

Lower Witham

Baseline evidence report

2025



Find out more

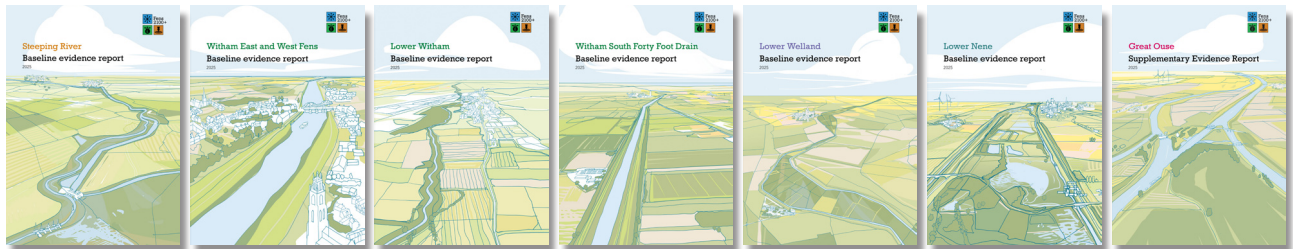
Summary baseline evidence report

Discover key findings from across the Fens.



Catchment baseline evidence reports

View the full suite of reports, for more detail on each catchment.



The Lower Witham Flood Resilience Baseline Report

A study conducted in 2025, which assessed asset condition and flood risk in the catchment.



Technical appendix

– Natural capital register and account

For more information contact:

Fens2100@environment-agency.gov.uk

This document has been produced by Arup in collaboration with the Environment Agency, Rivelin Bridge and the Fens 2100+ Partners as part of a wider programme of work, drawing from engagement across the area and sector.

The report in context

A robust evidence base

The Lower Witham catchment baseline report is a summary document based on the technical evidence detailed in the Lower Witham Flood Resilience Project Baseline Report (2025).

This report has been incorporated into the suite of catchment reports, offering a robust evidence base to support the Fens 2100+ Partnership in transforming the approach to investing in flood and coastal resilience, including:

- Maintaining and managing critical assets, which are ageing and under increasing pressure from climate change.
- Addressing how the area will function in the future, balancing flood risk, water supply, sustainability and economic growth.

Each report brings together data and insights from key Risk Management Authorities (RMAs) on their experience of managing the catchment. Information includes the historical and environmental context, the function of flood risk assets and their economic impact, current and future flood risks and investment challenges and opportunities.

Securing the future of the Fens

Located in eastern England, the Fens is one of the UK's most distinctive landscapes. Significantly influenced by human activity, it has evolved over centuries from marshland into fertile farmland through drainage systems, embankments and pumping stations. Today, it is a vital region for food production and manufacturing and environmental value, contributing significantly to the UK economy.

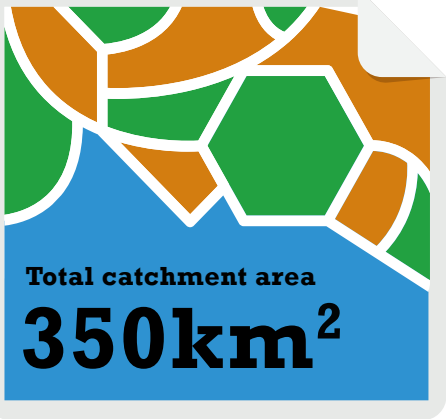
Lying largely at or below sea level, this highly vulnerable region faces increasing risks from rising sea and river levels driven by climate change and land subsidence caused by drying peat soils.

Without constant water management, large areas of the Fens would become uninhabitable, with the lives and livelihoods of over 600,000 being impacted by flooding from the rivers and the sea.

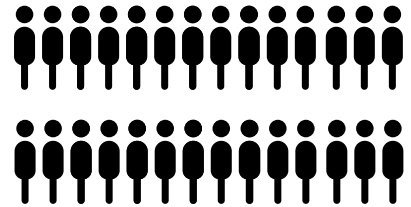
Yet, many of the 17,000 flood risk management assets that sustain the region are being affected by reliability and performance issues caused by their age. Many were built in the post-war period, with some dating back to the 1600s.

If these critical assets fail, the consequences would be catastrophic, risking lives, land, businesses and infrastructure.

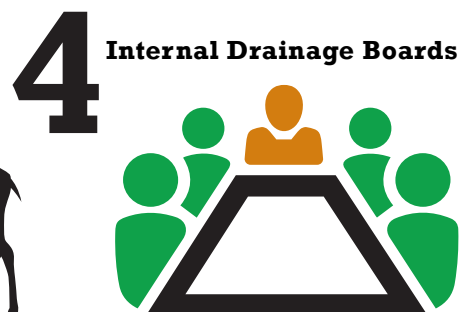
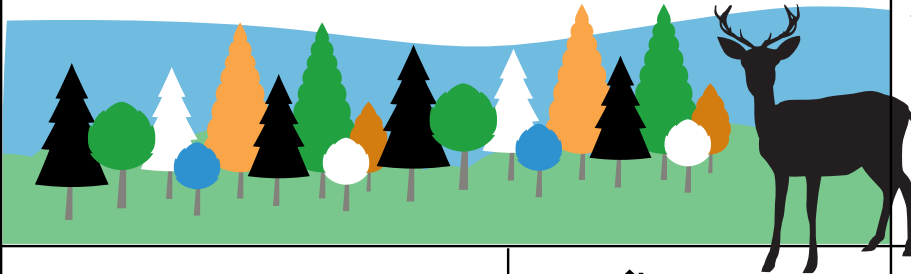
Lower Witham



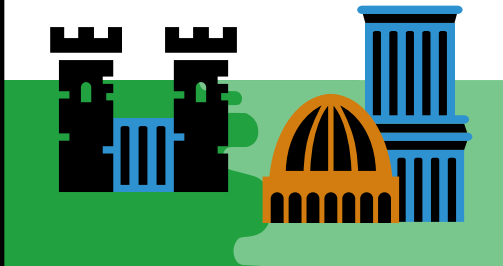
Estimated total
population
48,874



16 areas of designated Ancient Woodland



Over **3,000**
heritage assets
have been identified
within the catchment



Some areas of Boston
and Lincoln are
amongst the
10%
most deprived
neighbourhoods
in the country

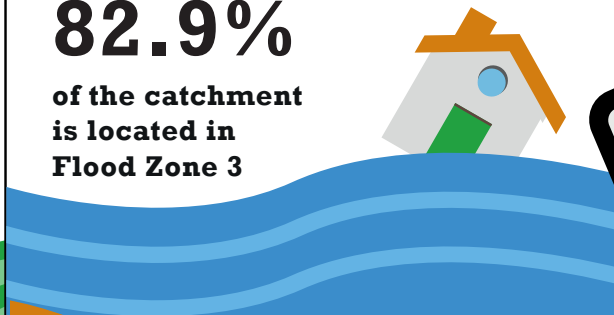
4 designated sites
for nature
conservation



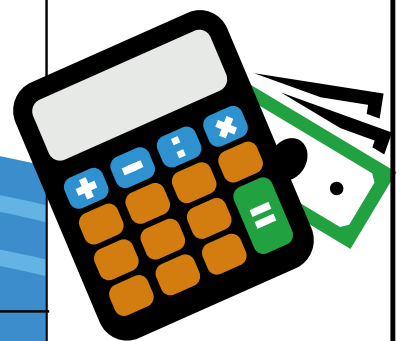
£29.6
million
total annual value
from natural capital



82.9%
of the catchment
is located in
Flood Zone 3



Approximately
300km
of raised earth
embankment



£4.2bn
economic benefits
of current flood
defences

Introduction

The evidence is clear: without urgent investment to maintain and upgrade flood risk assets across the Lower Witham catchment, £4.6 billion of damages could be sustained to land, homes and livelihoods.

