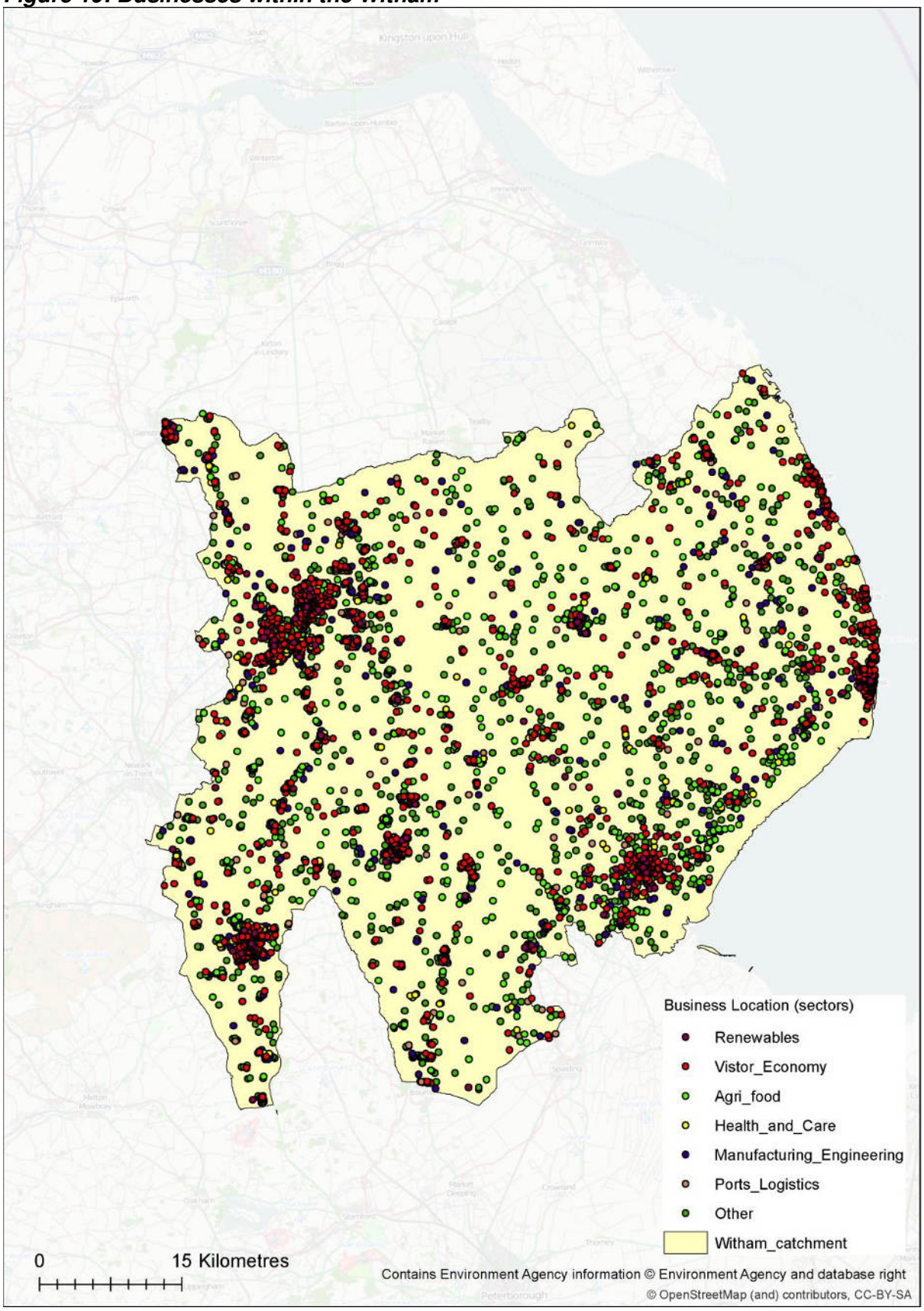
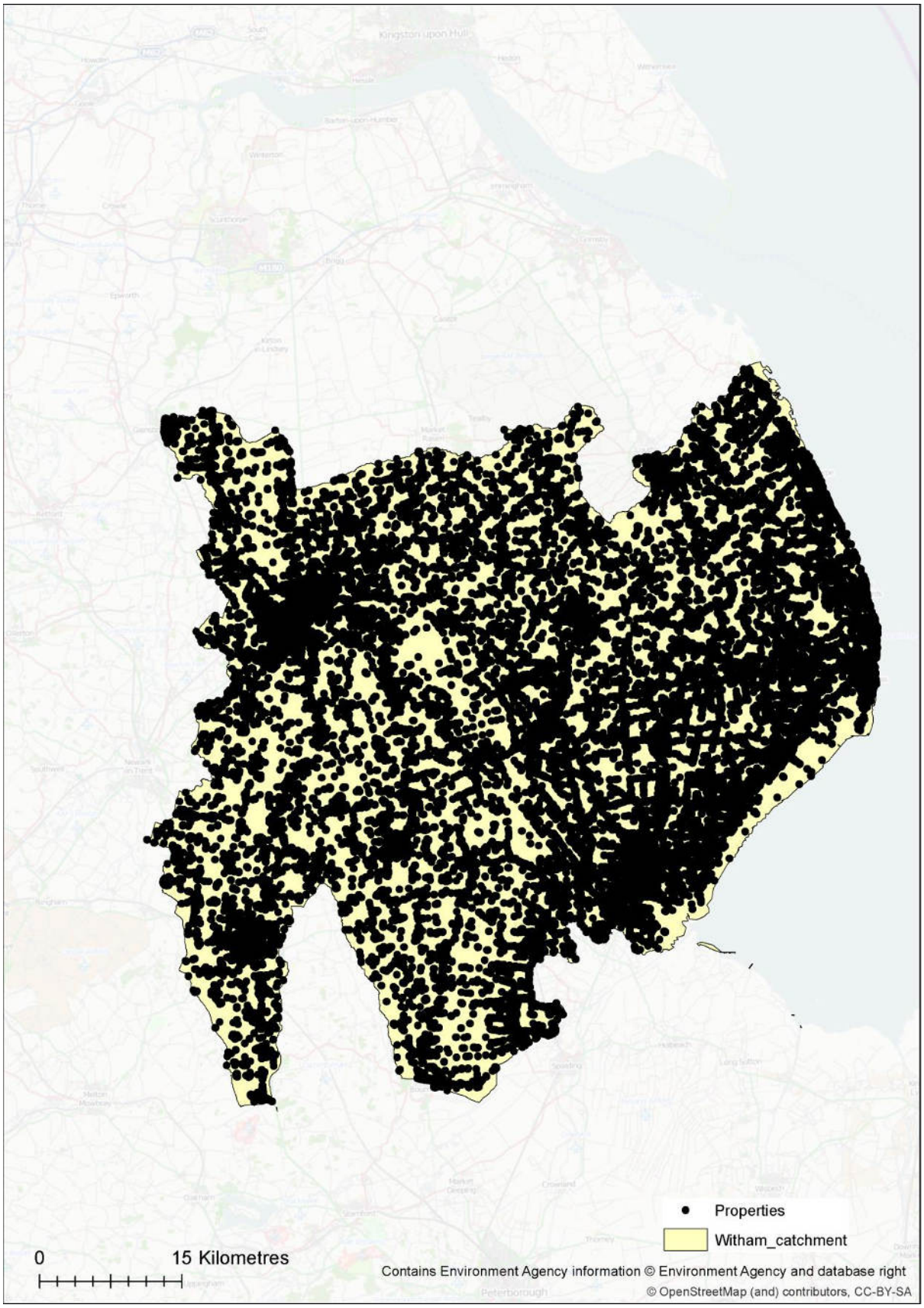


Figure 20: All properties within the Witham

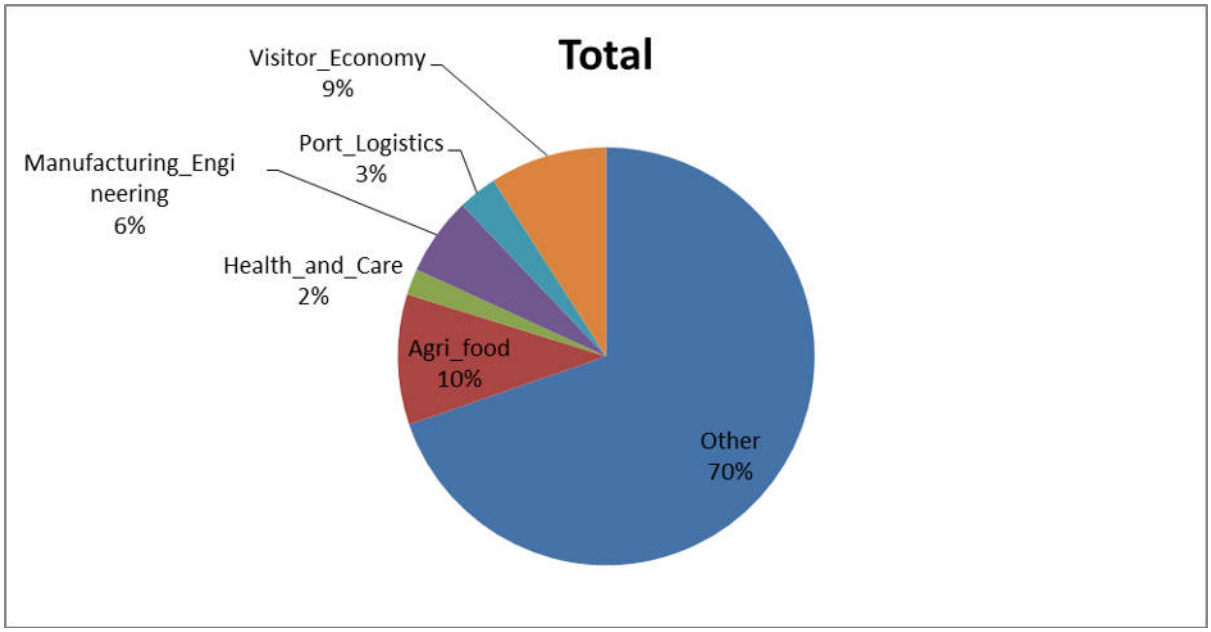


3.5 Boston (fluvial and tidal flood risk)

The Boston fluvial flood risk project will protect at least 100 business properties in the centre of Boston town that have a previous history of flooding. The scheme will result in the protection of businesses including at least 10 business properties registered as agri-food, 3 as ports and logistics, 9 as visitor economy, 2 as health and care, 6 as manufacturing and engineering, and 69 as 'other'. The scheme will maintain the livlihood of businesses; many of which saw flooding in December 2013[27]. The scheme will aim to avoid these type of damages (Figures 21 and 22).

Since modelling data was unavailable at the time of the study, benefits for the Boston scheme have been estimated at a high level. The outputs are conservative as we have used the historic flood risk maps to define the areas which benefit from improved flood protection. Evidence from the Environment Agency suggests that the actual number of properties which will benefit from the scheme is 1,600 in Boston. More can be done to picture the wider number of beneficiaries once modelling outputs are shared, but in the meantime this evidence should be treated as conservative.

Figure 21: Boston beneficiaries by business type



The scheme will reduce the risk of flooding of at least 678 residential properties who have historically flooded and up to 1,600 in total. Many of these saw flooding as recently as December 2013; the BBC reported that over 200 properties were waiting to return to their homes two days after the flooding. This, understandably, saw business disruption as many staff did not work as usual (Figure 23).

[27] A BBC news article reported that on 13 January 2013, over a month after the 5 December flood, St Botolph's Church in Boston is still drying out http://www.bbc.co.uk/news/uk-england-lincolnshire-25712340

Figure 22: Businesses who have a history of flooding benefiting from Boston Flood Risk Scheme

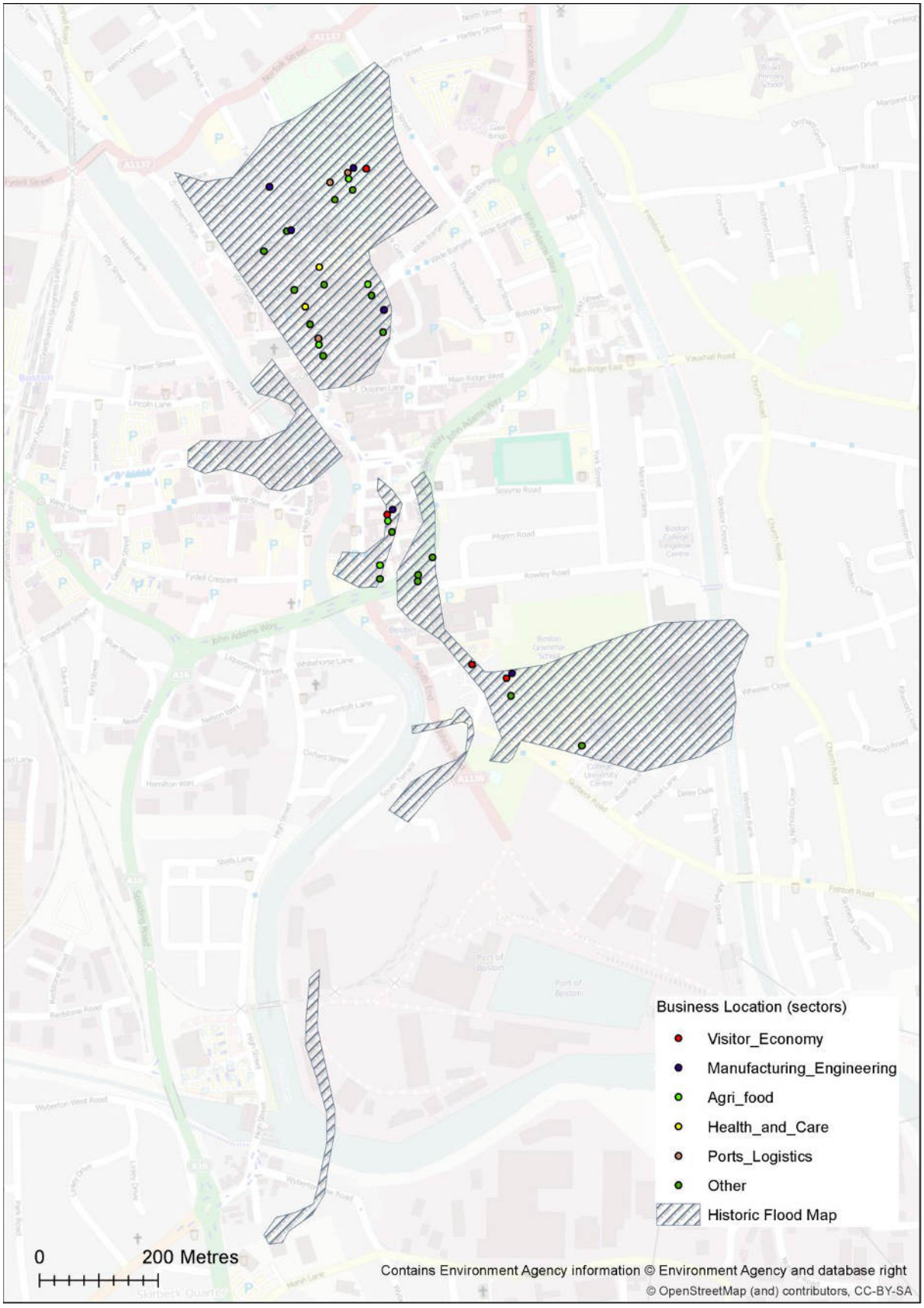
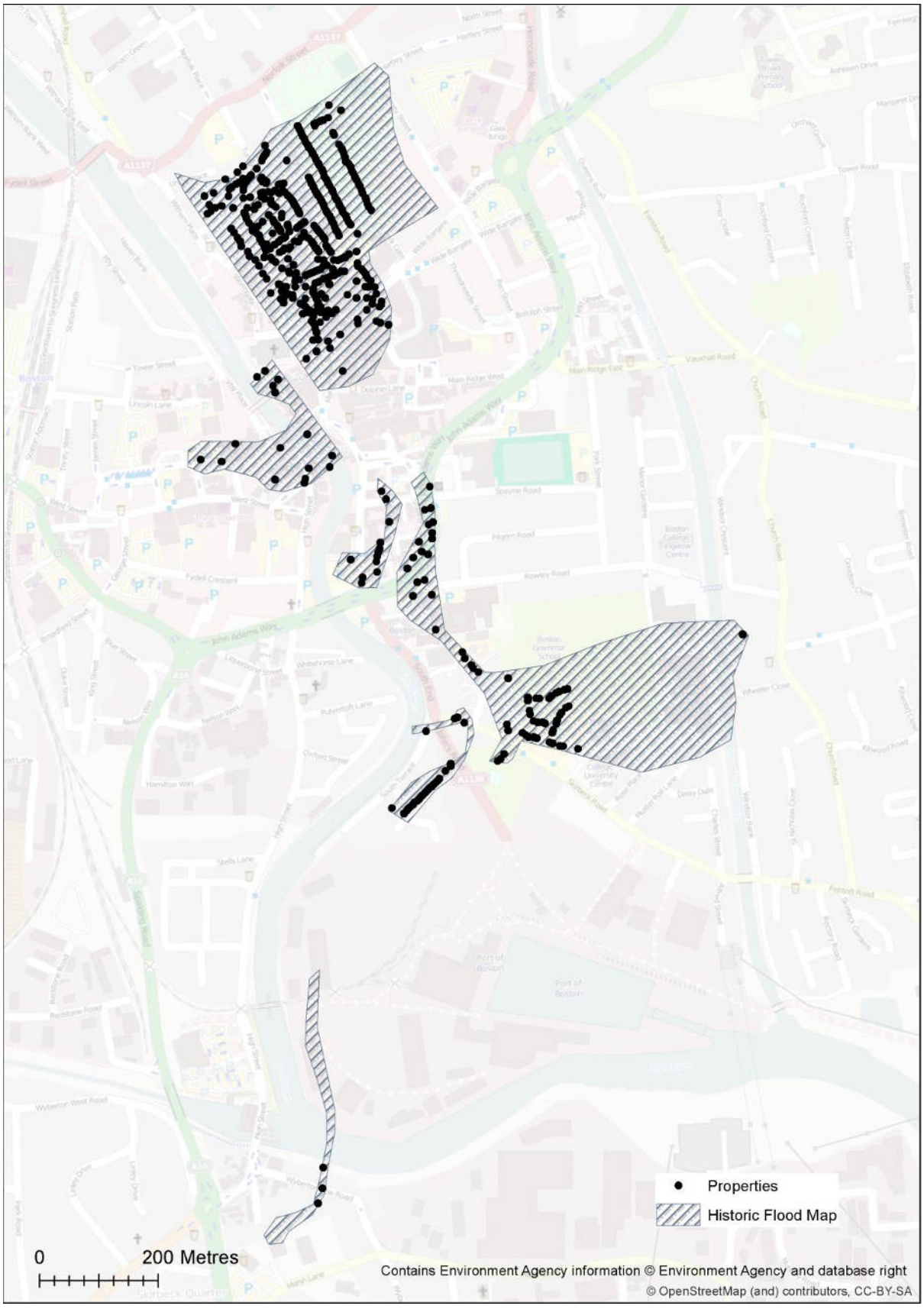


Figure 23: All properties that have a history of flooding benefiting from Boston Flood Risk Scheme



3.6 Ancholme Valley Improvements (Fluvial)

Despite past drainage improvements the Valley has a history of flooding to both agricultural land and residential areas, particularly in Brigg. Significant events occurred in 1973, 1978, 1981, 1993 and 2000. The 1981 event led to the flooding of 2,500 ha for up to 6 weeks.

The Environment Agency notes that the proposed scheme will reduce the flood risk to 840 properties within Brigg. Brigg is a small market town in North Lincolnshire, with a population of 5,076 living in 2,213 households (2001 UK census). The town lies at the junction of the River Ancholme and east-west transport routes across northern Lincolnshire. The River Ancholme drains approximately 560km sq. of predominately agricultural land.

The most significant beneficiaries of the scheme tend to be those located within the historic flood areas, although as development occurs within the catchment and flood risk investments are made, the flood risk area can shift. Businesses and properties within a 3km area of the Ancholme Valley have been mapped, anticipating that any flooding of a town centre will negatively affect those who travel and work within it.

It is estimated that the scheme will benefit up to 38 business properties registered as agri-food, 37 as ports and logistics, 54 as visitor economy, 28 as health and care, 44 as manufacturing and engineering, and 414 as 'other'. These businesses are located within 3km of the town centre and area of historic flooding (Figures 24, 25 and 26).

Figure 24: Ancholme Valley beneficiaries by business type

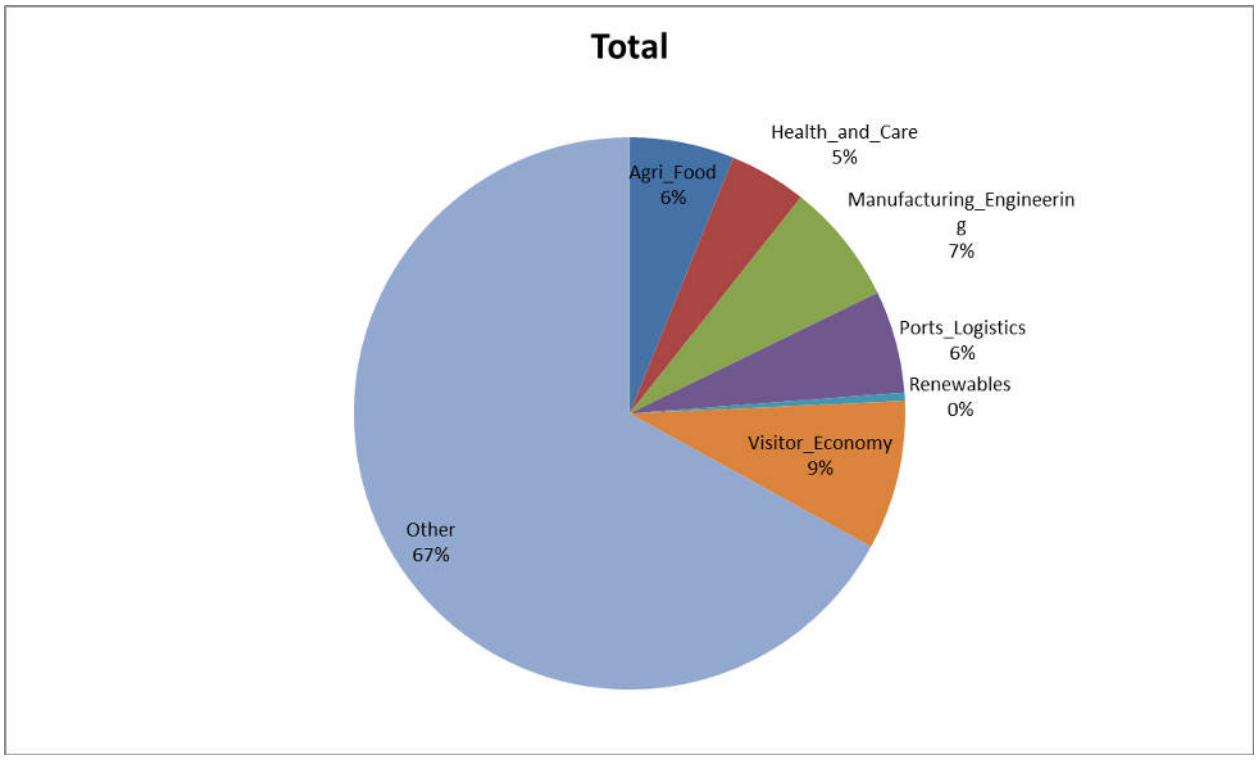


Figure 25: Business properties benefiting from Ancholme Valley Flood Risk Scheme

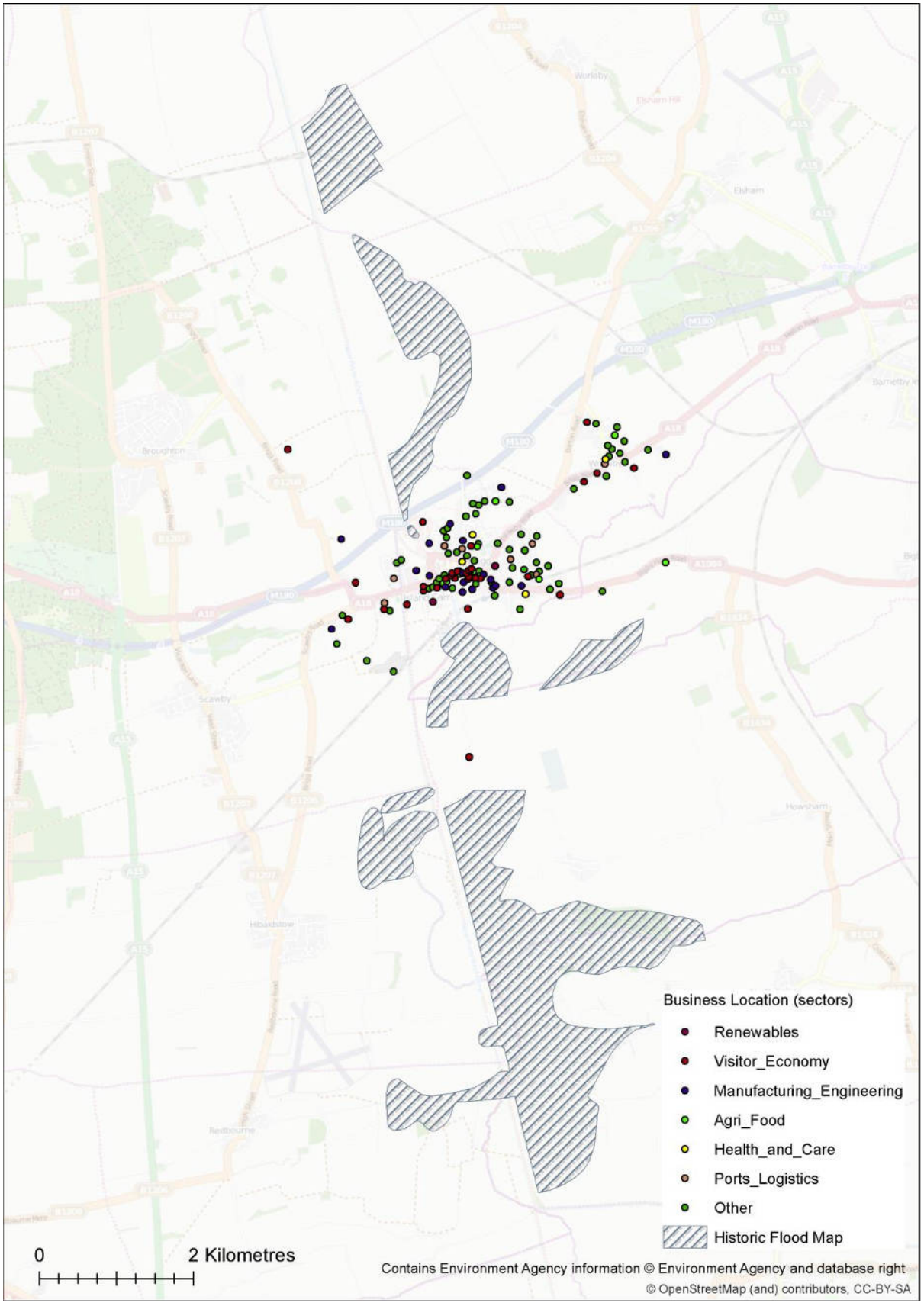
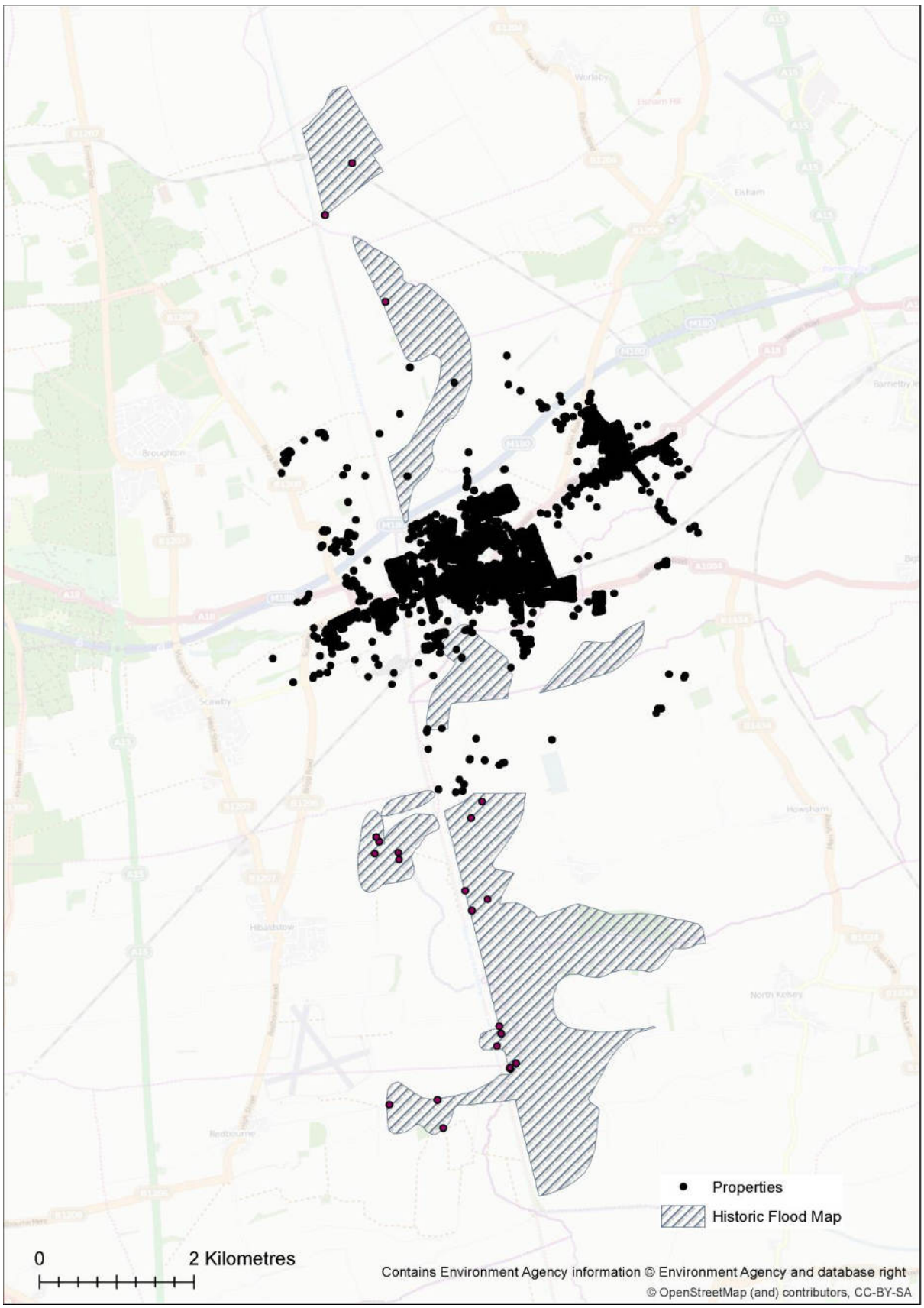


Figure 26: All properties benefiting from Ancholme Valley Flood Risk Scheme



3.7 Fens waterway link opportunity study (WFD/Visitor Economy)

This opportunity study will investigate the feasibility of implementing a project to link waterways within the Fens. The Fens Waterways Link is an infrastructure project that would promise to be one of the most significant waterway developments in two centuries, creating the biggest waterway enhancement scheme in Europe. It will connect the Cathedral Cities of the East of England and open up 240km of interconnected waterway, including 80km of new waterway and increased access to 160km. Here, we look at the potential benefits of the scheme if it was implemented.

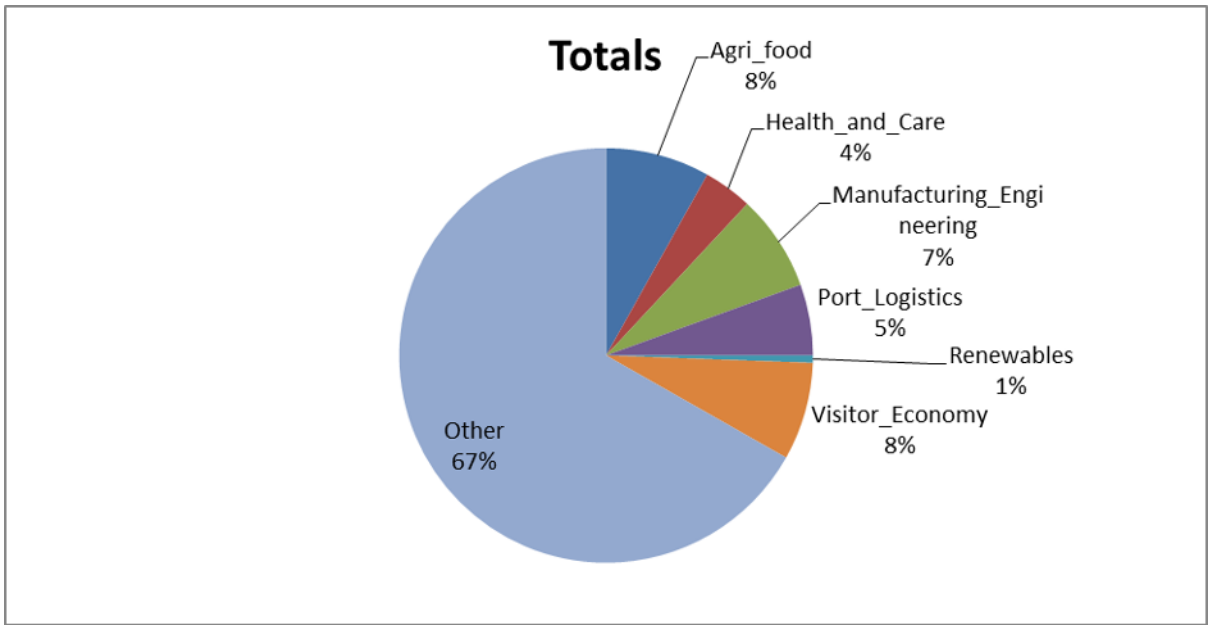
The implementation of the project is likely to promote the site from 'honeypot' to 'national' status. The Link will create a number of new circular routes for regional boating as well as wider opportunities for recreation, tourism and the environment. The new waterway will be sympathetic to the character and history of the Fens and sensitively linked with the water environment, promoting a better quality of life. It will put the Fens on the map as a nationally recognised destination, as well known as the Norfolk Broads.

The benefits of an enhanced environment and an increase in visitor numbers will, as a conservative estimate, affect businesses at least within 5km of the waterway. The visitor economy will directly benefit from increased demand for services.

Furthermore, local employees in walking or cycling distance from the waterway will benefit from any enhanced environment and improved transport links. It is well known that a healthy environment enjoyed through the window, during lunch time or on the way to and from work is conducive to productivity and an aesthetically pleasing environment is attractive to future employees.

The local beneficiaries within 5km of the scheme include 552 business properties registered as agri-food, 337 as ports and logistics, 518 as visitor economy, 259 as health and care, 510 as manufacturing and engineering, 38 as renewables and 5434 as 'other'. There are also around 70,000 residential properties within 5km of the link (Figures 27, 28 and 29).

Figure 27: Fens waterway link beneficiaries by business type



Visitor numbers will also improve as a result of the implementation of the Link. The Environment Agency Benefits Assessment Guidance suggests that the amount of visitors

decay over longer distances. It estimates the number of visits, dependant upon type of site is as follows:

Site type	Visit rate per adult per year	Visit rate average distance from site	% of population within distance
Local - mid	21.3	1km	100%
Honeypot - mid	17	1-3km	100%
Regional - mid	2	3-30km	20%

The implementation project will aim to progress the site from a 'honeypot' to 'regional' status. Taking the mid values, this would mean visitor numbers would be likely to increase to include 20% of those living between 3 and 30km from the site, assuming no other large substitute sites.