A landscape worth protecting

Covering 350km² (35,000ha) of eastern Lincolnshire, the Lower Witham catchment is an area of national agricultural importance. Its thriving agricultural economy supports 10,813 local jobs and contributes to the UK economy.

There are 16 designated ancient woodlands and four designated nature conservation sites, including Bardney Limewoods, which has the UK's largest concentration of small-leaved lime woodlands.

Natural capital delivers £29.6 million of benefits a year, including food production, flood risk management, carbon sequestration, clean water and recreation. Around 8% of land is underlain by rich peat deposits.

The catchment is home to the historic market town of Boston and lies just downstream of the cathedral city of Lincoln. It has an estimated total population of 48,874. There are over 3,000 heritage assets in the catchment.

What's needed?

£1-£1.4 billion
of investment

to sustain the current Standard of Service for 100 years

What's the challenge?

The majority of Lower Witham is in Flood Zone 3, with a high probability of flooding. Continuous land drainage and flood defences are all that protect low-lying areas from permanent inundation. 271km² (27,095ha) of agricultural land and 9,282 homes are at risk. Many assets date back to approximately 200 years ago and processes such as settlement and weathering can compromise their Standard of Service over time.

Over 6% of assets are rated 'Poor' or in worse condition. This includes critical assets. This complex system of assets requires significant resources and collaboration between RMAs.

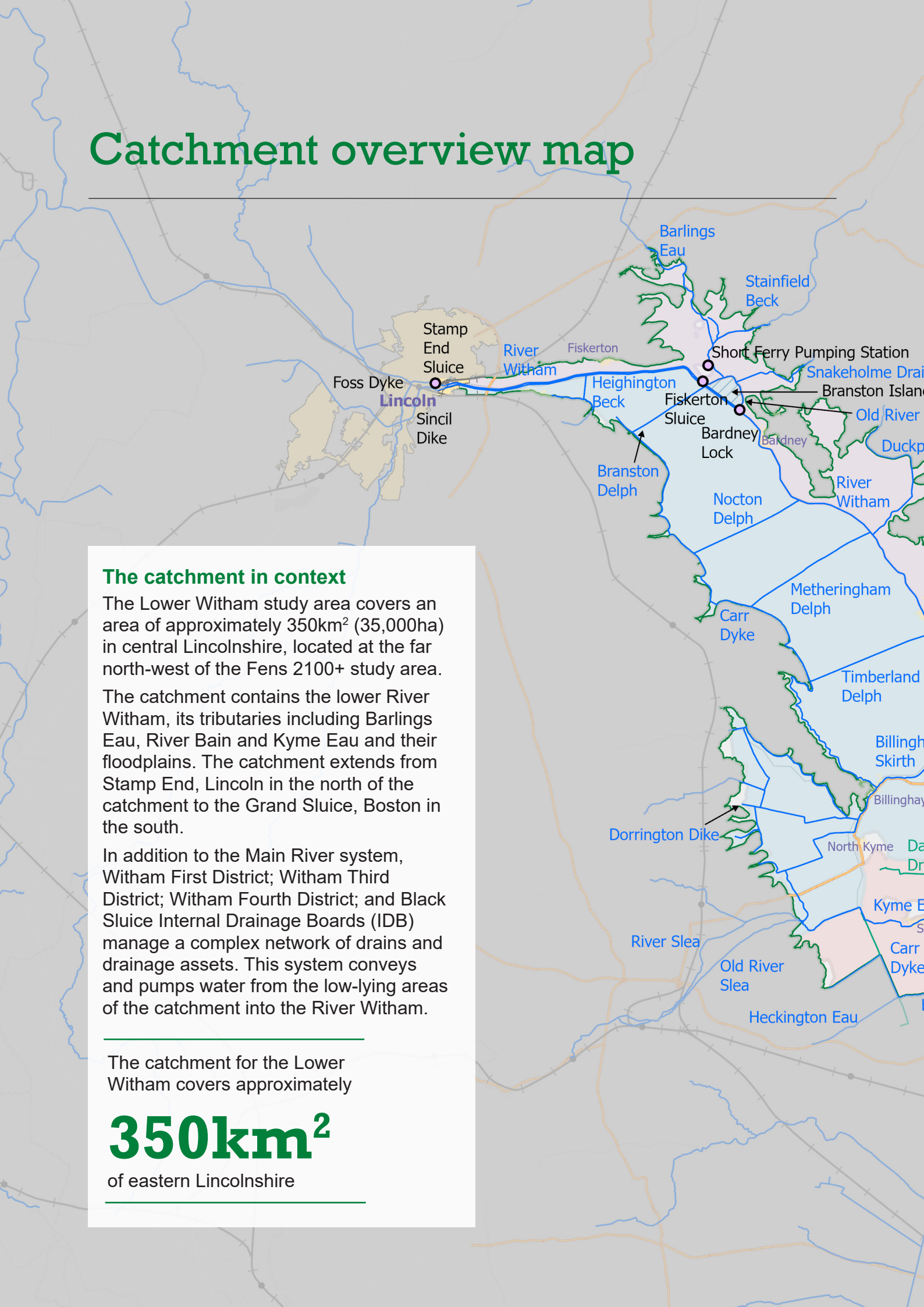
Repeated flooding events highlight the catchment's vulnerability, including 2007, 2008, 2012, 2019, 2023, 2024 and 2025. Climate change will intensify this risk, even if current defences are maintained.

To maintain

£4.2 billion
of benefits

through reduction of damages to properties, agriculture, transport and the environment

Catchment overview map



The catchment in context

The Lower Witham study area covers an area of approximately 350km² (35,000ha) in central Lincolnshire, located at the far north-west of the Fens 2100+ study area.

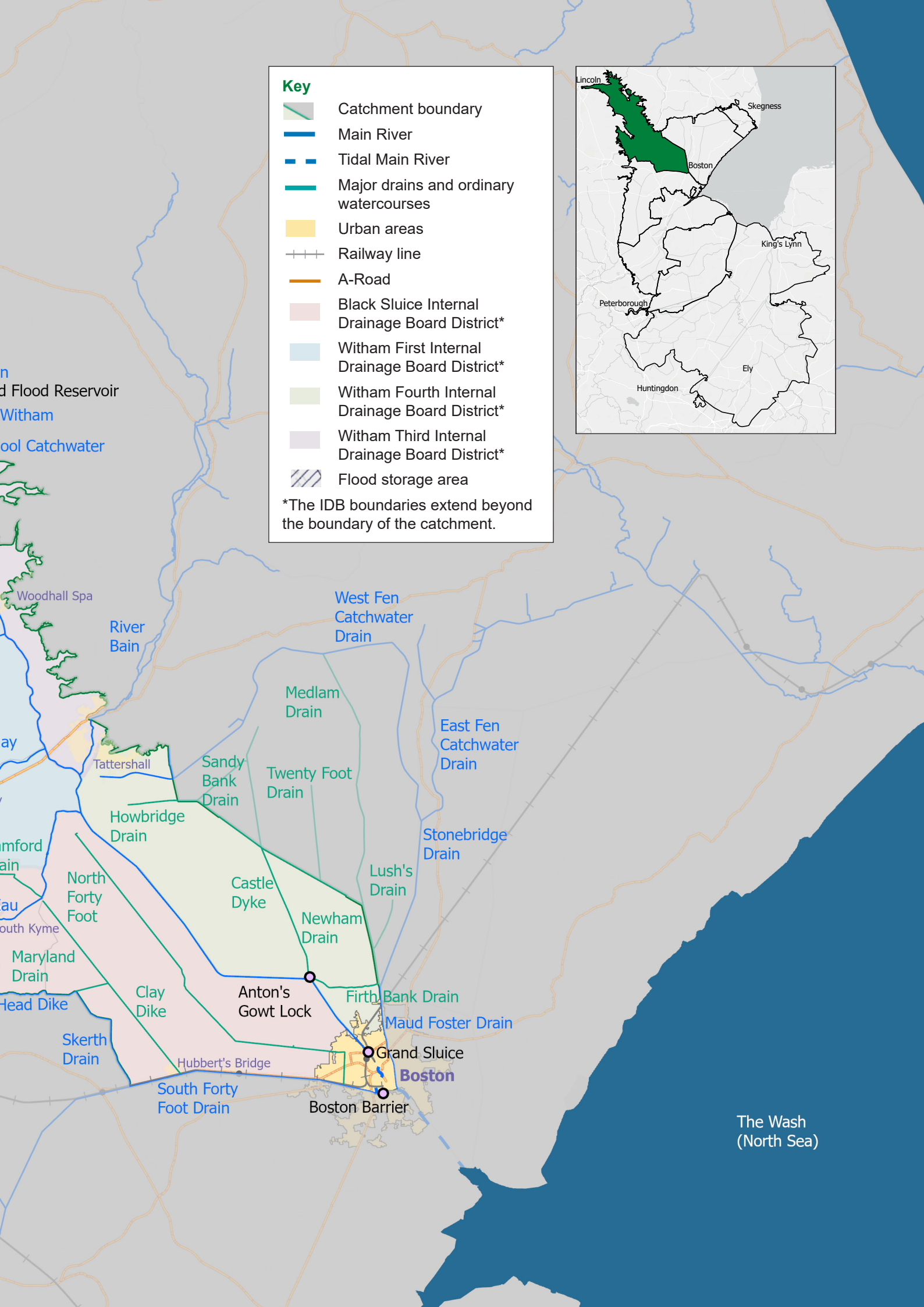
The catchment contains the lower River Witham, its tributaries including Barlings Eau, River Bain and Kyme Eau and their floodplains. The catchment extends from Stamp End, Lincoln in the north of the catchment to the Grand Sluice, Boston in the south.

In addition to the Main River system, Witham First District; Witham Third District; Witham Fourth District; and Black Sluice Internal Drainage Boards (IDB) manage a complex network of drains and drainage assets. This system conveys and pumps water from the low-lying areas of the catchment into the River Witham.













The catchment for the Lower Witham covers approximately

350km²

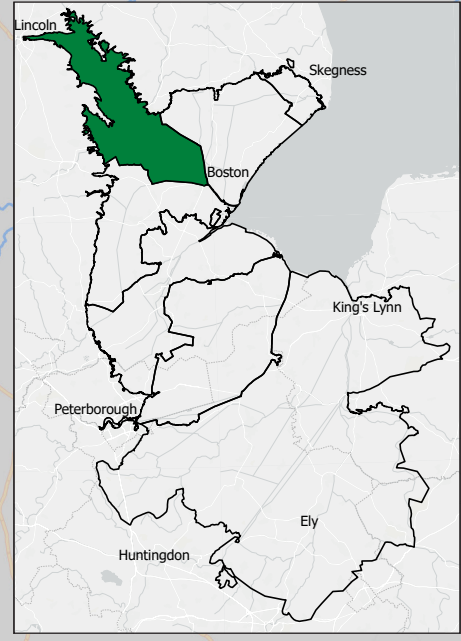
of eastern Lincolnshire



Key

-  Catchment boundary
-  Main River
-  Tidal Main River
-  Major drains and ordinary watercourses
-  Urban areas
-  Railway line
-  A-Road
-  Black Sluice Internal Drainage Board District*
-  Witham First Internal Drainage Board District*
-  Witham Fourth Internal Drainage Board District*
-  Witham Third Internal Drainage Board District*
-  Flood storage area

*The IDB boundaries extend beyond the boundary of the catchment.



Woodhall Spa
River Bain
West Fen Catchwater Drain
East Fen Catchwater Drain
Stonebridge Drain
Lush's Drain
Newham Drain
Firth Bank Drain
Maud Foster Drain
Boston
Boston Barrier
The Wash (North Sea)

Medlam Drain
Twenty Foot Drain
Sandy Bank Drain
Howbridge Drain
North Forty Foot
Maryland Drain
Head Dike
Skerth Drain
South Forty Foot Drain

Tattershall
Castle Dyke
Anton's Gowt Lock
Grand Sluice

Hubbert's Bridge

Catchment overview

With land levels ranging from 0m to 6m above sea level, this area would naturally be marshy wetland.

The River Witham rises to the south of Grantham near South Witham and flows in a generally northerly direction, where it is joined by several other rivers including Foston Beck and River Brant before it reaches Lincoln. The River Witham is then joined by the Fosdyke Navigation within Brayford Pool in Lincoln, before it enters the Lower Witham catchment at Stamp End.

From Stamp End, the River Witham flows in an easterly direction to Short Ferry and is flanked by the North and South Delph. The River Witham then flows in a south-easterly direction from Short Ferry all the way to Langrick Bridge, joined by several tributaries notably the Barlings Eau, several delphs, the Billingham Skirth, the River Bain and the River Sleas (also known as Kyme Eau).

The River Witham then has a couple of sharp meanders near Anton's Gowt before continuing south-east to Boston. Within Boston, the Grand Sluice acts to control water levels and separates the fluvial River Witham from the tidal reach of The Haven (downstream extent of the Lower Witham catchment study area). On the tidal section, the River Witham forms a confluence with South Forty Foot Drain and flows through the Boston Barrier structure before ultimately discharging into The Wash.

Throughout its course, the River Witham has been heavily modified. The channel has been artificially straightened and embanked, resulting in a perched watercourse with set minimum water levels to enable navigation.

The water levels upstream of Fiskerton Sluice are typically retained at 2.95m Above Ordnance Datum (AOD), whilst downstream of Bardney, the level is retained at 1.0m AOD during the winter months (31st October to 1st April) and 1.5m AOD during the summer months. This water level control is managed by the Environment Agency to maintain navigability and accommodate flood flows.

There are periods when high tide levels at the Grand Sluice prevent discharge of river water, known as periods of 'tide lock'. The effects of this can occur upstream of Bardney, reflecting the importance of water level control on the River Witham.