GIS analysis shows the numbers of those based near to the waterway link are as follows:

Distance	Total	Business	Residential
1km	17,396	1,356	16,040
3km	50,261	4,379	45,882
5km	76,648	6,788	69,860
10km	101,453	8,654	92,799
30km	221,553	17,646	203,907

Thus, the number of visits can be estimated to increase by over 100,000 per annum or 7.5%. These are conservative estimates.

Site type	Visit rate per adult per year	Visit rate average distance from site	% of population within distance	Cumulative visitor calculation
Honeypot - mid	17	1-3km	100%	1,562,097
Regional - mid	2	3-30km	20%	1,678,404
			Change =	116,306

These extra visitors are likely to benefit the visitor economy in particular; 518 local businesses.

Figure 28: Businesses benefiting from Fens Waterway Link

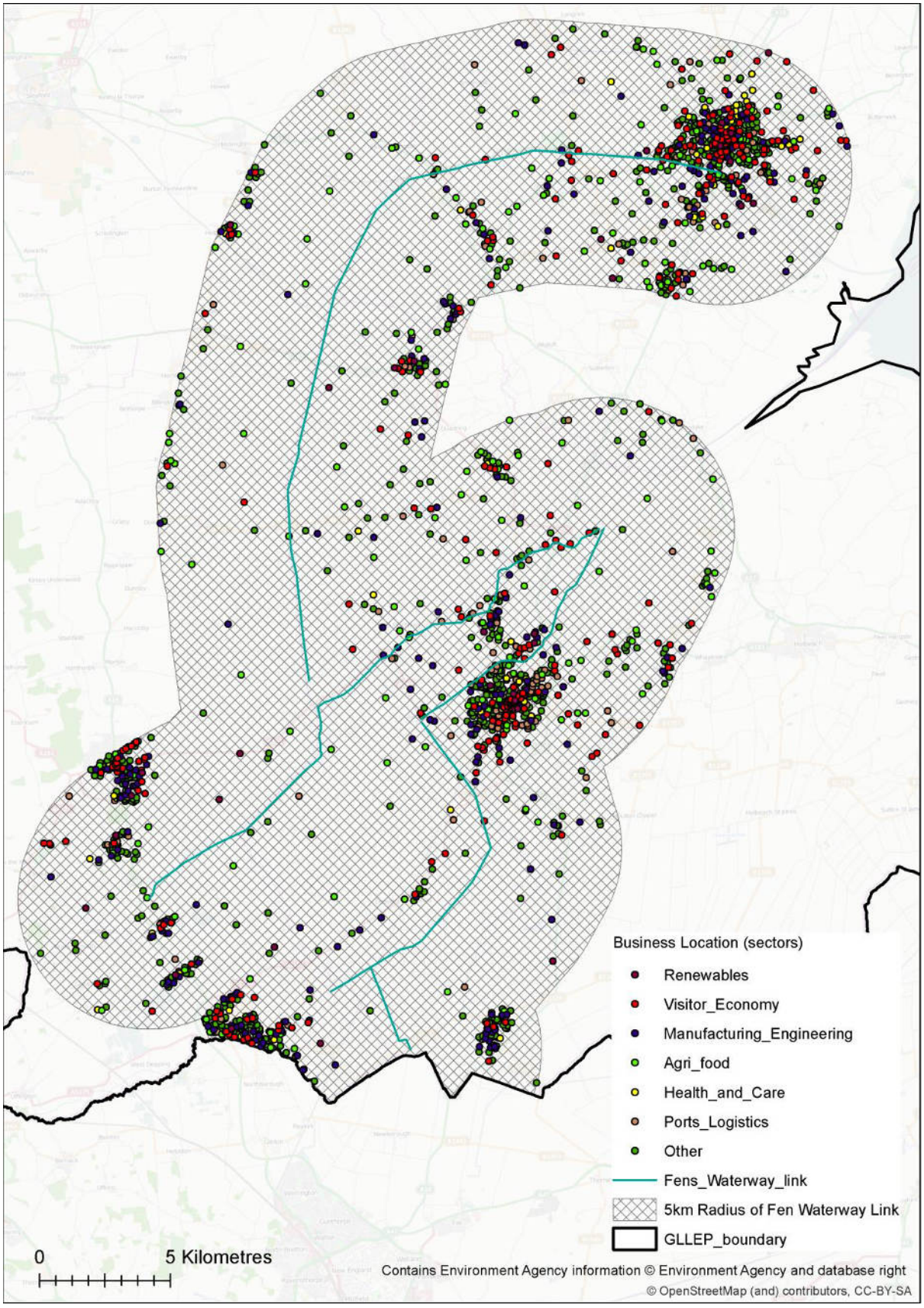
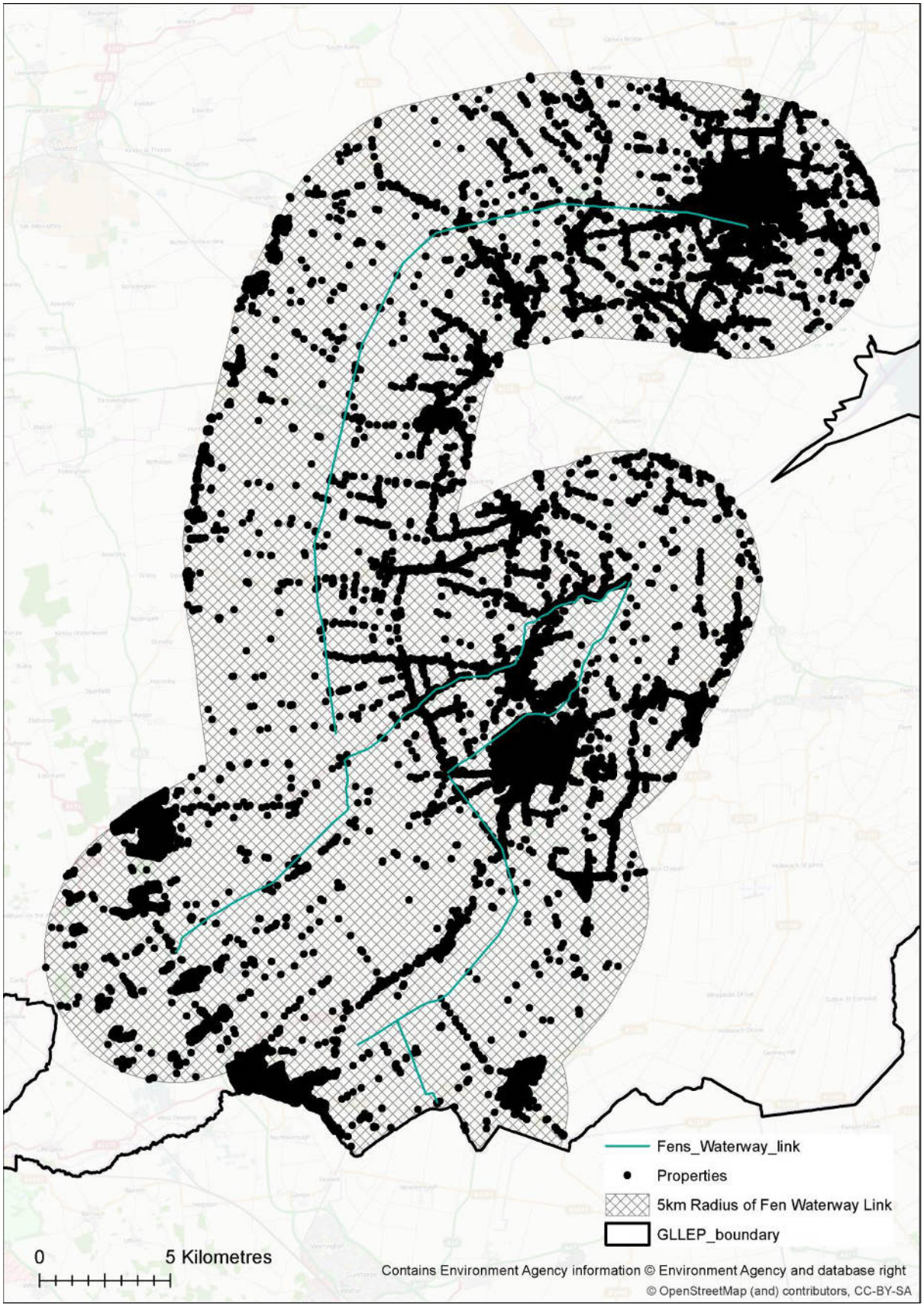


Figure 29: All properties benefiting from Fens Waterway Link



3.8 The Fens and Spalding projects

There are a number of projects which can provide significant benefits to the visitor economy and local businesses in Spalding and the Fens. These include:

- Ecosystem Services in the Fens study (WFD)
- Spalding Waterspace Study Implementation (WFD/Waterways)
- Fens Integrated Access Plan (Tourism)
- Destination Fens (Tourism)
- Water for wildlife and farming in the Fens (WFD/Water Resources)

The aim of the Waterspace Study Implementation project is to complement the Lincolnshire Waterways Partnership's vision for the Fens Waterways Link and in particular South Holland District Council's aspirations to promote Spalding as a waterway destination. The project will promote the river corridors as an integral part of the surrounding district in order to help maximise the economic opportunities and regeneration.

The Ecosystem Services in the Fens study (WFD), Fens Integrated Access Plan and Destination Fens projects aim to improve the appreciation of the environment and increase visitor numbers.

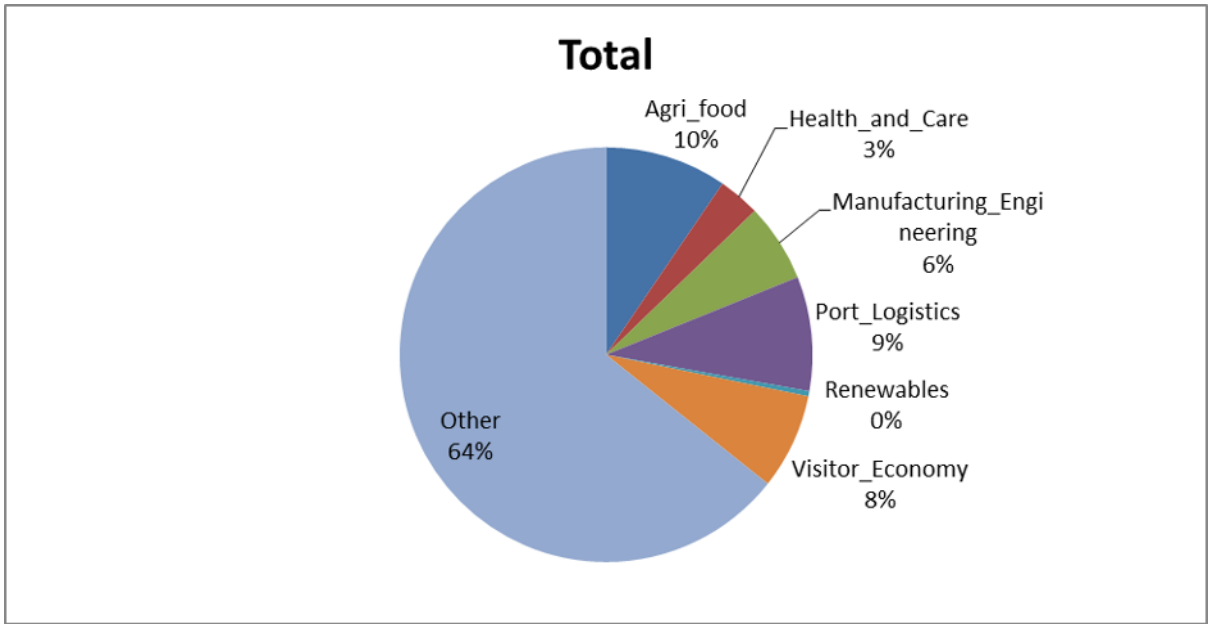
Finally, the Water for Wildlife and Farming in the Fens study will explore the potential for a cross-sector partnership approach to developing new 'storage wetlands' that can deliver significant areas of habitat and tolerate high levels of summer abstraction without compromising biodiversity interest.

Considerable investment in the area can support Spalding as a gateway of the Fens.

Again, it is estimated that businesses within 5km of Spalding will realise the benefits of the Fens projects. It has been assumed that Spalding Town is represented by a circle with a 1km radius and therefore the total area of benefit may be 6km from a central point.

The local beneficiaries within 6km of the central point of Spalding include 211 business properties registered as agri-food, 197 as ports and logistics, 165 as visitor economy, 72 as health and care, 135 as manufacturing and engineering, 9 as renewables and 1422 as 'other'. There are also 18,642 residential properties within 6km of Spalding (Figures 30, 31, 32 and 33).

Figure 30: Beneficiaries by business type for the Fens and Spalding projects



The visitor economy is particularly buoyant here. There is strategic potential in growing this comparative advantage. Using the estimates on visitor numbers from the Environment Agency's Benefit Assessment Guidance, an increase in visits by about 8,700 per annum or 13% is estimated if the projects can deliver a change from 'honeypot' to 'regional' status.

Site type	Visit rate per adult per year	Visit rate average distance from site	% of population within distance	Cumulative visitor calculation
Honeypot - mid	17	1-3km	100%	634,244
Regional - mid	2	3-30km	20%	721,944
				87,700