The catchment elevation varies between approximately 0m to 6m above sea level. It is a productive agricultural land with approximately 80% of the land classified as Grade 1 and 2 agricultural land. The landscape of the catchment includes small settlements, the historic market towns of Boston and the city of Lincoln. The catchment has a total population of approximately 48,874.

Connectivity from north to south throughout the Lower Witham catchment is limited with the road network reliant on most roads following an east-west axis connecting the A158 and A15. Railways within the built-up areas of Boston and Lincoln are present, largely connecting to Peterborough, Grimsby and Skegness. However, rail infrastructure through the rest of the area is confined to the western fringe where the Peterborough to Lincoln railway line runs between Ruskington and Metherringham.



The catchment has a total estimated population of

48,874



80%

of the land classified as Grade 1 and 2 agricultural land.



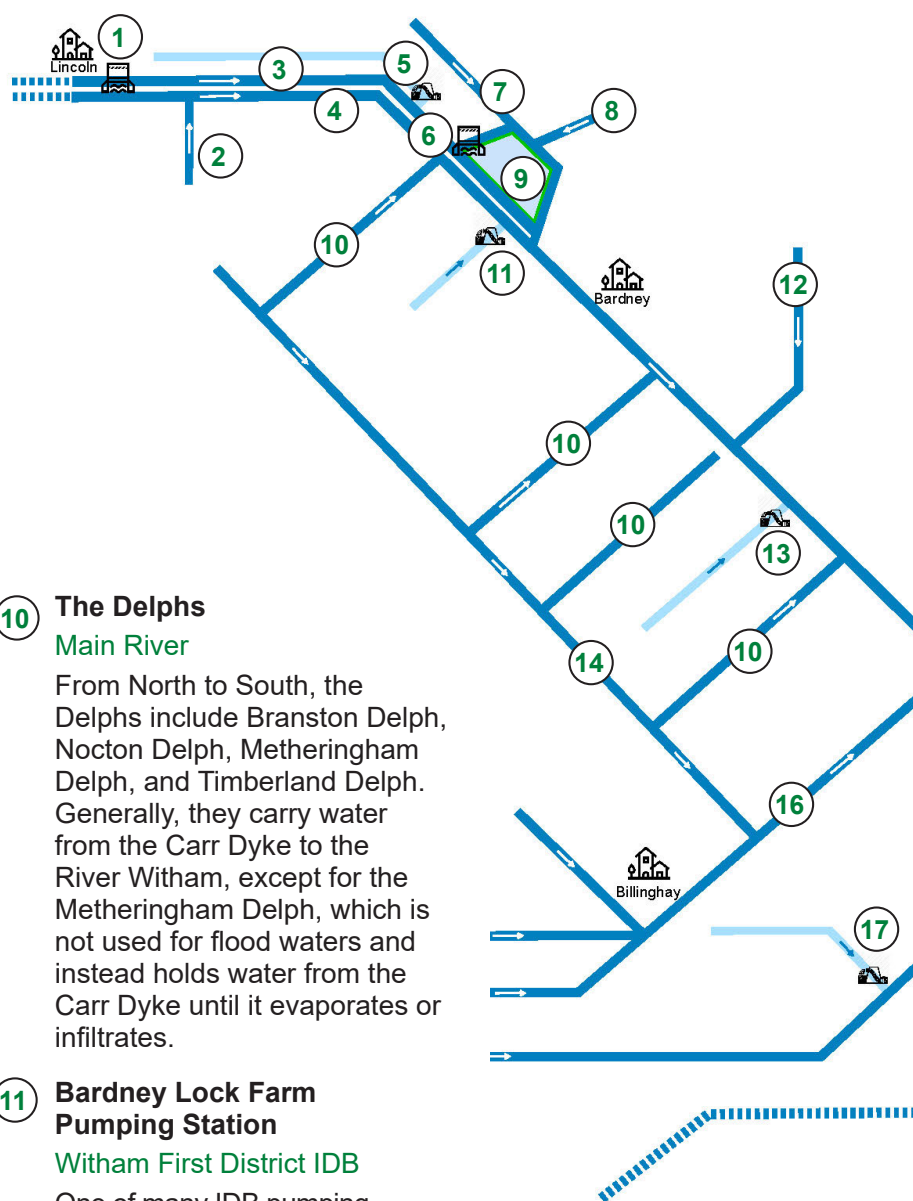
Embankments of the River Witham

© Arup (2025)

Flood management system

- 1 Stamp End Sluice and Lock**
Environment Agency
 Built to control river levels throughout the city for flood water management and navigation, including in Brayford Pool.
- 2 Sandhill Beck**
Main River
 Carries water from Heighington to the River Witham.
- 3 River Witham**
Main River
 The primary watercourse in the catchment. It is tidal downstream of Grand Sluice.
- 4 South Delph**
Main River
 Running parallel to the River Witham, it collects water from land to the south and discharges into the Witham at the downstream end of Branston Island.
- 5 Short Ferry Pumping Station**
Witham Third District IDB
 Pumps water from the North Delph into the River Witham.
- 6 Fiskerton Sluice**
Environment Agency
 Enables the high flows within the straightened, navigable River Witham to be diverted into the previous, meandering course of the River Witham which flows around Branston Island.
- 7 Barlings Eau**
Main River
 Carries water from higher ground to the north into the old course of the River Witham which circles Branston Island.
- 8 Snakeholme Drain**
Main River
 Carries water from higher ground to the north-east into the old course of the River Witham which circles Branston Island.

- 9 Branston Island Flood Storage Reservoir**
Environment Agency
 An embanked area of land which is designed to relieve water levels in the River Witham, offering some additional storage capacity during high flows to reduce the chance of local overtopping.



- 10 The Delphs**
Main River
 From North to South, the Delphs include Branston Delph, Nocton Delph, Metheringham Delph, and Timberland Delph. Generally, they carry water from the Carr Dyke to the River Witham, except for the Metheringham Delph, which is not used for flood waters and instead holds water from the Carr Dyke until it evaporates or infiltrates.
- 11 Bardney Lock Farm Pumping Station**
Witham First District IDB
 One of many IDB pumping stations moving water from land between the Delphs into the River Witham.

Key

- █ Main River
- █ IDB Drains
- ▬▬▬ Watercourses outside the study area
- █ Tidally-influenced Main River
- Flood storage area

Navigation and other water level control structures are not shown.

12 Duckpool Catchwater

Main River

Carries water southwards from Bucknall to the River Witham.

13 Blankney Pumping Station

Witham First District IDB

Moves water from land between the Delphs into the River Witham.

14 Carr Dyke

Main River

Designed to minimise the amount of water entering the IDB district, it intercepts run-off from the higher ground to the West. It carries this water into the Delphs which then discharge into the River Witham.

15 River Bain

Main River

Rising over 30km north in Ludford, it can bring significant flows from the Wolds into the River Witham.

16 Billingham Skirth

Main River

Carries water from the low lying fens to the west of Billingham to the River Witham. It receives water from the New Cut, Dorrington Dike and Farway Drain.

17 Damford Grounds Pumping Station

Black Sluice IDB

Pumps water out of the Damford Drain into Kyme Eau.