Figure 31: Businesses benefiting from Fens and Spalding projects

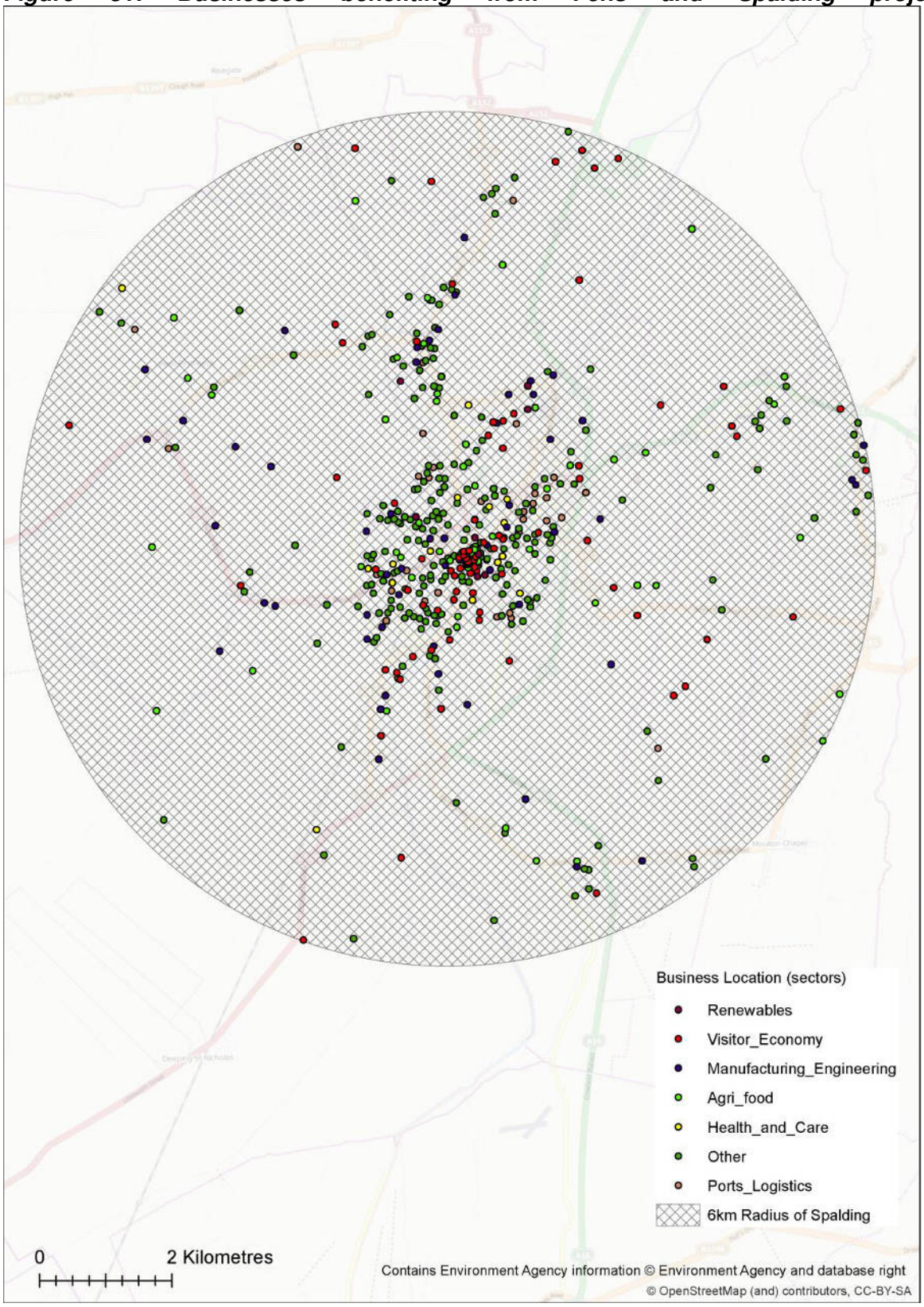


Figure 32: All properties benefiting from Fens and Spalding projects

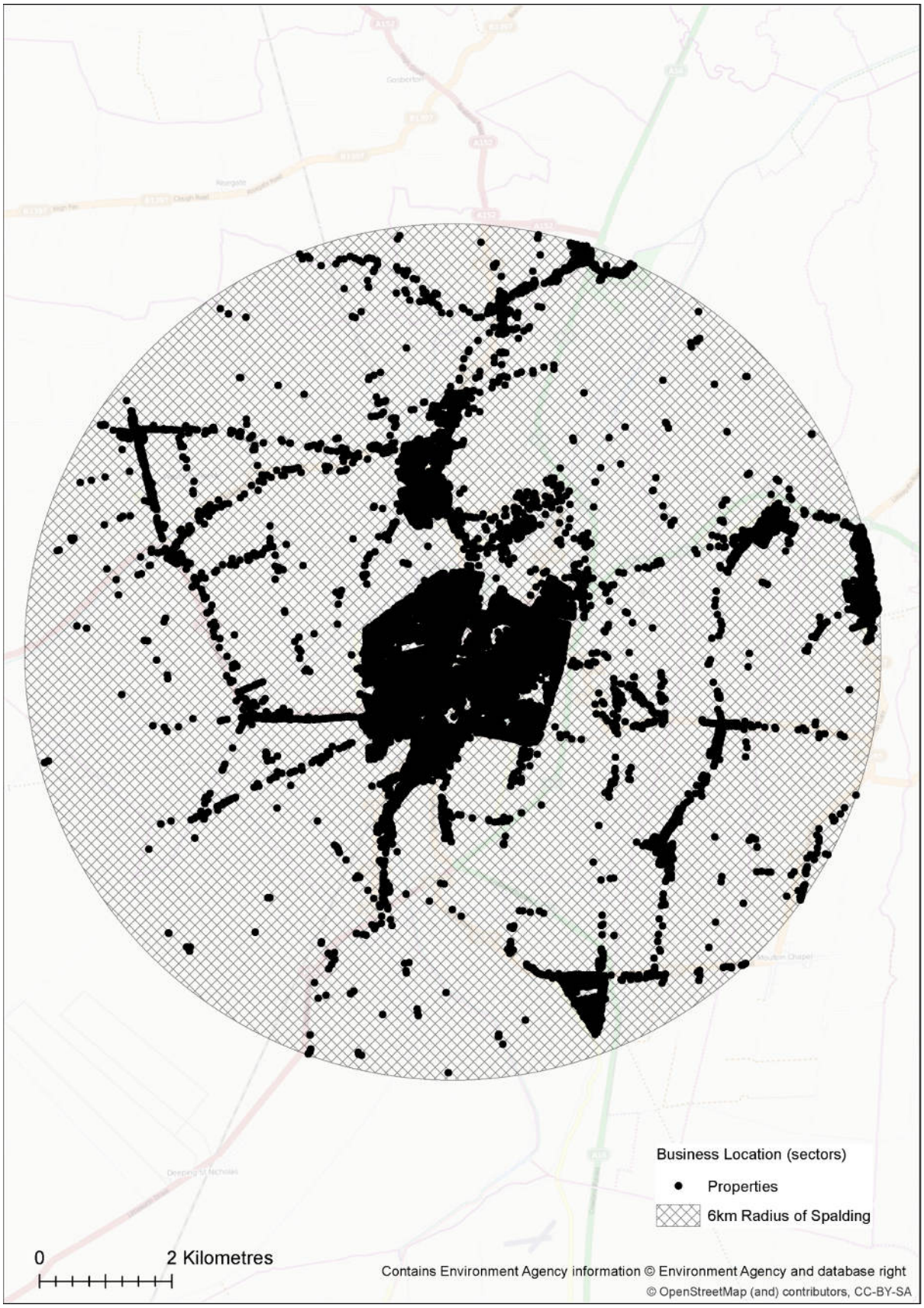
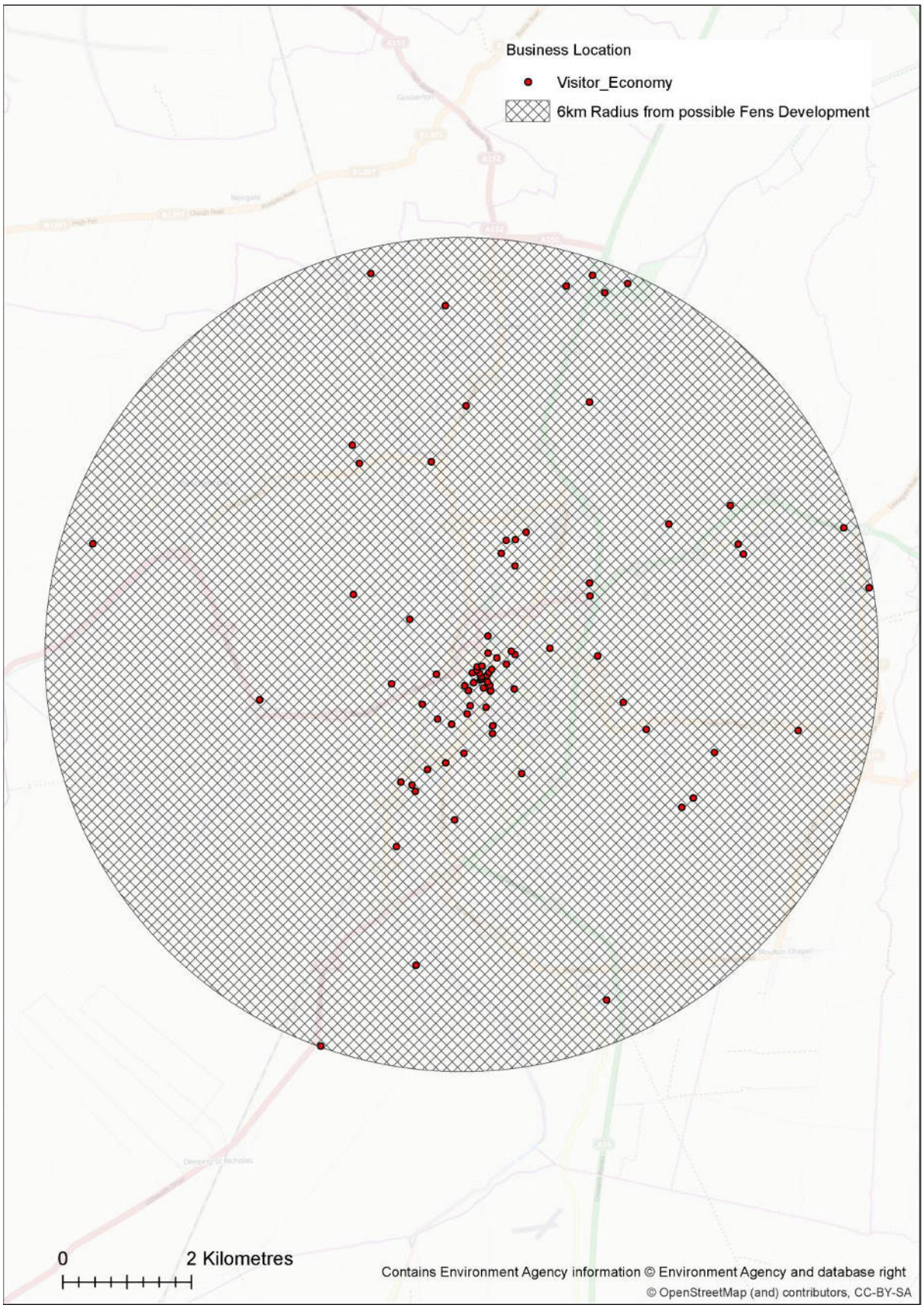


Figure 33: 165 visitor economy businesses benefiting from the Spalding projects



4 Business Impacts

4.1 Risk to business

Extreme weather events are a significant risk to businesses as they can restrict and even stop operations.

The 2013 Business Continuity Management Survey by the Chartered Management Industry (CMI) asked businesses which disruptions would have a major impact on their business (Figure 34). This year, before the 2013 floods had occurred, 43% of businesses surveyed said extreme weather would have a significant effect on their business.

Furthermore, a report by Ricardo-AEA on preparedness to climate change identified 'flooding' and 'very wet winters' are the two events most likely to have significantly affected organisations over the last three years (24% and 12% respectively)[28].

Figure 34: CMI, 2013, Business continuity management report[29]

Threats	Perceptions of threats in previous years						
	2008 %	2009 %	2010 %	2011 %	2012 %	2013 %	Increase/ decrease %
Loss of IT	73	71	69	67	72	63	-9
Loss of access to site	63	55	56	56	58	53	-6
Loss of telecommunications	68	59	62	55	61	52	-9
Loss of electricity[1]	-	-	-	-	-	49	n/a
Loss of skills	62	52	55	53	58	48	-10
Loss of people	59	54	52	51	54	47	-8
Fire	58	48	55	51	55	46	9
Damage to corporate image/brand/reputation	55	52	51	51	55	45	-10
Extreme weather e.g. flood/high winds	46	44	48	45	47	43	-4
Terrorist incident	53	42	46	43	47	40	-7
Negative publicity/coverage	51	41	41	42	44	39	-5
Employee health and safety incident	44	40	38	34	35	35	0
Transport disruption	-	-	37	35	36	34	-2
Loss of water/sewage	-	-	41	36	39	32	-7
Supply chain disruption	37	31	36	34	34	30	-4
Environmental incident	36	31	29	27	30	30	0
Loss of gas	-	-	-	-	-	27	n/a
Customer health/product safety incident	35	28	29	28	31	27	-4
Industrial action	26	24	29	27	32	26	-6
School/childcare closures	-	-	17	18	21	20	-1
Pressure group protest	27	21	19	17	21	20	-1

A representative from the agricultural sector in Greater Lincolnshire reported that he perceived natural hazards to be one of his top four challenges; the others being failure to innovate, damage to reputation and regulatory risk.[30]

The reason that natural hazards are considered so important is due to the potential impact they can cause. The following discussion outlines the quantitative evidence available on

[28] http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=18552
[29] available at http://www.managers.org.uk/node/92305/done?sid=38802
[30] From our survey at https://www.surveymonkey.com/s/5LTGGCG

these impacts. By avoiding negative impacts the benefits that Growth Fund funding can unlock in Greater Lincolnshire can be observed.

4.2 Flooding

During and after a flood, affected businesses slow or shut down operations due to property inundation, the loss of access to site and loss of IT and electricity.

The impact of flooding depends upon:

- The magnitude of storm,
- Flood risk management infrastructure in place,
- Location of the business with respect to the water source,
- Gradient and permeability of land
- Building type and
- The extent of low electrical and mechanical fixtures and fittings, low ceilings and basement conversions[31].

To reduce the impact, sustainable planning can regulate the construction and location of property development in the long term, while in the medium term the flood risk management infrastructure helps to alleviate the issue.

Flooding tends to come hand in hand with high winds which increase the likeliness of tree falling incidents. This is because the moisture in the ground lubricates the roots, making it easier for trees to uproot in the wind. The December 2013 storm caused a fatality through this manner in Nottinghamshire.

The costs to business include costs to replace damaged stock, costs of forgoing the income of damaged produce, lost business days, cost of hiring equipment (e.g. dehumidifiers and other tools) and their associated electricity costs, lost time spent on clearing and lost time spent on insurance claims, building/ structural damage, and other administration costs. There are also further non market costs such as stress and reputational loss. And in some cases, where flooding is severe there can be loss of life.

The length of lost business days depends upon the duration of the flood, clean up needs, funding and whether temporary premises are available. Wedwatt et al (2012) suggests that 80% of small and medium enterprises (SMEs) would have been closed for around 3 months if they had not moved to a temporary premise. The main activity conducted by businesses in the flood aftermath was cleaning and dehydration.

Middlesex University has estimated average damage costs to properties and agricultural farmland as a result of flooding. These are high level as they do not take in account the unique value of a property and the individual fixtures, fittings and valuables within. These values are those used by the Environment Agency as per the Flood and Coastal Risk Management Appraisal Guidance (FCERM-AG) to estimate damages (Table 14).

Real data from insurance claims are also available. The cost of 2007 floods report (Environment Agency, 2010) reviewed insurance data to understand the average claim per property during the flood.

The valuation information resulting from these sources is outlined below and will be used to estimate the avoided damages due to a better level of flood protection.

[31] Artimis, 2013 http://www.artemis.bm/blog/2013/12/07/european-windstorm-xaver-updates-from-risk-modellers/

Table 14: Economic damages during and after a flood

Category	Description	Best estimate	Range		Unit (2012 prices)	Source
Damage to residential properties	• **Direct damages** – insurance claims per property	£24,303	£13,000	£30,000	£/property	1
Damage to caravans and other mobile structures		£12,500	£10,000	£15,000	£/caravan	2
Damage to non-residential properties		£55,652	£24,000	£90,000	£/property or claim	1
Costs / effects of Temporary accommodation	Emergency shelters or alternative accommodation needed by households or businesses that have to abandon their premises due to flooding. Costs vary depending on the time spent out, which can range from a few days to months.					
Residential		£6,695			£/property	1
Commercial		£5461			£/property	1
Extra heating costs						
Residential		£716	£644	£788	£/property	2
non-residential		£716	£644	£788	£/property	2
Emergency services and road repairs (uplift factor)	Emergency costs are costs incurred by a number of organisations in tackling flooding. These include total emergency costs incurred by local authorities, the severe weather payments and the Environment Agency's emergency and recovery costs.	8.15%	5.6%	10.70%	uplift	2
Traffic and utility disruption, including communications (uplift factor)	• **Road** - Flooding creates traffic disruption when roads are inundated and damaged. In addition road closures and traffic diversions take additional time and increase travel costs; • **Rail** - Rail networks can also be affected by floods, knock-on effects vary depending on the importance of the line affected and duration of closure; and • **Utilities** – Power supply and generation, telecommunications, water supply and	Bespoke calculation				2

	sewerage systems can be disrupted by flooding. Several thousands of people are reported to have experience power cuts in 2012 (BBC, 2012a)					
Impacts on the local economy (uplift factor)	Costs on businesses can be assessed by looking at: • **Direct impacts** – e.g. damage to premises, equipment, fittings, and loss of stock; and • **Indirect impacts** – e.g. reduction in production of goods and services.	12%	8%	16%	Uplift on economic property losses	1, 3
Public health (2010 prices)	Flooding can result in stress, other related health impacts and in some cases a loss of life. There is a link between the type of flood event and the number of fatalities. Flash floods which come with little or no warning result in higher casualty rates. Whereas flooding as a result of prolonged rainfall results in lower mortality rates.					
Fatalities		Bespoke calculation				2
Injuries		unknown				
Mental Health		unknown				
Agricultural impacts (£/ha)		£1153	£731	£1575	£/hectare	
Grassland and Livestock farms	Farmland is vulnerable to flooding in the summer when crops are nearing harvest and grassland for livestock is most productive.	£647	£231	£1063	£/hectare	1
Arable land		£1293	£946	£1640	£/hectare	1
Other costs		£100	£52	£148	£/hectare	1

Source 1: Cost of the 2007 floods (Environment Agency, 2008),

Source 2 Multicoloured Handbook (Middlesex University, 2010).

Source 3 RPA and Royal Haskoning (2008), Economic impacts of flood risk in Yorkshire and Humber, A report for the Environment Agency, Yorkshire Forward and Yorkshire and Humber Assembly

Direct damages to business properties, such as clean-up costs and repairs to building fabric, can cost a business in the region of £24-90k depending upon the type of business and the flood event.[32] Furthermore, costs to agriculture, assuming crop damages have occurred, can range from £231-£1,063 for grassland and livestock (which is fairly adaptable) to around £946-£1,640 for arable (which is less so).

There are further knock on effects to the economy as a result of the reduction in production and sales of goods and services. This is of importance to the Treasury when the good affected is of national significance. This is of further importance to Greater Lincolnshire's economy if it disadvantages its unique selling point, encourages buyers to purchase elsewhere out of the region, or forces local businesses to shut down resulting in higher unemployment and lower business rate and council tax revenue. The Multi-coloured Manual (Middlesex, 2010) estimates we would see economic losses in the range of 16% of property losses. The 2007 floods report estimates that economic losses are 8% of property losses.

The potential economic impact to Agri-food industry and Ports from flooding is investigated in more detail below, as these are regarded as the most sensitive sectors.

4.2.1 Agri-food and flooding

Damage costs to business

The damage costs estimated using the Multi-coloured Manual (Middlesex, 2010) includes the loss of saleable produce as a result of a flood. For the agricultural sector, this is often worst during harvest time, where a loss of produce has major impacts on a farmer's revenue.

Where investments in flood risk management reduce the risk of premises being flooded, it is assumed, using the evidence outlined in the table above, that there has been an avoided cost of £55,652 per property. Where flood risk management investments have reduced the risk of agricultural land being flooded, it is assumed, using the table above, that since Greater Lincolnshire grows largely wheat, winter barley, spring barley and oilseed rape, an avoided cost of £1,293 per hectare (assuming 'arable land').

Additional economic impacts

Flooding can cause the following primary and secondary impacts on agriculture (Table 15):

Table 15: Tim Benton et al, 2012, 'Severe weather and food chain resilience'

Flooding	Impedes access	e.g. harvest
	Erodes soil, washes away nitrogen and other inputs	Long term yield loss
	Removes plants, drowns plants, lodges plants	Loss of yield, replacement planting
	Reduces growth	Yield/forage loss
	Livestock loss	Lost yield

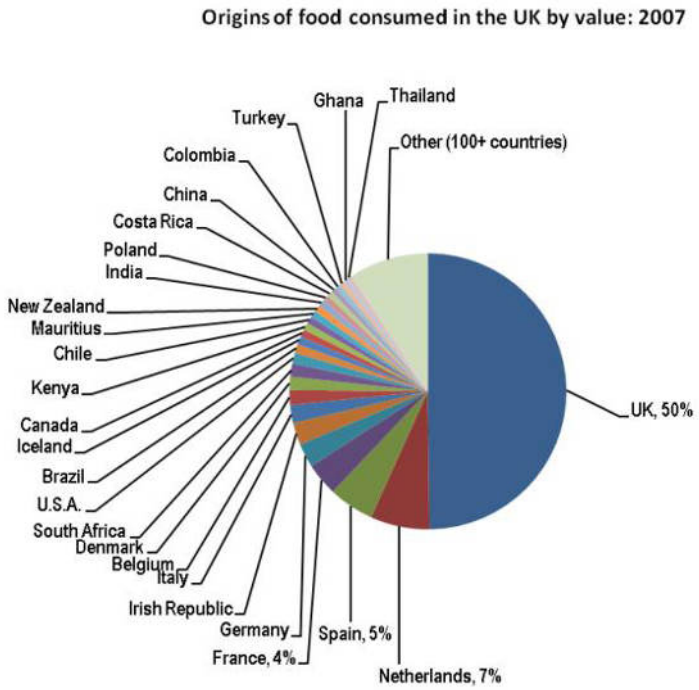
In simple terms, yield loss causes lower supply, which causes higher prices. Liam Halligan of the Guardian reported that 'It's certainly the case, though, that UK food production looks weak, as heavy rainfall in 2012 meant many crops were ruined and farmers couldn't plant as much as they wanted for 2013'. Despite a very dry first quarter, 2012 was this country's second-wettest year since records began in 1910. While it was the year-end winter flooding that caught the headlines, the impact of heavy rainfall from last spring onwards will continue to be felt in the inflation numbers well into 2013. While UK food price inflation accelerated to

[32] As outlined in the Middlesex multi-coloured manual (2010)

4.6pc in November according to the British Retail Consortium, up from 4.0pc the month before, these numbers are likely to get much higher over the next few months.'[33]

Defra is keen to encourage food security through globalisation to avoid the impact of price shocks due to changes in UK food supply. However, over half of domestic (unprocessed) food consumption is supplied by domestic producers (Figure 35).