18 River Slea / Kyme Eau

Main River

Kyme Eau is the name of the River Slea downstream of South Kyme. It brings water to the River Witham from west of Sleaford.

19 Chapel Hill Pumping Station

Black Sluice IDB

Pumps water out of the Twenty Foot Drain into Kyme Eau.

20 South Forty Foot Drain

Main River

A major tributary of the River Witham bringing water from the south.

21 Holland Fen Pumping Station

Black Sluice IDB

Pumps water out of the southern part of the catchment, (known as Holland Fen) into the South Forty Foot Drain.

22 Cook's Lock Pumping Station

Black Sluice IDB

Pumps water out of Holland Fen (via the North Forty Foot Drain) into the South Forty Foot Drain.

23 Anton's Gowt Lock

Canal and River Trust

Provides access between the River Witham and the Witham Navigable Drains managed by Witham Fourth District IDB.

24 Castledyke Drain

Witham Fourth District IDB

Carries water from north of the River Witham towards Hobhole Pumping Station (beyond the catchment, downstream), where it is discharged into The Haven.

25 Grand Sluice

Environment Agency

Controls water levels on the River Witham, and prevents the tide coming further inland.

26 Boston Barrier

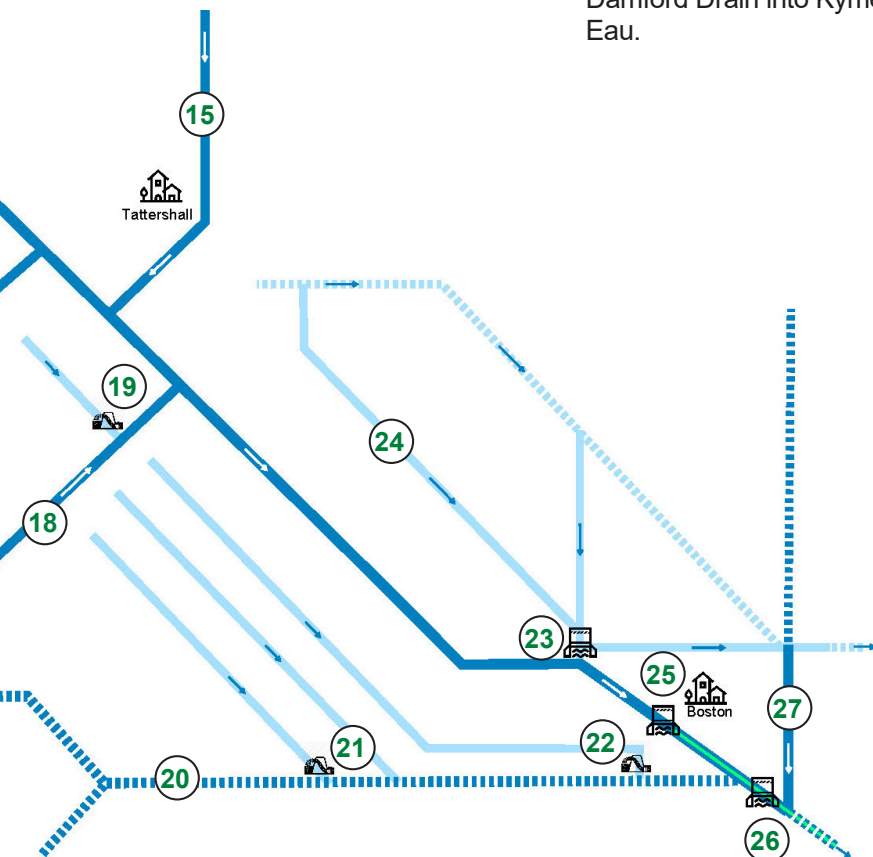
Environment Agency

Prevents extreme high tides or surges from flooding Boston and the surrounding land.

27 Maud Foster Drain

Main River

Forms the catchment boundary with the neighbouring East and West Fens catchment.



History of the catchment

Modification and control of water levels in the Lower Witham catchment have been ongoing since the Bronze Age.

Several artificial and modified waterways were initially constructed back in the Bronze Age and used through the Medieval period, with the Fosseydyke navigation being built to connect the River Witham and the River Trent back in AD120.

In the early 1600s, the fenlands in the area began to be drained. The drainage works were hampered by the deteriorating condition of the previously canalised/improved banks of the River Witham which were prone to failure and leakage.

Further drainage channels were constructed in the early to mid-1700s to drain the fenlands for agriculture. In 1762, an Act of Parliament created the Witham General Drainage Commissioners, which enabled the straightening, widening and scouring of the River Witham. Between 1764 and 1766, the Grand Sluice was constructed and in 1807 the new Maud Foster Sluice was constructed. Once drained, the soils of the former fenland began to shrink, causing the surface level to drop beneath that of rivers, tributaries, ditches and drains.

During the 1800s, water pumps, powered by horses and then wind, were a key part of the landscape's water management infrastructure. This maintained drier conditions for arable production.

The Witham Drainage Act (1881) enabled the construction of Boston dock, which opened in 1884. Some of the current infrastructure along the River Witham and its tributaries are 150-200 years old.

The 1900s saw further developments of a wide range of water management infrastructure, and electricity was used to power pumps for the first time. Throughout the 1900s and into the 2000s agriculture has dominated the landscape and the economy, despite some industrialisation the land remains highly productive.

Meanwhile the River Witham itself provides a navigable link to The Wash and has many recreational uses including fishing, boating and the Public Rights of Way along its banks.

Records of flooding have been a constant occurrence in the catchment, particularly around Sandhill Fen, the South Delph and the Barlings Eau. Most recently, significant flood events have affected properties and communities in 2007, 2008, 2012, 2019, 2023/2024 and 2024/2025. The winter storms of 2023/2024 caused significant fluvial flooding which had implications for agriculture in the area of Barlings Eau.



Boston dock and lock gates in 1914

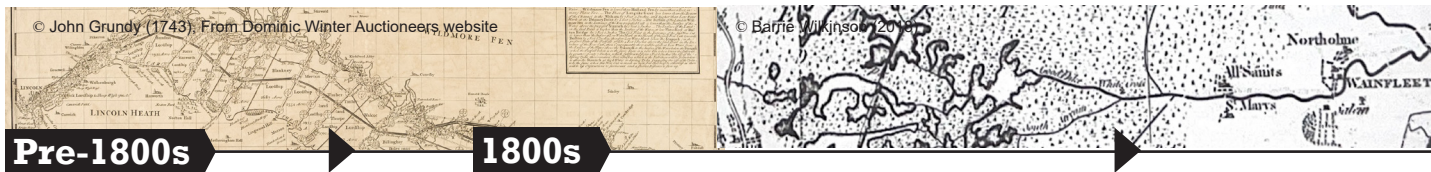
© Boston Official Guide 1970



River Witham close to Brayford Pool, Lincoln in 1993

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Timeline



Pre-1800s

120AD

The Romans connected the River Witham and the Trent via the Fossdyke navigation.

1014

The mouth of the River Witham moved from Bicker Haven following severe flooding and Boston became important as a port.

1200s

Commissions of Sewers were established (the earliest drainage authorities).

1671

Act of Parliament for the improvement of navigation on the River Witham.

1762

Act of Parliament creating the Witham General Drainage Commissioners. The Act enabled the straightening, widening and scouring of the River Witham.

1764-1766

Construction of Grand Sluice in Boston.

1773

The Enclosure Act leads to increase in land owner investment in fen drainage works.

1800s

1807

New Maud Foster Sluice in Boston constructed.

1808-1812

Further Acts of Parliament led to the relocation of the existing locks to more satisfactory positions and the construction of the catchwater drains to the south of the river in order to separate local and long-distance drainage.

1810

Extreme tidal event resulting in raising the existing sea banks in Boston by 0.6m.

1829

Further Acts of Parliament obtained to raise more money to further widen and deepen the River Witham just below Stamp End Lock in Lincoln.

1830s

Steam powered drainage introduced.

1861

The Land Drainage Act amended the powers of the Court of Sewers.

1877

Flood event.

1880

The River Witham Outfall Improvement Act enabled. This gave powers to carry out the making of a new cut approximately 3.2km long at the outfall of the River Witham, extending from Hobhole Sluice seawards to Clayhole.

1881

The Witham Drainage Act authorised the Corporation of Boston to construct a dock in an old cut-off meander.

1883

Flood event.

1884

Boston dock opened.

1889

Flood event.



1900s

- 1934**
Witham First, Third and Fourth IDB formally constituted under The Land Drainage Act (1930).
- 1935**
Black Sluice IDB formed under The Land Drainage Act (1930).
- 1947**
Snow melt caused significant flooding across the catchment.
- 1958**
Flood event.
- 1962**
Witham Transfer Order.
- 1964**
Blankney Pumping Station installed.
- 1971**
Trent and Lincolnshire Water Act.

2000s

- 1975**
Witham Valley Improvement Scheme saw the construction of seven pumping stations between Heighington and North Kyme.
- 1974**
Trent Witham Ancholme Water Transfer Scheme (TWA) commissioned.
- 1981**
Flood event.
- 1991**
Scheme to transfer water from River Witham to Dogdyke and IDB system commissioned to manage water levels.
- 1993**
The right bank of Barlings Eau breached due to flooding.
- 1997**
Lower Witham Strategy Study Report published.
- 2007**
Highest recorded rainfall since 1766 caused widespread flooding as a result the Barlings Eau left bank was overtopped, damaged and repaired.
- 2007**
Lower Witham Strategy Study Review Project published.
- 2008**
Flood event.
- 2012**
Flood event.
- 2019**
Heavy rain resulted in overtopping in many locations and breaches on Barlings Eau and Timberland Delph.
- 2023/2024**
Widespread fluvial flooding was experienced during the winter of 2023/2024 as a result of Storm Babet and Storm Henk. The flooding has a significant impact on agriculture in the area of Barlings Eau.
- January 2025**
Water levels in the South Forty Foot Drain were the highest ever recorded.

Managing flood risk

Across the Lower Witham catchment, flood risk is the responsibility of multiple organisations.

Roles and responsibilities

The **Environment Agency** have permissive powers to carry out flood and coastal erosion risk management activities on Main Rivers.

Witham First District; Witham Third District; Witham Fourth District; and Black Sluice IDB are responsible for managing the complex network of drainage channels and pumping stations which drain the land within their district. They also regulate water levels on non-Main Rivers (ordinary) watercourses.

Riparian Landowners have the main legal responsibility for maintaining all watercourses.

Lincolnshire County Council (LCC) acts as both the Lead Local Flood Authority (LLFA) and the local Highway Authority. The Highways department is responsible for maintaining highway drainage assets, while the LLFA has overall responsibility for local flood risk matters. Lincolnshire was one of the first areas in England to publish and implement a Local Flood Risk Management Strategy and was forward looking in the way all of the relevant risk management authorities were involved in the strategy's development.

Boston Borough Council, North Kesteven District Council, East Lindsey District Council, West Lindsey District Council and City of Lincoln Council have a responsibility to promote sustainable development in their role as the Local Planning Authority. They have responsibilities under the Land Drainage Act (1991) to undertake flood risk management works on ordinary watercourses outside IDB areas.

Anglian Water is the main water and sewerage company within the Lower Witham catchment and have a role in managing the risk of flooding posed by public drainage infrastructure.

Legislation

The roles and responsibilities of these RMAs are set out in the Flood and Water Management Act (FWMA) (2010). The FWMA is national legislation developed in response to the widespread flooding experienced across England in 2007. The Act re-established the roles and responsibilities of the RMAs related to flood risk. This Act is supported by local policies and plans that outline the management of local flood issues.

Local groups and partnerships

Under the FWMA (2010), Regional Flood and Coastal Committees (RFCCs) were established by the Environment Agency. RFCCs guide flood and coastal erosion risk management activities within their river catchments and along the coastline.

The Lincolnshire Flood Risk and Water Management Partnership was set up to improve the management of flood risk and water resources in the region. This is comprised of the Environment Agency, Anglian Water, LCC, the district and borough councils and IDBs across Lincolnshire, as well as Lincolnshire Resilience Forum and Natural England. This partnership provides co-ordinated management and delivery of flood risk and drainage functions across Lincolnshire.

Future Fens Integrated Adaptation (FFIA) is a strategic partnership initiative, with the aim of working together across sectors to determine the actions that partners involved in managing water across the landscape can jointly take to secure a vibrant future for the Fens.

National strategies

In 2020, the Environment Agency published the latest National Flood and Coastal Erosion Risk Management Strategy. It contains 'Measure 1.5.4', which requires development of a long-term plan for managing future flood risk in the Fens.

Local policies, strategies and plans

The key local policies, strategies and plans that directly influence how flood risk management is undertaken in the catchment are:

Anglian River Basin District Flood Risk Management Plan 2021-2027

This plan outlines a partnership to explore measures that will help the basin district to be more resilient and informs the delivery of existing flood programmes.

Joint Lincolnshire Flood Risk and Drainage Management Strategy 2019-2050

This provides a framework for flood risk management across Lincolnshire linking all the RMA's.

Joint Lincolnshire Strategic Flood Management Plan (2017)

This outlines how development should consider flood risk at every stage of the development process. It includes a standard advice appendix which describes the assessment and mitigation measures required, based on Flood Zones and vulnerability to flood risk.

Lower Witham Flood Resilience Project

The project considered how the current level of flood risk management in the area can be maintained and what the future of long-term flood risk management might look like in support of the Fens 2100+ Partnership.

Environmental Land Management Scheme

This will pay landowners to implement schemes which provide environmental improvement and will replace farming subsidies under the European Union's Common Agricultural Policy.