Figure 35: Defra, 2010, Food Security Assessment.

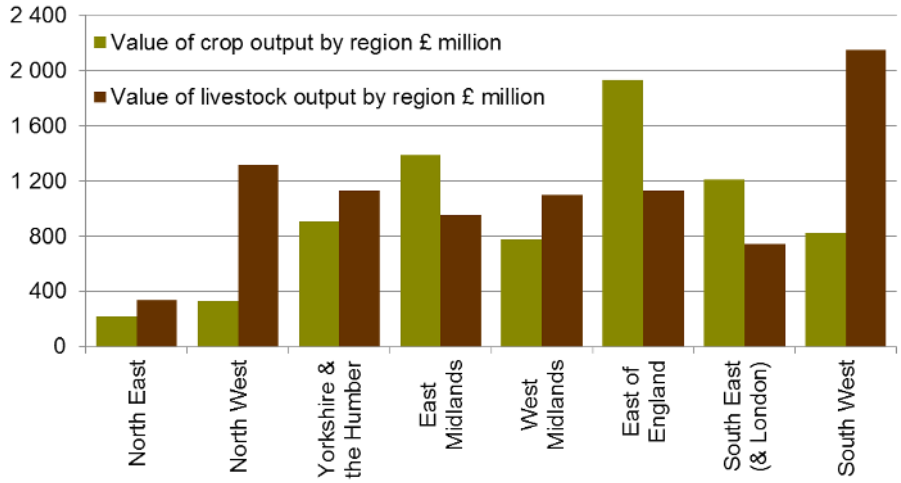


The Defra Food Security Assessment (2010) notes that 'Climate change impacts are captured by, or will have implications for, a number of the themes and indicators, for example... More frequent extreme weather events in the UK will test business continuity planning and infrastructure resilience. Coastal flooding can affect ports and agricultural land use.'

Currently, the value of crop output of East Anglia is the highest in the UK, accounting for 22% of total UK farming income or 26% of total crop output (see Figures 36, 37 and 38). This means that East Anglia supplies around 1/8th of total UK food consumption.

[33] Guardian (2013) online at http://www.telegraph.co.uk/finance/comment/liamhalligan/9782815/Rising-food-prices-will-reap-a-bitter-harvest.html

Figure 36: Defra, 2013, Agriculture in the English regions[34]



Over 70% of the land in Anglian region (2.1 million ha) was farmed in 2009, with 1.6 million hectares used for crops and horticulture. A third of the most productive farmland is at risk of flooding[35]. Widespread flooding, therefore, could have an impact on the UK's agricultural output.

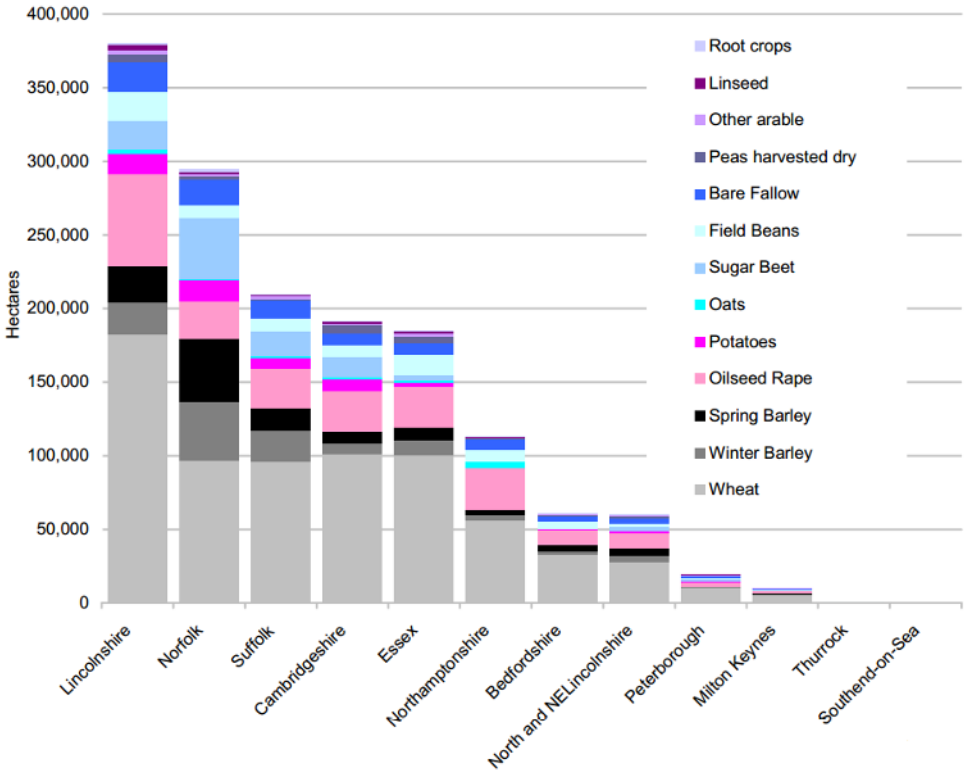
Figure 37: Defra, 2013, Agriculture in the English regions[36]

£ million

Region	Total crop output	Total livestock output	Gross output at basic prices	Intermediate consumption	Gross Value Added at basic prices	Total Income from Farming
England	7 600	8 862	18 034	10 834	7 200	3 802
North East	219	335	602	308	294	210
North West	334	1 313	1 782	1 089	692	213
Yorkshire & the Humber	910	1 131	2 222	1 274	948	634
East Midlands	1 391	953	2 600	1 679	921	548
West Midlands	779	1 099	2 036	1 199	837	382
East of England	1 933	1 132	3 445	2 176	1 270	845
South East (& London)	1 210	746	2 122	1 218	904	369
South West	823	2 152	3 226	1 892	1 334	602

[34] Online at https://www.gov.uk/government/publications/agriculture-in-the-english-regions
[35] Environment Agency (2012) State of the Environment Report, online at http://www.environment-agency.gov.uk/static/documents/Business/SOE_-_Agriculture_and_Land_Management.pdf
[36] Online at https://www.gov.uk/government/publications/agriculture-in-the-english-regions

Figure 38: Environment Agency, 2012, 'State of the Environment Report' (Anglian – Agriculture)



Since Greater Lincolnshire farms the largest proportion of food in East Anglia, there is no other county in the UK that can claim their supply of agricultural outputs is more nationally important.

While there is a strong case to protect Greater Lincolnshire's agricultural sector from flooding to improve UK food resilience and to encourage growth in an area with a clear unique selling point, calculating the impact of a supply side shock due to flooding on the UK's food price is more difficult to do.

In particular, food prices are very sensitive to energy prices and transportation. Decoupling the effects of these variables and others from food prices to isolate the link between a flood and price would require extensive regression analysis which would seem spurious and beyond the scope of this project. However, historical events provide an alternative approach.

In the report 'Severe weather and food chain resilience' (2012), Tim Benton et al note that 'current early estimates, compiled by the BBC, of 2012's wet summer on UK production indicate economic losses in excess of £1bn. Provisional statistics on harvest yields for 2012 show that overall yields for cereals in the UK have dropped from 7.0 tonnes per hectare in 2011 to 6.2 tonnes per hectare in 2012.'

Flooding also causes a negative effect on the food and drink sector. The Defra Food Security Assessment (2010) notes that 'In order for the consumer to have guaranteed access to food on supermarket shelves, deliveries need to be made on a regular, predictable basis. Food security would only be threatened by widespread significant delays resulting from flooding, severe weather events, malicious attacks or any other accidental or malicious disruption affecting multiple points on the network.'

4.2.2 Ports and flooding

There are eight major ports in Greater Lincolnshire; Immingham Dock, Grimsby, Flixborough, Boothferry Terminal (Goole), Port of Boston, The Old Shipyard (Gainsborough), North Killingholme and Port Sutton Bridge which handle around 80m tonnes of cargo (Table 16;

2012 data). They largely import steel for UK wide distribution. Greater Lincolnshire's ports generate £700m for the local economy each year and employ around 18,000 workers[37].

Table 16: ONS (2013), Port Freight Statistics

		Thousand tonnes
`	**Port Group**	**2012**
(a) All traffic		
Boston	Wash & Northern E Anglia	829
Fosdyke	Wash & Northern E Anglia	.
Grimsby & Immingham	Humber	60,091
River Ouse [3]	Humber	157
River Trent 3	Humber	1,244
Rivers Hull and Humber [3]	Humber	10,283
Sutton Bridge	Wash & Northern E Anglia	415
Wisbech	Wash & Northern E Anglia	57
United Kingdom Total		**500,860**

The ports of Immingham and Grimsby are the largest Ports in the UK by tonnage and have been popular choices for some large blue chip companies working in offshore wind. The Humber Port has been coined as the largest development area for renewables in the UK[38]

Immingham Dock	The Port of Immingham is the UK's largest port by tonnage, handling up to 55 million tonnes, including nearly 20 million tonnes of oil and 10 million tonnes of coal.
Grimsby	Although retaining its strong connection with the fishing and food industry, Grimsby is the UK's major car import terminal and is at the forefront in serving the developing offshore wind energy industry. Handles more than 500,000 imported vehicles each year. Centrica, Siemens and RES have established operations within the port. The modern fish market, operated by Grimsby Fish Dock Enterprises Ltd, is recognised as one of the most important fish markets in Europe and handles some 20,000 tonnes of fresh fish each year.

The Defra Food Security Assessment (2010) noted that 'There are clusters of ports used for handling food import traffic, for instance in the South East and North East regions, and their geographical proximity suggests they could share some risks of disruption from extreme events (such as coastal flooding)'.

During severe flood warnings, particularly in the case of North Sea surges, anticipated ship loads will be re-routed or delayed due to the risks of stormy weather. During a flood, shipping loads cannot be transported where surrounding transport routes are inundated. In some events piers will be damaged, causing several weeks of disrupted production while engineers are consulted and repairs are made.

[37] Greater Lincolnshire LEP Strategic Economic Plan (2013)
[38] For more see http://www.investinnorthlincolnshire.co.uk/why-north-lincolnshire/north-lincolnshire-key-developments/able-humber-port/

There are historic reports of port emergency response and action. In February 1953, severe flooding affected Immingham Dock. The cargo steamer Hebble was turned on her side in the graving dock[39]. Meanwhile in the December 2013 floods, Nick Ellis, of Grimsby Mooring Services, said of the Royal Dock in Grimsby 'People have been saying it was all hype but what they don't realise is that if Associated British Ports (ABP) had not implemented their emergency procedures by running the dock down to accommodate the excess water, this combined with their excellent flood defences, the whole of the West Marsh would have been under water'[40]. Again in 2013, The Port of Boston rail link service underwent disruption. This normally sees two trains a week, carrying 1,000 tonnes of steel per train, to operate from Boston to a dedicated facility in Birmingham.[41]

Assuming regular business patterns and a 260 day business year, the broad brush estimate of the economic impact of a day's closure of all Greater Lincolnshire Ports is around £2.7m per day. This does not include damage costs to equipment, buildings, docks, piers and other areas of the port. The economic effects of flooding can last between three days and six months depending upon the impact and damage caused.

Following the methodology used by the EA on the 'cost of the 2007 floods' (2009), the damage costs can be estimated at the value of the site minus VAT divided by two. The value of a port would require a bespoke survey. The latest harbour for sale advertised online was the Charlestown Harbour, a small historic harbour for £5m[42]. As they are working ports, it is assumed that the smaller Greater Lincolnshire ports were worth at least ten times as much (with the Immingham and Grimsby worth considerably more than that). As a very conservative estimate, the damage costs to each port could therefore be in the region of £20m per smaller port per serious flood. If the risk of flooding decreased from 1:20 to 1:100 this would see an annual average benefit of £0.8m per smaller port.

These are very broad brush estimates. As a result, these values should be used with the right caveats. A bespoke valuation could confirm the validity of the calculations.

4.3 Water resources

A drought can occur when the demand for water outstrips available supply and there is unsustainable capacity to meet need. Often this occurs when rainfall has been low, since the majority of our water supply is reliant on freshwater and groundwater sources. In some cases the water company will initiate supply restrictions (a Temporary Use Ban/ hose pipe ban) and in major cases water supply to some customers can be halted completely. Meanwhile, to cater for direct water abstractions, the Environment Agency will enforce restrictions where conditional licences are in place. A licence will be in place where a business wants to take more than $20m^3$/day (4,400 gallons) from a 'source of supply' (river, stream, lake, well, groundwater, etc).

As Chapter 1 outlined, Greater Lincolnshire does not have a public water supply demand deficit overall (assuming unchanging public water supply abstraction licences), although there are localised demand supply deficits which are relieved through water transfers.

However, many parts of Greater Lincolnshire are over abstracted and Catchment Abstraction Management Strategies are in place[43]. Here, all licence renewal applications must pass a water efficiency test and Hands Off Flow requirements ensure that abstraction cannot take place when water levels drop below sustainable levels, such as during a drought.

To improve resilience during a drought, businesses can adapt by ensuring that their production is the least water intensive as possible. A project has been developed, related to

[39] Online at http://www.immingham100.co.uk/Events/Countdown/
[40] Online at http://www.grimsbytelegraph.co.uk/Dock-s-actions-praised/story-20274122-detail/story.html#ixzz2n5DqlK3K
[41] Online at http://www.visitoruk.com/Boston/
[42] http://www.businessesforsale.com/uk/Historic-Charlestown-Harbour-Shipyard-Business-Marine-Development-Land-For-Sale.aspx
[43] http://www.environment-agency.gov.uk/business/topics/water/119931.aspx

agriculture, where a Growth Fund investment can help farmers in Greater Lincolnshire become more resilient to drought. This is the 'Water for Wildlife and Farming on the Fens'.

4.3.1 Agri-food and water resources

Drought affects agriculture in the following primary and secondary ways:

Figure 39: Tim Benton et al, 2012, 'Severe weather and food chain resilience'

Heat/drought	Increased stress Heat stress (e.g. pre-sheering in sheep) Reduction in forage requiring supplementary feeding	Lost yield and quality

Benton et al (2012) notes that 'the impact of any drought will depend on its duration and its severity'. In addition, it will depend on temperature as droughts coupled with high temperatures have larger impacts on yields as well as high temperatures influencing a range of social factors that impact upon water availability for agricultural purposes.'

Locally, the Environment Agency reports that 'water availability for summer spray irrigation of crops is becoming an increasing issue in the Fens. It is likely that a significant number of new winter storage reservoirs will be needed to meet current and future demand.'

'The current design of farm reservoirs can provide some additional benefits for biodiversity and fisheries but these tend to be limited and peripheral. Equally many newly created wetlands have integral reservoirs to store and circulate water but are never abstracted from. Neither sector 'shares' water to any significant degree'.

The Water for Wildlife on the Fens project will explore the potential for a cross-sector partnership approach to developing new 'storage wetlands' that can deliver significant areas of habitat and tolerate high levels of summer abstraction without compromising biodiversity interest.'[44].

Both the UK NEA (2011) and Atkins and Cranfield (2000) have estimated the value of water for irrigation for crops. The value relates to an increase in yield as a result of irrigation during a year (Table 17).

Table 17: Value of irrigation

The physical characteristics of the goods: e.g. the impact, pollutant, habitat, species, resources, etc	Unit Value (£s)	Parameter (e.g. per household per annun	Value year	Source	Comments
Water for irrigation for crops	£0.0023 to £1.38 per m3	Market values for water for irrigation per m3	2011	UK NEA (2011)	Values for Scotland, should be broadly applicable
Water for irrigation for main crop potatoes	£0.65 per m3	Average yield value increase due to irrigation per m3	2011	WS Atkins Ltd and Cranfield University (2000)	values for eastern England.
Water for irrigation for carrots	£1.00 per m3	Average yield value increase due to irrigation per m3	2011	WS Atkins Ltd and Cranfield University (2000)	values for eastern England
Water for irrigation for parsnips	£2.21 per m3	Average yield value increase due to irrigation per m3	2011	WS Atkins Ltd and Cranfield University (2000)	values for eastern England
Water for irrigation for leeks	£3.40 per m3	Average yield value increase due to irrigation per m3	2011	WS Atkins Ltd and Cranfield University (2000)	values for eastern England
Water for irrigation for salad onions	£4.80 per m3	Average yield value increase due to irrigation per m3	2011	WS Atkins Ltd and Cranfield University (2000)	values for eastern England

[44] Environment Agency, 2013, Note on GLLEP Project Pro-forma, Water for Wildlife and Farming on the Fens

The impact of a drought and therefore the value of irrigation will depend upon the crop and soil type. If it is heavy clay then water retention is high and the crop can be fairly resistant to drought. Salads are less resilient; one month of drought would likely damage an entire year's worth of crops.

The Environment Agency is yet to establish the hectares of land which will benefit from the Water for Wildlife on the Fens scheme. Thus, in order to be conservative these figures were not applied. If these were included at a later date they would only increase the benefits quoted within this report.

4.4 Water Quality

Water quality impacts on most of us, although it is the least publically well-known need of the three water infrastructure types. It affects health which in turn implies a treatment cost to manage health impacts. It causes changes in clarity, safety for recreational contact and biodiversity which is a consideration for green tourism.

Water is also an input into many businesses. A survey responder to the online questionnaire from the Greater Lincolnshire agricultural sector stated that the water required for their operations should be to 'drinking water standards' and a pollution incident would be 'potentially very damaging'.

Meanwhile, there is significant aesthetic and recreational and existence value for good quality water environments. In the National Water Environment Benefits Survey Study (Metcalfe, 2012) the national average value of improvements from the Water Framework Directive classifications of Bad to Poor was £17.4k per km per annum, Poor to Moderate was £20k per km per annum and Moderate to Good was £23.2k per km per annum for rivers.