Local Witham strategies

Strategic choices for the Lower Witham have been considered in the following reports:

- Lower Witham Strategy Study Report (1997)
- Lower Witham Strategy Study Review Project Appraisal Report (2007)
- River Witham Opportunities Study (2014)
- Lower Witham Flood Resilience Baseline Report (2025)
- The Lower Witham Sustainable Recovery Pilot Project (LWSRP) (2025)



The role of critical infrastructure

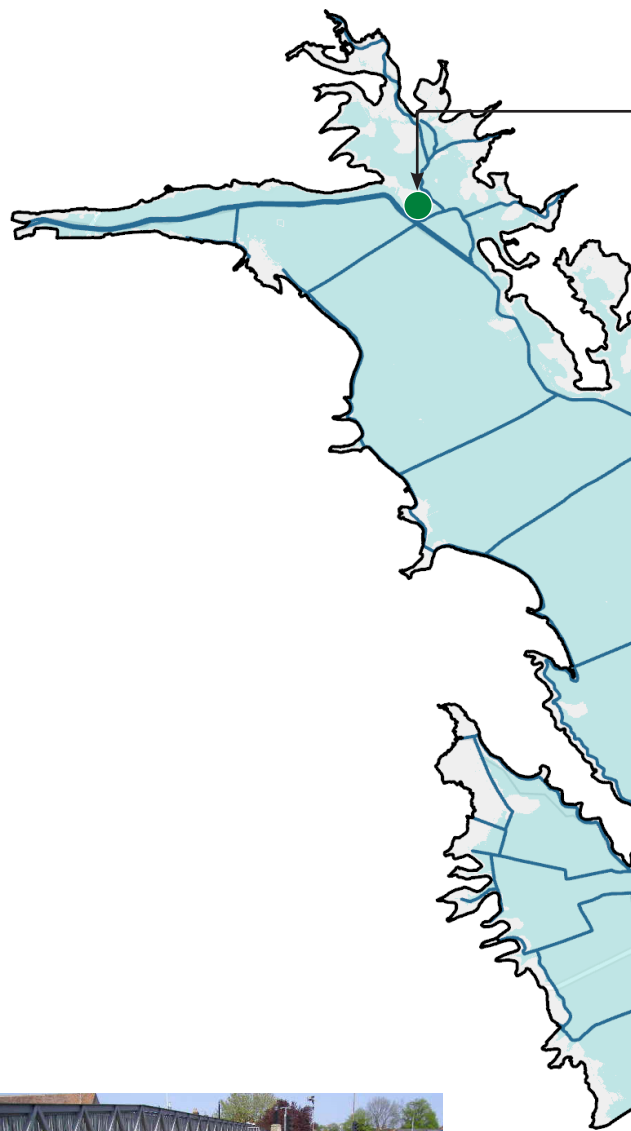
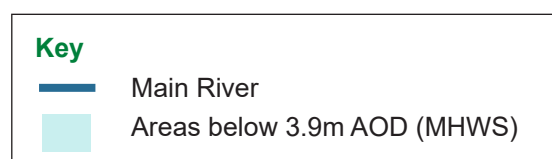
Only the continuous operation of flood risk assets can protect the low-lying areas of the Lower Witham catchment from severe and long-term flooding.

Before human intervention, much of the Lower Witham catchment was a waterlogged landscape, covered by freshwater and intertidal marsh. Over centuries, huge effort and investment has enabled the transformation of the area into a habitable and productive landscape. If flood risk assets were abandoned, and constant management of water levels were to cease, then the landscape would soon be inundated, becoming an uninhabitable inland salt lake.

To demonstrate the existential risk of flooding to the catchment in the absence of defences, the map of tidal inundation from the Mean High Water Spring (MHWS) tide shows the tidal inundation that would occur on a regular basis in the absence of tidal flood defences. In this scenario, the tide would inundate the land to a level of 3.9m AOD. Whilst some areas of the catchment would drain as the tide recedes, the frequency of tidal inundation would mean the land was essentially uninhabitable.

A low-lying catchment

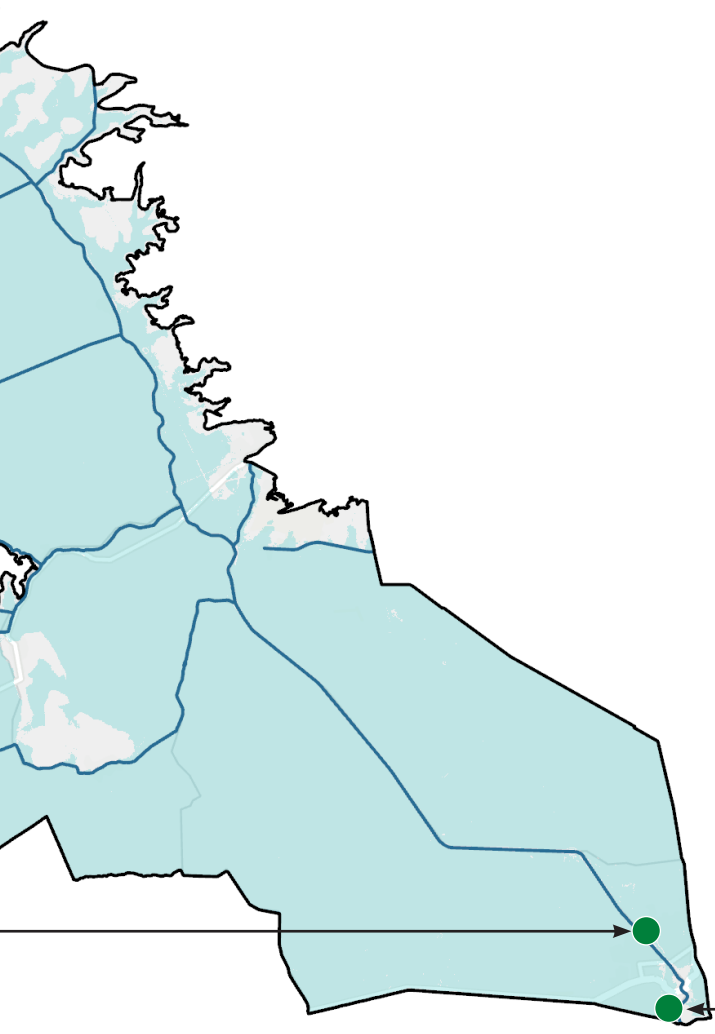
The catchment topography is low lying, with slightly elevated land running along the eastern and western boundary of the catchment, and lower-lying areas further inland. The lowest point of the Lower Witham catchment would be flooded to a depth of 3.9m in the MHWS tidal event. The topography makes it difficult for water to drain naturally from these lower-lying areas and if flooding occurs, the lack of gradient allows floodwaters to spread over a large area.



Grand Sluice © Brian Green. Licensed for reuse under the Creative Commons Licence.



Short Ferry Pumping Station
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Reliance on flood risk assets

Defence of the land against tidal inundation relies on the presence of tidal defences along the coast and the tidal reaches of The Haven.

The effective removal of water from the land drainage system into Main Rivers relies on the operation of pumping stations. In turn, the pumped system relies on other assets to prevent extra water entering the district which would have to be pumped out. Some of the most important are the embankments which contain the Main Rivers which carry water from higher ground across the catchment. Without effective containment, the Main River system would contribute additional water to the IDB network, and place greater pressure on pumping station capacity.

Sluices and other water management assets are monitored and adjusted all year round to maintain water levels in both the IDB and Main River systems. If these assets were not present, or if existing defences were allowed to deteriorate through age or lack of maintenance, extreme events would severely compromise drainage and would result in the inundation scenario depicted on the map, leading to uninhabitable conditions.

Extreme events

Even with current flood risk assets in place, tidal and fluvial flooding poses a significant risk to the catchment, as evidenced by major flood events in 2007, 2008, 2012, 2019, 2023/2024 and 2024/2025. For example, the winter storms of 2023/2024 led to extensive fluvial flooding which had implications for agriculture in the area of Barlings Eau.