There are additionally considerable business benefits from regenerated watersides. A more attractive or accessible site results in a more buoyant visitor economy, meanwhile access to nice water environments improve employee productivity and attracts new staff.

4.4.1 Visitor economy and water quality

The Environment Agency Benefits Assessment Guidance (2003) outlined the following benefits to visitors (Table 18):

Table 18: Suggested Transfer Values for Changes in Quality and Informal Recreation

Table 2.9: Suggested Transfer Values for Changes in Quality and Informal Recreation (2001 prices)				
Study	**From**	**To**	**Transfer Value**	**Required Adjustments**
Green and Tunstall (1991)	RE4 or RE5 Not capable of supporting water birds	RE3 Good enough for water birds	£0.65 per visit	Surveys carried out at 12 different sites within the Southeast. Adjustment for relative wealth may not be required given that values relate to day trippers and holiday makers.
	RE4 (top) or RE3 Good enough for water birds	RE3 (top) or RE2 Good enough to support fish	£0.13 per visit	
	RE2 (bottom) Good coarse fishery	RE2 (top) or RE1 Able to support trout	£0.09 per visit	
Coker *et al* (1990)	Litter within river channel and along river banks, channel partly filled with water	Litter removed from channel and river banks and channel filled with water	£1.35 per visit	Study relates to Maidenhead residents and visitors from the surrounding area. Adjustment for wealth may be deemed appropriate.
Tapsell *et al* (1992)	Channelised river system	Creation of new meanders, bankside planting and some habitat	£2.91 to £3.61 per user (dependent on degree of habitat creation)	No adjustment suggested when assessing local schemes.
Garner *et al* (1995)	Straightened river channel with some adjoining park area	River restoration through channel modifications, habitat creation and landscaping	£8.75 per adult per visit	No adjustment suggested when assessing local schemes. Adjustment for wealth may be deemed appropriate.

The idea behind willingness to pay studies is that, the values cited are ones which potential visitors are willing to pay to enjoy the site. In real life, this is often realised in the amount that people spend on travel to and from the site and the amount spent on food and activities while there. Thus these values will have relevance to the economic activity that the site generates.

There are a number of projects which would benefit from Growth Funding which would have a positive impact on tourism. The relevant studies used to estimate the benefits and their value in 2012 prices are outlined below.

Scheme	Best estimate	Base year	2012 prices	Reference
Improve area for visitors including access and litter removal	£1.35	2001	£1.89	Coker et al
Channel restoration	£3.61	2001	£5.06	Tapsell et al

5 Cost and benefit analysis

5.1 Partnership funding

The Environment Agency's Partnership Funding Calculator identifies the amount of Flood Defence Grant in Aid (FDGiA) a scheme is eligible for on the back of scores based upon the number of properties protected and hectares of habitat created (among other factors).

However, this fund is limited and projects which can add value by a partnership funding agreement are given higher priority to proceed. Growth Funding can be an important mechanism to unlock FDGiA funding.

FDGiA is allocated based upon the scheme's ability to avoid damages. The emphasis is on property damage avoidance; particularly residential property. Conversely, the Growth Fund aims to support business and economic growth, and therefore the calculation of benefits is slightly different in the business case for Growth Funding than for FDGiA.

Thus in order to understand value for money, this Chapter outlines a high level estimate of the overall benefits of the investment projects and singles out benefits to business and job creation. Later in the chapter these benefits are compared with the Growth Funding investment amount to provide information on the £ benefit per £ growth funding cost.

5.2 Job creation

There is clear agreement that flood risk schemes can avoid economic shocks, create and maintain jobs. At the 'Ev 52: Environment, Food and Rural Affairs Committee: Evidence'[45] debate on 26 March 2013 Owen Patterson stated that "*emphatically, these flood defence schemes help grow the economy. There is no doubt about that at all...I am absolutely emphatically convinced of the merit of these schemes as generators. I will repeat: they protect existing properties, they help protect existing businesses, but they will lead to increased business because whole tracts of our cities are currently blighted*."

In the same debate, he noted that the Leeds scheme, costing £150m, would create 18,000 jobs.

In order to estimate the number of jobs the GL LEP investments could create the following have been considered:

- Jobs created in the building of the scheme (direct)
- Jobs created once the scheme has been implemented (indirect)

Direct job creation

Page 183 of the Flood and Coastal Erosion Risk Management Appraisal Guidance states that 15% of the cost of the measured work is for contractor preliminaries covering the 'Establishment & Running Costs of Contractors Site Offices /Toilets/Mess Facilities, Mobilisation & Demobilisation of Construction Equipment, Provision of site vehicles (4x4s, cars…), Contractors Site Management Team, Provision of Stores & Warehousing including labour & plant and Surveys, permits & insurances'. A further 15% is for design, supervision and management. Due to the labour intensive nature of these activities, it can be assumed that a total of 30% of scheme cost directly result in job creation.

[45] http://www.publications.parliament.uk/pa/cm201314/cmselect/cmenvfru/330/330.pdf

The non FCERM investments are less capital intensive than the Flood schemes. As a result, it is assumed that 50% of non FCERM capital investments and 80% of non-capital (tourism based) projects are labour costs which translate into jobs. An average wage of £27,000 from the ONS[46] is used to covert labour cost into Full Time Equivalent (FTE).

Table 19: Direct job creation

Project type	Projects	Total Cost	Labour %	Labour cost	FTE
FCERM	Lincshore Beach Nourishment Scheme (2015-2020) (Coastal)	£28,400,000	30%	£8,520,000	316
	Horncastle (Fluvial and Surface water)	£7,000,000		£2,100,000	78
	Witham catchment (Fluvial and WFD)	£1,000,000		£300,000	11
	Boston (Fluvial and Tidal)	£90,200,000		£27,060,000	1002
	Ancholme Valley Improvements (Fluvial)	£5,000,000		£1,500,000	56
Non-FCERM capital investment	Fens Waterways Link (WFD/Waterways)	£150,000	50%	£75,000	3
	Ecosystem Services in the Fens study (WFD)	£100,000		£50,000	2
	Spalding Waterspace Study Implementation (WFD/Waterways)	£1,200,000		£600,000	22
	Water for wildlife and farming in the Fens (WFD)	£150,000		£75,000	3
Non-capital	Fens Integrated Access Plan (Tourism)	£560,000	80%	£448,000	17
	Destination Fens (Tourism)	£50,000		£40,000	1
	TOTAL	£133,810,000		£40,768,000	1,510

It is estimated that approximately 1,510 full time equivalent jobs will be directly created or maintained from these investment projects.

Indirect job creation

Where a flood causes local economic damages due to a reduction in production of goods and services, revenue will reduce and flexible costs including staff hour costs are likely to reduce (unless the revenue reduction can be avoided through profit absorption). The equivalent FTE reduction resulting from these local economic damages has been calculated and it is assumed that these damages are avoided when flood risk management is in place.

[46] http://www.ons.gov.uk/ons/rel/ashe/annual-survey-of-hours-and-earnings/2013-provisional-results/stb-ashe-statistical-bulletin-2013.html

Where the project physically improves the environmental and there are increases in visitor numbers, it is assumed that the benefits felt by visitors are reflected in an increase of spending on travel to and food and drink purchases at the environmental destination. This translates to an increase in revenue for the tourist economy which has been converted to FTE (Table 20).

Table 20: Indirect job creation

Project type	Projects	Impacts on the local economy	unit	FTE
FCERM	Lincshore Beach Nourishment Scheme (2015-2020) (Coastal)	£78,365,932	per flood	2,902
	Horncastle (Fluvial and Surface water)	£3,423,946	per flood	127
	Witham catchment (Fluvial and WFD)	unknown		
	Boston (Fluvial and Tidal)	£3,100,084	per flood	115
	Ancholme Valley Improvements (Fluvial)	£20,066,957	per flood	743
Non-FCERM capital investment	Fens Waterways Link (WFD/Waterways)	£8,486,375	per annum	314 on implementation only
	Ecosystem Services in the Fens study (WFD)	£1,365,074	per annum	51
	Spalding Waterspace Study Implementation (WFD/Waterways)			
	Water for wildlife and farming in the Fens (WFD)			
Non-capital	Fens Integrated Access Plan (Tourism)			
	Destination Fens (Tourism)			
	TOTAL	**£114,808,367**		**3,938**

This gives an overall estimate of around 3,940 FTE jobs created as an indirect result of the investments.

Total

It is estimated that the schemes will create approximately 1,500 FTE jobs directly through implementation and 3,940 FTE jobs indirectly after implementation. The investment will create approximately 5,440 FTE jobs in total. This equates to roughly £26,250 per FTE job. If partnership funding sees the Growth Fund investing £20.5m, since this will unlock other funding, this equates to a cost of just £3,750 of Growth Fund monies per job.

5.3 Overview of costs and benefits

The costs and benefits of each scheme have been estimated, as shown in the remainder of the Chapter. The summary of the total costs, Growth Fund contribution and benefits to business are outlined in Table 21.

Table 21: Cost and benefits results

Project type	Projects	Total Cost	Growth fund contribution	Appraisal period (years)	PV Benefits to business	NPV (Business benefit - Growth Fund Investment)	Business benefit per £ Growth Fund Investment
FCERM	Lincshore Beach Nourishment Scheme (2015-2020) (Coastal)	£28,400,000	£11,200,000	10	£38,209,226	£27,009,226	3.4
	Horncastle (Fluvial and Surface water)	£7,000,000	TBC	100	£19,932,157	TBC	TBC
	Witham catchment (Fluvial and WFD)	£10,000,000	TBC	100	unknown	unknown	unknown
	Boston (Fluvial and Tidal)	£90,200,000	£2,000,000	100	£6,611,616	£4,611,616	3.3
	Ancholme Valley Improvements (Fluvial)	£5,000,000	Up to £5m	100	£64,464,972	£59,464,972	12.9
Non- FCERM capital investment	Fens Waterways Link Opportunities study (WFD/Waterways)	£150,000	£150,000	10	Could lead to £60m of PV benefits on implementation	Could lead to £60m of PV net benefits on implementation	n/a
	Ecosystem Services in the Fens study (WFD)	£100,000	£150,000	10			
	Spalding Waterspace Study Implementation (WFD/Waterways)	£1,200,000	£1,200,000	10			
	Water for wildlife and farming in the Fens (WFD)	£150,000	£150,000	10			
Non- capital	Fens Integrated Access Plan (Tourism)	£560,000	£560,000	10			
	Destination Fens (Tourism)	£50,000	£50,000	10	£11,750,126	£9,690,126	5.7
	TOTAL	**£142,810,000**	**£20,460,000**		**£140,968,097**	**£120,508,097**	**6.9**

5.4 Costs and contributions required

The breakdown of the costs and contributions of the projects recommended for Growth Funding investment are provided in Table 22.

Table 22: Cost and Funding status of recommended GLLEP investment projects

Project name	Funding status	Total cost	INDICATIVE FCRM GIA funding (£k)				Total contribution confirmed	Recommended contribution from Growth Fund	No. business who benefit
			2014/ 15	2015/ 16	2016/ 17	2017/ 18			
Lincshore Beach Nourishment Scheme (2015-2020) (Coastal)	Not proceeding before 2015	£28,400,000		6,000	5,600	5,600	£11.2 million required	£11.2m	1,344 (who had historically flooded. More are estimated)
Horncastle (Fluvial and Surface water)	Not proceeding before 2014	£7,000,000	1300	-	-	-	Lincolnshire County Council £2.3 million East Lindsey District Council £0.5 million Internal Drainage Board precept £0.3 million Local Levy £2.6 million.		187 (who had historically flooded. More are estimated)
Witham catchment (Fluvial and WFD) ▪ **Washingborough Fen** ▪ **Wllingham Fen** ▪ **Flood storage at Barlings Eau** ▪ **Lower Witham single water level** ▪ **Whisby Nature Park and gravel pits** ▪ **Metheringham habitat**	Not proceeding before 2015	£10,000,000 (indicative)	-	TBC	-	-	None as yet. Up to £1m required	Up to £1m	Up to 22,051

creation ▪ **Beckingham Stapleford flood storage** ▪ **Cowbridge Drain** ▪ **River Bain**									
Boston (Fluvial and Tidal)	Not proceeding before 2017	£90,200,000			77,200		£11 million confirmed from Lincolnshire County Council. £2 million required to progress or £7.2 million to fast track.	£2m to proceed or £7.2m to promote	99 (who had historically flooded. More are estimated)
Ancholme Valley Improvements (Fluvial)	Not proceeding before 2015	£5,000,000					None as yet Up to £5m required	Up to £5m	618 (who had historically flooded. More are estimated)
Fens Waterways Link (WFD/Waterways)	Not proceeding before 2017	£150,000				TBC	£150,000 required	£150,000	6,788
Ecosystem Services in the Fens study (WFD)	Not proceeding before 2014	£100,000		-	-	-	£150,000 required	£150,000	165 from the visitor economy
Spalding Waterspace Study Implementation (WFD/Waterways)	Not proceeding before 2016	£1,200,000					£1.2m required	£1.2m	165 from the visitor economy
Water for wildlife and farming in the Fens (WFD)	Not proceeding before 2014	£150,000					£150,000 required	£150,000	Up to 211 in agri food industry and 165 from the visitor

									economy
Fens Integrated Access Plan (Tourism)	Not proceeding before 2014	£560,000		-	-	-	£560k required	£560,000	165 from the visitor economy
Destination Fens (Tourism)	Not proceeding before 2014	£50,000					£50k required	£50,000	165 from the visitor economy
TOTAL		£133,810,000						£27,110,000	

5.5 Lincshore Beach Nourishment Scheme (2015-2020) (coastal flood risk)

The strategic benefits calculated include:

Damage avoidance			
Property damages	Yes	Public health	No
Temporary Accommodation	Yes	UK food supply	No
Crop and livestock damages	Yes	Roads and transport	No
Working days lost (economic activity)	Yes	Reduced pressure on business continuity measures	No
Emergency services	Yes	Working days lost specific to ports	No

In order to be precautionary, only the impacts that are considered to have a reasonable level of confidence have been valued. It is therefore important to note that further benefits could be included at a project level. More on this is outlined in chapter 4.

Using the flood risk benefits calculator and the values outlined in section 4.2, averting a flood along the Greater Lincolnshire coastline adjacent to the Lincshore Beach area could see benefits of£400k-£1bn per flood averted. The reason for these large numbers is due to the large amount of businesses and residential properties which are protected from the beach nourishment scheme (Table 23).

Table 23: Lincshore Beach Nourishment Scheme benefit inputs

Category	Count	Unit	Best estimate	Range (lower)	Range (upper)
Damage to residential properties	19792	property	£565,166,092	£302,314,907	£697,649,787
Damage to caravans and other mobile structures		caravan	£0	£0	£0
Damage to non-residential properties	1344	property	£87,883,344	£37,899,811	£142,124,290
Costs / effects of Temporary accommodation					
Residential	19792	property	£132,507,440	£0	£0
Commercial	1344	property	£7,339,584	£0	£0
Extra heating costs					
Residential	19792	property	£15,387,480	£13,840,136	£16,934,824
non-residential	1344	property	£1,044,906	£939,831	£1,149,980
Emergency services and road repairs (uplift factor)		n/a	£53,223,529	£19,052,024	£89,855,826
Traffic and utility disruption, including communications (uplift factor)		n/a			
		n/a			
		n/a			
Impacts on the local economy (uplift factor)		n/a			
		n/a			
		n/a	£78,365,932	£27,217,177	£134,363,852
Public health (2010 prices)					
Fatalities		n/a			
Injuries		n/a			
Mental Health		n/a			
Agricultural impacts (£/ha)	11750	hectare	£15,918,191	£10,092,105	£21,744,276
Grassland and Livestock farms		hectare	£0	£0	£0
Arable land		hectare	£0	£0	£0
Other costs	11750	hectare	£1,380,589	£717,906	£2,043,272
Total damages avoided from a flood			**£958,217,087**	**£412,073,898**	**£1,105,866,106**

Assuming a change in risk from a 1:20 to a 1:200 level, the total present value benefits over a 10 year period is between £160m-430m (table 24). This represents the benefits from reduced property damage, crop damage and additional economic damage which was avoided as a result of the flood risk management investment.

Table 24: Lincshore Beach Nourishment Scheme total economic benefits

Total economic benefits				
	Units	**Best estimate**	**Range (lower)**	**Range (upper)**
Risk of flooding		**Damages avoided (annual)**		
Before	1/20	£47,910,854	£20,603,694.91	£55,293,305.32
After	1/200	£4,791,085	£2,060,369.49	£5,529,330.53
Appraisal time frame (years)		**Total PV benefits**		
10		£371,161,453	£159,615,132	£428,352,694

Singling out benefits to business, it is estimated that the present value benefits over a ten year appraisal period would be between £15m-£80m (Table 25). The lower range represents the potential of businesses to significantly reduce the damages to their businesses through property level changes such as moving stock upstairs and using flood compatible fixtures and fittings. The upper range assumes property level changes are not done.

Table 25: Lincshore Beach Nourishment Scheme benefits to business

Total benefits to business				
	Units	Best estimate	Range (lower)	Range (upper)
Risk of flooding		Damages avoided (annual)		
Before	1/20	£9,596,627	£3,843,342	£15,071,283
After	1/200	£5,057,203	£2,155,630	£5,978,610
Appraisal time frame (		Total PV benefits		
10		£39,073,940	£14,527,295	£78,266,886

The beach replenishment costs have been estimated at £28m. The contribution required from the growth fund is £11.2m (Table 26).

Table 26: Lincshore Beach Nourishment Scheme Growth Fund costs

Total PV costs				
		Best estimate	Range (lower)	Range (upper)
Appraisal time frame (years)		Total PV costs		
10		£11,200,000	£11,200,000	£11,200,000

Thus, each £1 of Growth Funding will see benefits to business of around £3.50 for this project. This is a conservative estimate since a number of benefits have not been calculated. These include avoided damages to public health and changes to UK food supply (Table 27).

Table 27: Lincshore Beach Nourishment Scheme returns to Growth Funding investment

PV benefits to business only							
		Best estimate	Range (lower)	Range (upper)	Best estimate	Range (lower)	Range (upper)
Appraisal time frame (years)		Total PV net benefits			Benefit-Cost Ratio		
10		£27,873,940	£3,327,295	£67,066,886	3.5	1.3	7.0

5.6 Horncastle (fluvial and surface water flood risk)

The strategic benefits calculated include:

Damage avoidance			
Property damages	Yes	Public health	No
Temporary Accommodation	Yes	UK food supply	No
Crop and livestock damages	Yes	Roads and transport	No
Working days lost (economic activity)	Yes	Reduced pressure on business continuity measures	No
Emergency services	Yes	Working days lost specific to ports	No

Using the data from the beneficiary analysis, the economic benefits of investing in Horncastle's flood risk management scheme were calculated (Table 28). Total damages avoided during a flood are estimated at approximately £16.5m-£51.5m.

Table 28: Horncastle scheme benefit inputs

Category	Count	Unit	Best estimate	Range (lower)	Range (upper)
Damage to residential properties	571	property	£16,305,065	£8,721,797	£20,127,225
Damage to caravans and other mobile structures		caravan	£0	£0	£0
Damage to non-residential properties	187	property	£12,227,816	£5,273,262	£19,774,734
Costs / effects of Temporary accommodation					
Residential	571	property	£3,822,845	£0	£0
Commercial	187	property	£1,021,207	£0	£0
Extra heating costs					
Residential	571	property	£443,929	£399,288	£488,570
non-residential	187	property	£145,385	£130,765	£160,005
Emergency services and road repairs (uplift factor)		n/a	£2,325,430	£783,723	£4,269,510
Traffic and utility disruption, including communications (uplift factor)		n/a			
		n/a			
		n/a			
Impacts on the local economy (uplift factor)					
		n/a			
		n/a	£3,423,946	£1,119,605	£6,384,313
Public health (2010 prices)					
Fatalities		n/a			
Injuries		n/a			
Mental Health		n/a			
Agricultural impacts (£/ha)	200	hectare	£270,948	£171,781	£370,115
Grassland and Livestock farms		hectare	£0	£0	£0
Arable land		hectare	£0	£0	£0
Other costs	200	hectare	£23,499	£12,220	£34,779
Total damages avoided from a flood			**£40,010,070**	**£16,612,442**	**£51,609,251**

The total economic benefits have been estimated as between £20m-56 over the 100 year lifetime of the scheme (Table 29).

Table 29: Horncastle scheme total economic benefits

Total economic benefits				
	Units	**Best estimate**	**Range (lower)**	**Range (upper)**
Risk of flooding		**Damages avoided (annual)**		
Before	1/20	£2,000,504	£830,622.08	£2,580,462.53
After	1/75	£533,468	£221,499.22	£688,123.34
Appraisal time frame (years)		**Total PV benefits**		
100		£43,825,616	£18,196,681	£56,530,948

Singling out benefits to current businesses (not including future growth to be precautionary), the scheme will benefit businesses by an estimated £3-£18m (Table 30).

Table 30: Horncastle scheme benefits to business

Total benefits to business				
	Units	Best estimate	Range (lower)	Range (upper)
Risk of flooding		Damages avoided (annual)		
Before	1/20	£855,640	£335,382	£1,336,197
After	1/75	£564,473	£231,949	£745,050
Appraisal time frame (		Total PV benefits		
100		£8,698,193	£3,089,907	£17,659,683

5.7 Witham catchment (Fluvial and WFD)

The £10m Witham catchment project is in the early stages of planning. The specific WFD and Flood Risk projects will come to the fore over the coming year, if funding is given the conditional go ahead. It is anticipated that these projects will improve the water environment at:

- Washingborough Fen
- Wllingham Fen
- Flood storage at Barlings Eau
- Lower Witham single water level
- Whisby Nature Park and gravel pits
- Metheringham habitat creation
- Beckingham Stapleford flood storage
- Cowbridge Drain
- River Bain

Beneficiary analysis counted 1,407 agri-food business properties in the Witham catchment. Since a third of land is at risk of flooding in Anglian region (see section 4.2.1), this project could contribute towards protecting around 470 agri food businesses. If 50% of these were farms, this would see reduced flooding to up to 235 farms and approximately 11,750 hectares; a total agricultural damage reduction of £10-20million per flood. This is without calculating benefits to other business and to the homes of business employees and customers.

Although further detail were not available, the individual schemes are likely to be a number of quick wins and we recommend that they be explored.

The average cost benefit ratio for flood risk schemes nationally is £7 (benefits to £1 cost) and is often greater for water quality projects (although the benefits are usually less, the schemes tend to be cheaper). Any investment into the project would aim to achieve a cost benefit ratio of at least 1.5.

5.8 Boston (fluvial and tidal flood risk)

The strategic benefits calculated include:

Damage avoidance			
Property damages	Yes	Public health	No
Temporary Accommodation	Yes	UK food supply	No
Crop and livestock damages	Yes	Roads and transport	No
Working days lost (economic activity)	Yes	Reduced pressure on business continuity measures	No
Emergency services	Yes	Working days lost specific to ports	No

This scheme is in the later stages of planning and therefore the benefits are better defined. The flooding in December, 2013, further emphasised the urgency of this scheme. The estimated benefits, related to GL LEPs interests are given in Table 31.

Table 31: Boston scheme benefit inputs

Category	Count	Unit	Best estimate	Range (lower)	Range (upper)
Damage to residential properties	678	property	£19,360,480	£10,356,180	£23,898,876
Damage to caravans and other mobile structures		caravan	£0	£0	£0
Damage to non-residential properties	99	property	£6,473,550	£2,791,727	£10,468,977
Costs / effects of Temporary accommodation					
Residential	678	property	£4,539,210	£0	£0
Commercial	99	property	£540,639	£0	£0
Extra heating costs					
Residential	678	property	£527,118	£474,111	£580,124
non-residential	99	property	£76,968	£69,229	£84,708
Emergency services and road repairs (uplift factor)		n/a	£2,105,473	£736,283	£3,677,360
Traffic and utility disruption, including communications (uplift factor)		n/a			
		n/a			
		n/a			
Impacts on the local economy (uplift factor)					
		n/a			
		n/a	£3,100,084	£1,051,833	£5,498,856
Public health (2010 prices)					
Fatalities		n/a			
Injuries		n/a			
Mental Health		n/a			
Agricultural impacts (£/ha)	250	hectare	£338,685	£214,726	£462,644
Grassland and Livestock farms		hectare	£0	£0	£0
Arable land		hectare	£0	£0	£0
Other costs	250	hectare	£29,374	£15,275	£43,474
Total damages avoided from a flood			**£37,091,581**	**£15,709,362**	**£44,715,020**

Damages avoided are estimated as £15m-£45m per flood (Table 32). Again, the range represents the potential level of property level preparedness which has been incorporated. If the risk of flooding changed from 1:30 to 1:300 this would see present value benefits of £15-£40m over the 100 year lifetime of the scheme.

Table 32: Boston scheme total economic benefits

Total economic benefits				
	Units	**Best estimate**	**Range (lower)**	**Range (upper)**
Risk of flooding		**Damages avoided (annual)**		
Before	1/30	£1,236,386	£523,645.41	£1,490,500.66
After	1/300	£123,639	£52,364.54	£149,050.07
Appraisal time frame (years)		**Total PV benefits**		
100		£33,241,750	£14,078,847	£40,073,933

More specifically, the benefits to business would be approximately £2.5m-£11m over the 100 year lifetime of the scheme (Table 33).

Table 33: Boston scheme total benefits to business

Total benefits to business				
	Units	Best estimate	Range (lower)	Range (upper)
Risk of flooding		Damages avoided (annual)		
Before	1/30	£351,977	£138,093	£551,955
After	1/300	£130,657	£54,819	£161,308
Appraisal time frame (		Total PV benefits		
100		£6,611,616	£2,487,697	£11,670,036

The scheme has a number of forthcoming contributions including Flood Defence Grant in Aid. £2m is required to progress the scheme or £7.2m is required from the Growth Fund in order to push forward the project (Table 34).

Table 34: Boston scheme Growth Fund investment costs

Total PV costs				
		Best estimate	Range (lower)	Range (upper)
Appraisal time frame (years)		Total PV costs		
100		£7,200,000	£7,200,000	£7,200,000

To push forward

Total PV costs				
		Best estimate	Range (lower)	Range (upper)
Appraisal time frame (years)		Total PV costs		
10		£2,000,000	£2,000,000	£2,000,000

To progress

If £2m was invested, each £1 of Growth Funding will see benefits to business of around £3.30 for this project. The £7.2m investment is a less worthwhile investment. The extra funding would see short term and more immediate benefits. This is a conservative estimate since a number of benefits have not been calculated. These include avoided damages to roads, public health and changes to UK food supply (Tables 35 and 36).

Table 35: Boston scheme return on Growth Fund investment on £7.2m

PV benefits to business only							
		Best estimate	Range (lower)	Range (upper)	Best estimate	Range (lower)	Range (upper)
Appraisal time frame (years)		Total PV net benefits			Benefit-Cost Ratio		
100		-£588,384	-£4,712,303	£4,470,036	0.9	0.3	1.6

Table 36: Boston scheme return on Growth Fund investment on £2m

PV benefits to business only							
		Best estimate	Range (lower)	Range (upper)	Best estimate	Range (lower)	Range (upper)
Appraisal time frame (years)		Total PV net benefits			Benefit-Cost Ratio		
100		£4,611,616	£487,697	£9,670,036	3.3	1.2	5.8

Sensitivity analysis

It is noted that the benefits outlined above are likely to be an underestimate. Evidence from the Environment Agency flood risk models suggest that the number of properties who benefit from reduced risk in Boston is 1,600. If this is the case, we see more beneficial results if we assume that there are around 1,400 residential properties and 200 business properties.

The first table below summarises overall benefits. The next summarises benefits to business only of a £7.2m investment.

Table 37: Boston scheme sensitivity test: return on Growth Fund investment on £7.2m

Total PV net benefits							
		Best estimate	Range (lower)	Range (upper)	Best estimate	Range (lower)	Range (upper)
Appraisal time frame (years)		Total PV net benefits			Benefit-Cost Ratio		
100		£101,763,352	£38,836,576	£124,063,816	15.1	6.4	18.2

PV benefits to business only							
		Best estimate	Range (lower)	Range (upper)	Best estimate	Range (lower)	Range (upper)
Appraisal time frame (years)		Total PV net benefits			Benefit-Cost Ratio		
100		£12,697,900	£12,697,900	£12,697,900	2.8	2.8	2.8

5.9 Ancholme Valley Improvements (Fluvial)

The strategic benefits calculated include:

Damage avoidance			
Property damages	Yes	Public health	No
Temporary Accommodation	Yes	UK food supply	No
Crop and livestock damages	Yes	Roads and transport	No
Working days lost (economic activity)	Yes	Reduced pressure on business continuity measures	No
Emergency services	Yes	Working days lost specific to ports	No

The project is mostly concerned with protecting the town of Brigg and the productivity of agricultural land within the area. The count of properties and agricultural land from the beneficiary analysis has been inputted into the benefits calculator as set out in Table 37.

Table 38: Ancholme Valley benefit inputs

Category	Count	Unit	Best estimate	Range (lower)	Range (upper)
Damage to residential properties	4441	property	£126,813,996	£67,834,504	£156,541,163
Damage to caravans and other mobile structures		caravan	£0	£0	£0
Damage to non-residential properties	618	property	£40,410,645	£17,427,145	£65,351,794
Costs / effects of Temporary accommodation					
Residential	4441	property	£29,732,495	£0	£0
Commercial	618	property	£3,374,898	£0	£0
Extra heating costs					
Residential	4441	property	£3,452,698	£3,105,499	£3,799,897
non-residential	618	property	£480,470	£432,155	£528,785
Emergency services and road repairs (uplift factor)		n/a	£13,628,808	£4,774,652	£23,742,546
Traffic and utility disruption, including communications (uplift factor)		n/a			
		n/a			
		n/a			
Impacts on the local economy (uplift factor)					
		n/a			
		n/a	£20,066,957	£6,820,932	£35,502,873
Public health (2010 prices)					
Fatalities		n/a			
Injuries		n/a			
Mental Health		n/a			
Agricultural impacts (£/ha)	950	hectare	£1,287,003	£815,957	£1,758,048
Grassland and Livestock farms		hectare	£0	£0	£0
Arable land		hectare	£0	£0	£0
Other costs	950	hectare	£111,622	£58,043	£165,201
Total damages avoided from a flood			**£239,359,592**	**£101,268,888**	**£287,390,307**

Since the historic flood risk map for this area limited the accuracy of beneficiary analysis the lower estimates were used, in order to be precautionary in the benefits estimates. Thus approximately £96m of damage could be avoided (Table 38).

Table 39: Ancholme Valley total economic benefits

Total economic benefits				
	Units	Best estimate	Range (lower)	Range (upper)
Risk of flooding		Damages avoided (annual)		
Before	1/20	£11,967,980	£5,063,444.41	£14,369,515.36
After	1/200	£1,196,798	£506,344.44	£1,436,951.54
Appraisal time frame (years)		Total PV benefits		
100		£321,773,768	£136,136,895	£386,341,994

This would result in around £136m of benefits over a 100 year lifetime of the scheme.

The benefits to business alone have been narrowed down and it is estimated that present value benefits of around £22m over the 100 lifetime of the scheme could be realised (Table 39).

Table 40: Ancholme Valley benefits to business

Total benefits to business				
	Units	Best estimate	Range (lower)	Range (upper)
Risk of flooding		Damages avoided (annual)		
Before	1/20	£3,286,580	£1,277,712	£5,165,335
After	1/200	£1,264,942	£530,218	£1,555,664
Appraisal time frame (		Total PV benefits		
100		£60,393,558	£22,330,320	£107,833,793

The contribution required towards the Ancholme Valley Improvement Project is £5m (Table 40).

Table 41: Ancholme Valley Growth funding costs

Total PV costs				
		Best estimate	Range (lower)	Range (upper)
Appraisal time frame (years)		Total PV costs		
100		£5,000,000	£5,000,000	£5,000,000

Thus, each £1 of Growth Funding will see benefits to business of around £4.50 for this project. A number of benefits have not been calculated. These include avoided damages to roads, public health and changes to UK food supply. However, better modelling of the benefits would improve the benefits estimate (Table 41).

Table 42: Ancholme Valley return to Growth Funding investment

PV benefits to business only							
		Best estimate	Range (lower)	Range (upper)	Best estimate	Range (lower)	Range (upper)
Appraisal time frame (years)		Total PV net benefits			Benefit-Cost Ratio		
100		£55,393,558	£17,330,320	£102,833,793	12.1	4.5	21.6

5.10 Fens waterway link (WFD/Visitor Economy)

The strategic benefits calculated include:

Benefits

Increased number of visits	Yes	Increased location attractiveness to new employees	No
Increased spending by existing visitors	Yes	Improved property prices	No
Increased revenues by visitor economy	Yes	Increased productivity due to location adjacent to improved environment	No

The opportunity study will investigate the potential for a Fens waterway link which would aim to open up 240km of interconnected waterway, including 80km of new waterway and increased access to 160km.

Although the opportunity study would not in itself result in substantial benefit, it would be a pathway to the final implementation project. We are therefore interested in the final outcomes. The benefits of the implementation project have been estimated by considering the visitors to the area and the extra economic activity which this will generate using willingness to pay data. Willingness to pay reflects the value that an existing or new visitor places on their visit. In practice, this would translate to the market in terms of increased expenditure in travel to the destination and hotel, food expenses etc.

The benefit is only a benefit to the UK when it does not displace visits elsewhere. Thus, substitutes in the evaluation were considered. The aspiration is for the Fens to become as popular as the Norfolk Broads[47].

The information within the Benefits Assessment Guidance (2003) was used to calculate the value of the implementation project. The method is explained in more detail in Section 2.2. It was assumed that the site would improve from a 'honeypot' to a 'regional' site and that there would be physical channel restoration that both existing and new visitors would enjoy (Table 42).

[47] Since the Broads is a national substitute, in order to account for any displacement between the two destinations an increase in visitors beyond 30km was not considered. However, we believe that there are no significant substitutes within 30km and therefore we are able to count an increase in visits within this range.

Table 43: Fens waterway link benefit inputs

Project type	Yes/no	Notes
Is there access to the river?	yes	
Does informal recreation take place along the river or wetland area now?	yes	
Would the scheme result in changes in quality, such that they would be perceived by current informal recreation users?	yes	
Type of site	**Category (see below)**	
Site type and importance BEFORE	honeypot - mid	
Site type and importance BEFORE	regional - mid	
Number of substitutes	**Number**	
Number of local substitute sites		none
Households within the following radius	**hh**	
1km	16040	
3km	45882	
5km	69860	
10km	92799	
30km	203907	
Adult population estimate (2.3 people per hh, 80% of whom are adults)	**Number**	
1km	29514	
3km	84423	
5km	128542	
10km	170750	
30km	375189	
Number of visitors to site	**Number**	
Before	1562097	
After	1678404	
Change	116306	
Does the project:		£ per visit
Choose one option	Channel restoration	£5.06
Benefits		
For existing visitors	£7,898,305	
For new visitors	£588,070	
Annual TOTAL	£8,486,375	

These totals up to a significant present value benefit of £73m over a ten year time period or annual benefit of around £8m (Table 43). This number is large as it reflects the size of the waterway and the magnitude of potential visitors located within its vicinity.

Table 44: Fens waterway link annual benefits

		Best estimate
Annual benefits (current prices)		£8,486,375

Since the area of the waterway overlaps with the Spalding and Fens area, there is a chance of double counting. In order to avoid double counting benefits, the present value benefits of the Fens and Spaldings projects have been removed. Thus benefits of around £61m over a 10 year period are observed.

Current cost of the opportunity study is £150k, and the cost of the implementation study is approximated by the Environment Agency as around £100m.

It would not be appropriate to compare costs with benefits as the £150k study is only a small proportion of the costs of implementation. But, it is important to outline the benefits that implementing the waterway link could generate. These are outlined below. An adjustment is made to avoid double counting the benefits from the Spalding and Fens projects.

Table 45: Benefits of implementation of the Fens Waterway Link

Appraisal time period	Total PV benefits	Adjustment to avoid double counting with Spalding and Fens
10	£73,048,056	£61,297,930

5.11 The Fens and Spalding projects

The strategic benefits calculated include:

Benefits			
Increased number of visits	Yes	Increased location attractiveness to new employees	No
Increased spending by existing visitors	Yes	Improved property prices	No
Increased revenues by visitor economy	Yes	Increased productivity due to location adjacent to improved environment	No

There are a number of projects which can provide significant benefits to the visitor economy and local businesses in Spalding and the Fens. These include:

- Ecosystem Services in the Fens study (WFD)
- Spalding Waterspace Study Implementation (WFD/Waterways)
- Fens Integrated Access Plan (Tourism)
- Destination Fens (Tourism)
- Water for wildlife and farming in the Fens (WFD/Water Resources)

The information within the Benefits Assessment Guidance (2003) was used to calculate the value. The method is explained in more detail in Section 2.2. It is assumed that the site would improve from a 'honeypot' to a 'regional' site and that there would be improved access for existing and new visitors to enjoy (Table 47).

Table 46: Fens and Spalding projects benefit inputs

Project type	Yes/no	Notes
Is there access to the river?	yes	
Does informal recreation take place along the river or wetland area now?	yes	
Would the scheme result in changes in quality, such that they would be perceived by current informal recreation users?	yes	
Type of site	**Category (see below)**	
Site type and importance BEFORE	honeypot - mid	
Site type and importance BEFORE	regional - mid	
Number of substitutes	**Number**	
Number of local substitute sites		None
Households within the following radius	**hh**	
1km	16183	
3km	16183	
5km	18495	
10km	25557	
30km	135341	
Adult population estimate (2.3 people per hh, 80% of whom are adults)	**Number**	
1km	29776.72	
3km	29776.72	
5km	34030.8	
10km	47024.88	
30km	249027.44	
Number of visitors to site	**Number**	
Before	634244.136	
After	721944.424	
Change	87700.288	
Does the project:		£ per visit
Choose one option	Improve area for visitors including access and litter removal	£1.89
Benefits		
For existing visitors	£1,199,247	
For new visitors	£165,826	
Annual TOTAL	£1,365,074	

The annual total benefits gained could be around £1.3m. Thus, over a ten year time period, the present value benefits could be approximately £11.7m (Table 48).

Table 47: Fens and Spalding project's benefits

Appraisal time period	Total PV benefits
10	£11,750,000

The expected Growth Fund investment required for all Fens and Spalding projects is just over £2m (Table 49).

Table 48: Fens and Spalding projects Growth Fund costs

Appraisal time frame (years)	Total PV costs
10	£2,060,000

Thus, over ten years, the present value net benefit is estimated as around £9.7m, which would provide the GLLEP area with £6 of benefits for every £1 Growth Fund spent (Table 50).

Table 49: Fens and Spalding projects return on Growth Fund investments

Appraisal time frame (years)	Total PV net benefits	Benefit-Cost Ratio

10	£9,690,000	6

6 Alternative funding sources

This report has so far focused upon the potential for contributions that could be met by Structural and Investment Funds and Local Growth Funds.

The Growth Fund was set up with the aim to support jobs and growth in areas that rely on the public sector. The national audit office[48] noted that the expected cost per job varied considerably between projects, from under £4,000 per job to over £200,000 per job. This study suggests that a £20.5m Growth Fund contribution to 11 environmental infrastructure projects in Greater Lincolnshire could unlock approximately 5,440 FTE jobs in total. This equates to just £3,750 of Growth Fund monies per FTE job.

Despite being at the cheaper end of the scale, and therefore potentially highly attractive for Growth Funding, it is important to flag up alternative funding sources. This also demonstrates that other methods of funding have been considered. GLLEP can also refer to this when they are interested in funding further environmental infrastructure projects which are currently only in the conceptual stage.

Table 50: Table adapted from 'Securing alternative sources of funding for flood risk management' (Local Government Group, 2011)

Source	What is it?	Pros	Cons	Most appropriate for?	Further info
Flood defence Grant-In-Aid	Funding raised through general taxation for FCERM projects	Large Sums	Total amount limited each year	All size of project. Flood risk and habitat creation	Environment Agency (EA)
RFCC Local Levy	Money raised from LLFAs for additional FCERM priorities	LLFA payments are compensated by central Government grants	Relatively small pot, £30m a year across England, 1/3rd of the total in London. Large increases may impact on council tax.	Topping up flood risk projects that score almost 100% under the new system	RFCCs
Regional Growth Fund	Government money to help regions reliant on public sector industries to realise private sector growth	Recognises environmental infrastructure projects can help meet regeneration and economic growth goals	Only available for a few years. 2011/12 fund over-subscribed.	Specific projects that achieve regeneration and economic development goals	
Business Rate Supplements	Following a vote of businesses, allows for an up to 2p increase on local business rates	Potentially raises significant sums over a period of time.	Needs to be levied across a whole authority and only on properties with a rateable value above £50,000	Increasing levels of Protection and benefits, primarily to businesses.	

[48] https://www.nao.org.uk/report/the-regional-growth-fund/

Water company investment	Funds raised through the price review process. Water companies are able to invest in some types of surface water management, and increased resilience for their assets.	Water companies may be increasingly willing and able to invest in local FRM strategies in order to protect their assets and customers on the flood plain. Additionally they are responsible for sewer flooding related incidents.	Amounts available may be limited unless water companies own the assets themselves or will reduce their level of sewer flooding incidences.	Water resources and water quality projects. Increased surface water drainage capacity and combined sewers.	Anglian Water Severn Trent Water
Community Infrastructure Levy	A locally set general charge which authorities can choose to implement. Levied on developers, per m^2 of most new development across an authority's area.	Large sums could potentially be raised over time. Is flexible: authorities can adjust spending plans to meet priorities. Developers may be supportive as it will increase value of developments.		Long-term approaches to flood alleviation and regeneration, hand in hand	
Business Improvement Districts	Following a vote of businesses, allows for a levy to be raised on local ratepayers	Can raise revenues over small areas – does not need to be an authority wide levy	Can only be levied for 5 year periods – second terms are allowed following a further vote	Small scale very localised business protection or benefit.	
General Drainage Charge/ Special Drainage Charge	Money raised from landowners for additional works by the Environment Agency	Raises £3m a year in Anglian region	Not applied outside of Anglian region (but could be)	Projects that protect largely agricultural areas.	

There are other sources have not been listed here including Section 106 agreements, Trusts, Council Tax and loans. For more information, see the Local Government Association (formally 'Group') paper[49].

There are a tranche of environmental infrastructure projects which would make good investments, such as those outlined in the appendices. All projects aspire to a mix of funding from a variety of sources, such as those outlined above.

It should be noted that the eleven projects outlined in this report particularly align with the interests of the Growth Fund.

[49] http://www.local.gov.uk/paying-for-flood-and-coastal-erosion-risk/-/journal_content/56/10180/3600920/ARTICLE

7 Conclusions

Extreme weather events are a significant risk to businesses as they can restrict operations. Extreme weather events in Greater Lincolnshire can affect the UK as a whole if not managed appropriately. The ports of Immingham and Grimsby are the largest Ports in the UK by tonnage and East Anglia as a whole supplies around 1/8th of total UK food consumption.

The 2013 Business Continuity Management Survey by the Chartered Management Industry (CMI) asked businesses which disruptions would have a major impact on their business. This year 43% of businesses surveyed said extreme weather would have a significant effect on their business.

During and after a flood, affected businesses slow or shut down operations due to property inundation, the loss of access to site, IT and electricity. For the agricultural sector, this is often worst during harvest time, where a loss of produce has major impacts on a farmer's revenue. During severe flood warnings, particularly in the case of North Sea surges, anticipated ship loads will be rerouted or delayed due to the risks of stormy weather. During a flood, shipping loads cannot be transported where surrounding transport routes are inundated. In some events piers will be damaged, causing several weeks of disrupted production while engineers are consulted and repairs are made.

Meanwhile, water availability for summer spray irrigation of crops is becoming an increasing issue in the Fens. It is likely that a significant number of new winter storage reservoirs will be needed to meet current and future demand.

While there are risks, there are also significant opportunities. There are considerable business benefits from regenerated watersides. A more attractive or accessible site results in a more buoyant visitor economy, meanwhile access to nice water environments improve employee productivity and attracts new staff.

This study suggests that a £20.5m Growth Fund contribution to 11 environmental infrastructure projects in Greater Lincolnshire could unlock approximately 5,440 FTE jobs in total. This equates to just £3,750 of Growth Fund monies per job. In terms of benefits to business, this investment could unlock over £120m of benefits to business over 100 years (largely to the visitor-economy sector) which would approximate £7 of business benefits for every £1 contributed.

Appendices

Appendix 1: Greater Lincolnshire flooding risk management schemes programme of work for coastal erosion and sea flooding

Appendix 2: Greater Lincolnshire flooding risk management schemes programme of work for surface runoff

Appendix 3: Greater Lincolnshire flooding risk management schemes programme of work for river flooding

Appendix 1 - Greater Lincolnshire flooding risk management schemes programme of work for coastal erosion and sea flooding

Infrastructure funding status

Greater Lincolnshire has a number of coastal risk management schemes that are set to take place over the next five years. The table below shows those schemes that the Environment Agency Board has allocated Department for the Environment, Food and Rural Affairs (Defra) grant in aid and have been approved by the Regional Flood & Coastal Committees (RFCCs)[50]. The programme colour coding shows:

- Green: Schemes expected to spend Flood and coastal erosion risk management Grant in Aid (FCRM GiA) and/or contributions in 2013/14.
- Blue: Local Authority or Internal Drainage Board projects expected to spend FCRM GiA and/or contributions in 2013/14.
- Amber: schemes expected to spend FCRM GiA and/or contributions between 2014/15 and 2017/18 and onwards.
- Red: schemes not expected to spend FCRM GiA and/or contributions before 2018/19 because they are not ready to start, need to demonstrate better value for money or find additional contributions

Greater Lincolnshire flooding risk management schemes programme of work for coastal erosion and sea flooding (correct as of September 2013)[51]

Project Name	Funding status	Parliamentary Constituencies	Total Project Cost (£k)	RESERVED FCRM GIA funding (£k)	INDICATIVE FCRM GIA funding (£k)				Total Contributions Confirmed	Funding gap	Houses with improved protection
				2013/14	2014/15	2015/16	2016/17	2017/18			
Cleethorpes North Promenade Terminal Groyne Replacement	Reserved funding for 2013/14	Cleethorpes	780	462	47	-	-	-	271		275
Witham 4th District Bridge Replacement	Other Local Authority and Internal Drainage Board projects, 2013/14	Boston and Skegness		45	-	-	-	-	-		-
Humber Killingholme Marshes & Halton to Killingholme	Indicative funding for 2014/15 onwards. FDGiA is indicative, but partnership funding may still be required.	Cleethorpes	7,650	-	-	-	2,550	5,000	-	100	92

[50] http://www.environment-agency.gov.uk/research/planning/118129.aspx
[51] http://www.environment-agency.gov.uk/research/planning/118129.aspx

Lincshore Beach Management		Louth and Horncastle	28,400	-	-	6,000	5,600	5,600	-	16,600	6,760
Works Arising From Wash Banks Strategy		Boston and Skegness	1,200	-	-	600	500	50	-	50	3,219
Humber Tetney to Saltfleet Phase 2	Not proceeding before 2018/19	Louth and Horncastle	5,000	-	-	-	-	-	-	5,000	1,199
Winteringham Ings & South Ferriby		Brigg and Goole	9,586	-	-	-	-	-	-	9586	1,074

Appendix 2 - Greater Lincolnshire flooding risk management schemes programme of work for surface runoff

Lincolnshire flooding risk management schemes programme of work for surface runoff (correct as of September 2013)[52]

Project Name	Funding status	Total Project Cost (£k)	RESERVED FCRM GIA funding (£k)	INDICATIVE FCRM GIA funding (£k)				Total Contributions Confirmed	Funding gap	Houses with improved protection
			2013/14	2014/15	2015/16	2016/17	2017/18			
Holbeach River Tidal Sluice Refurbishment	Reserved funding for 2013/14	580	41	47	-	-	-	474		29
Culverted Watercourse Lining (Witham 4th District)		291	45	45	45	45	45	-		-
Boston- Marsh Lane Surface Water Alleviation Scheme		95	-	-	-	-	-	95		
Cherry Willingham Surface Water Alleviation Scheme		95	-	-	-	-	-	95		6
Crowland Surface Water Alleviation Scheme		98	-	-	-	-	-	98		
Heighington- Fen Lane Surface Water Alleviation Scheme		98	-	-	-	-	-	98		3
Holbeach - Langwith Gardens Surface Water Alleviation Scheme		50	23	-	-	-	-	27		40
Lincoln- Bunkers Hill Surface Water Alleviation Scheme		98	-	-	-	-	-	98		7
Morton -Station Road Surface Water Alleviation Scheme		90	41	-	-	-	-	49		16

[52] http://www.environment-agency.gov.uk/research/planning/118129.aspx

Nettleham - The Green - Surface Water Flood Risk Improvement Works		98		-	-	-	-	98		11
Tetney - Station Road - Surface Water Flood Risk Improvement Works		80	44	-	-	-	-	37		16
Barnetby Woodland View Flood Alleviation Scheme		582		-	-	-	-	582		69
Barrow Cherry Lane Flood Alleviation Scheme		71		-	-	-	-	71		15
East Halton Flood Alleviation Scheme		72	24	-	-	-	-	48		29
Piped Surface Water System Tytton Lane	Indicative funding for 2014/15 onwards. FDGiA is indicative, but partnership funding may still be required.	40	-	-	40	-	-	-		30
Woodside Estate Gulley and Pipework Re-Routing		25	-	-	25		-	-		67
Clay Lake Pipeline Replacement/Refurbishment		530	-	-	-	-	126	292	112	147
Dawsmere Pumping Station Refurbishment		550	-	-	-	-	23	303	224	123
Fleet Haven Pumping Station Refurbishment		330	-	-	-	-	-	330		15
Westmere Pumping Station and Sluice Refurbishment		280	-	-	70	56	-	154		226
Goxhill, Thornton Road Flood Alleviation Scheme		32	-	-	21		-	11		19
Ulceby Flood Alleviation Scheme		403	-	-	66		-	337		29
Bourne Investigation of Surface Water Piped Systems	Not proceeding before 2018/19	15	-	-	-	-	-	-	15	9
Boston East Pumping Station Refurbishment		206	-	-	-	-	-	-	206	18
Littlemoor Lane Pumping Station Refurbishment		162	-	-	-	-	-	-	162	17

Appendix 3 - Greater Lincolnshire flooding risk management schemes programme of work for river flooding

Greater Lincolnshire flooding risk management schemes programme of work for river flooding (correct as of September 2013)

Project Name	Funding status	Parliamentary Constituencies	Total Project Cost (£k)	RESERVED FCRM GIA funding (£k)	INDICATIVE FCRM GIA funding (£k)				Total Contributions Confirmed	Funding gap	Houses with improved protection
				2013/14	2014/15	2015/16	2016/17	2017/18			
Coulson Road Pumping Station [Health & Safety] Refurbishment	Reserved funding for 2013/14	Lincoln	190	70	-	-	120	-	-	-	-
Hobhole Refurbishment Programme		Boston and Skegness	577	135	50	-	-	-	-	-	1,688
Ancholme Valley Improvements	Indicative funding for 2014/15 onwards. FDGiA is indicative, but partnership funding may still be required.	Brigg and Goole	3,975	-	-	200	500	3,000	-	275	840
Works Arising from Lower Witham Strategy Review		Louth and Horncastle	750	-	-	250	250	250	-	-	2,370
Works Arising from Upper Witham Strategy Review		Sleaford and North Hykeham	900	-	-	150	250	250	-	250	390
Grainthorpe Pumping Station Improvements		Louth and Horncastle	35	-	-	16	-	-	19	-	324

Lindsey Marsh Pumping Station Improvements - 2015		Louth and Horncastle	151	-	-	84	-	-	67	-	6,026
Lindsey Marsh Pumping Station Improvements - 2016		Louth and Horncastle and Boston and Skegness	149	-	-	-	89	-	60	-	600
Lindsey Marsh Pumping Station Improvements - 2017		Louth and Horncastle and Boston and Skegness	20	-	-	-	-	9	11	-	174
Burton Pumping Station [Health & Safety] Refurbishment		Gainsborough	110	-	-	30	-	-	-	80	-
Pyewipe Pumping Station Refurbishment		Lincoln	40	-	-	-	25	-	-	15	-
Spalding Defences	Not proceeding before 2018/19	South Holland and The Deepings	750	-	-	-	-	-	-	750	2
Lindsey Marsh Pumping Station Improvements - 2018		Louth and Horncastle and Boston and Skegness	47	-	-	-	-	-	-	47	-
Lindsey Marsh Pumping Station Improvements - 2019		Louth and Horncastle and Boston and Skegness	98	-	-	-	-	-	-	98	-

Lindsey Marsh Pumping Station Improvements - 2020		Louth and Horncastle and Boston and Skegness	262	-	-	-	-	-	-	262	-
Lindsey Marsh Pumping Station Improvements - 2021		Louth and Horncastle and Boston and Skegness	242	-	-	-	-	-	-	242	-
Aubourn Pumping Station Refurbishment		Sleaford and North Hykeham	83	-	-	-	-	-	-	83	1
Boultham Pumping Station [Health & Safety] Phase 2		Lincoln	90	-	-	-	-	-	-	90	-
Hykeham Pumping Station [Health & Safety] Refurbishment		Sleaford and North Hykeham	40	-	-	-	-	-	-	40	-
Sand Syke Pumping Station Refurbishment		Sleaford and North Hykeham	40	-	-	-	-	-	-	40	-
Saxilby Pumping Station [Health & Safety] Refurbishment		Sleaford and North Hykeham	125	-	-	-	-	-	-	125	-
Benington Pumping Station Refurbishment		Boston and Skegness	1,185	-	-	-	-	-	-	1185	-

Hobhole Pumping Station Refurbishment		Boston and Skegness	18,670	-	-	-	-	-	-	18470	740
Lade Bank Pumping Station Refurbishment		Boston and Skegness	11,761	-	-	-	-	-	-	182	182

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