The Boston Barrier © Ian Paterson.
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Current flood risk

The Lower Witham catchment is at significant risk of flooding from rivers and the sea.

Tidal

Tidal flooding represents flood risk from the sea and can be caused by high astronomical tides, storm surges and wave action. The Grand Sluice prevents tidal water ingress into the Lower Witham catchment.

Naturally, the River Witham would have a typical tidal range up to the Chapel Hill area, approximately 16km upstream of the Grand Sluice.

Fluvial

Fluvial (river) flooding occurs when river levels rise above bank level and overtop. Several factors heighten the risk of fluvial flooding within the catchment.

- The Main River system is elevated above the surrounding ground level due to ground subsidence caused by draining the peat rich soils.
- Water is contained within the Main River system by earth embankments constructed either side of the channel. When sections of embankment fail, significant areas of land can become inundated.
- The Main River system and the network of feeder drains can suffer from low velocities due to the low gradient of the land that they are set within.
- Due to the low gradient topography and incidents where land has subsided to below sea level, there is a reliance on pumped systems.
- During high tide events, the whole fluvial system can become tide-locked with no water able to leave the catchment by gravity.

At the time of writing no suitable hydraulic model was available to provide accurate maps of the flood risk posed by the River Witham and its tributaries within the Lower Witham catchment.

However an existing model of the Lower Witham is being updated and is due for completion in 2026.

Other sources

Groundwater flooding. This can occur when the water table rises above the surface. Groundwater flooding is not a significant risk in the catchment owing to the extensive drainage, but can occur when local drainage systems are overwhelmed.

Surface water flooding. This describes situations when the volume and intensity of rainfall overwhelm local drainage systems. There are isolated areas of high (3.3% AEP), medium (between 1% and 3.3% AEP) and low (between 0.1% and 1% AEP) surface water flood risk in the catchment, with depths from 300mm to over 900mm.

Reservoir flooding. This is associated with the failure of flood storage reservoirs at Lincoln, Branston Island and Horncastle and affects land alongside the River Witham and its tributaries. The likelihood of reservoir flooding is considered low due to the provisions of the Reservoirs Act (1975). According to the Anglian Water interactive mapping service, there are no water supply reservoirs within the catchment.

AEP = Annual Exceedance Probability.

The probability of a certain sized flood event being equalled or exceeded in a given year.

Future flood risk

Tidal and fluvial flood risk will increase over the next 100 years, even if defences are maintained to the current level of protection.

Future tidal and fluvial flood risk will rise due to the increasing height and frequency of tidal surges and river flows driven by climate change. These changes pose a growing threat to agricultural land and residential properties, with the potential for more frequent and severe overtopping events and failure of defences.

Climate change

The UK Climate Projections 2018 (UKCP18) predict how the climate might change under different scenarios. The high emissions Representative Concentration Pathways (RCP8.5) scenario for the East Midlands region, in which the Lower Witham catchment is located, has been reviewed. This suggests that mean precipitation rates for winter are anticipated to increase by 10% in 2060 and 19% in 2080. In the summer, precipitation rate is anticipated to decrease by 22% in 2060 and 30% in 2080.

The UK Centre for Ecology and Hydrology have generated predictions for changes in peak river flows based on the climate projections. By the 2080s, the central estimate for peak flow increases is 21% while the upper estimate is 57%. As climate change will lead to increased flows in the Lower Witham catchment, the risk of flooding will also increase.

As with current flood risk there is no suitable hydraulic model available to provide flood maps, with the Lower Witham model being updated. The updated model will incorporate climate change scenarios currently stipulated by DEFRA, which will describe the impact of climate change on flood risk.

Assessment of climate change scenarios are based on government guidance and best available data at the time of writing, or model production. This guidance is revised as climate change projections are revised. Irrespective of the predicted magnitude of change, climate change will increase the frequency and severity of flood events over time. Longer term climate change scenarios have been considered within a Fens Climate Change Risk Assessment undertaken by FFIA.



Branston Island flood storage area in operation in 2024 © Simon Tomson. Licensed for reuse under the Creative Commons Licence.

Flood risk management assets

A complex network of ageing assets enable flood risk to be managed within the Lower Witham catchment.

The assessment of asset condition for the Lower Witham catchment has been derived from two sources of information:

- The Environment Agency’s Asset Information and Maintenance (AIMS) dataset which provides an overall score for each asset based on the last visual inspection of the asset.
- The Lower Witham Flood Resilience Baseline Report (2025). This undertook analysis of the condition of geotechnical assets.



Branston Island Flood Storage Area © Chris.
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Key catchment challenges



Assets are ageing

Many of the assets within the Lower Witham catchment date back approximately 200 years.



Embankments are vulnerable

There are over 300km of embankments within the catchment. These assets have been assessed to determine their vulnerability considering their age and a range of geotechnical properties. The analysis indicated that 7% of embankments were at very high risk of failure.



Other asset challenges

Flood risk management is underpinned by the operation of critical assets such as the Grand Sluice.



Investment needs

Many of the existing assets in the catchment are of an age where considerable investment of between £1- 1.4 billion is required over the next 100 years to maintain their Standard of Service.

Data availability and quality

Data analysis is based on a criteria including the AIMS Score (an overall score assigned by the Environment Agency based on the last visual inspection of the asset), low spots in the embankment and embankment dimensions and characteristics including angle of slope and toe protection. The Environment Agency has advised that some data within AIMS may be outdated, potentially underestimating the number of assets currently under stress.

The AIMS assets comprise:

- 644 embankment assets
- 35 wall assets
- 108 natural high ground sections
- 21 engineered high ground sections
- 514 other point assets such as outfalls, weirs, culverts, bridges and debris screens etc.

Asset age profile

Analysis from the Lower Witham Flood Resilience Baseline Report (2025) indicates that many of these assets date back to approximately 200 years ago and processes such as settlement and weathering can compromise their Standard of Service over time.

Asset condition profile

Approximately 38% of the assets within the Lower Witham were considered to have a current condition score of 'Good' in AIMS. Conversely, almost half were considered 'Fair' whilst over 6% were considered to be in 'Poor' or worse condition. For a more detailed analysis of asset health and condition, refer to the Lower Witham Flood Resilience Baseline Report (2025).



Grand Sluice © Bob Harvey. Licensed for reuse under the Creative Commons Licence.

Operating challenges

Grand Sluice has been in place for over 250 years. It is a key control structure designed to regulate upstream river levels and allows flows in the River Witham to discharge. V-shaped pointing doors prevent tidal inflows entering the Lower Witham catchment from The Haven. These close automatically when tidal levels exceed the upstream river level and open when river levels are higher than the tide. This can result in periods of tide-lock, when tides are too high to allow upstream flows to discharge by gravity.

Aside from tide-locking, the condition of the structure is a concern. It has been refurbished many times in its history but some components have now been in use since the early 1980s and are showing signs of deterioration. As a result, works are underway to refurbish components of the structure, in order maintain its Standard of Service. These works will not address the issue of tide-locking or increase the Standard of Protection.



The Grand Sluice © Bob Harvey. Licensed for reuse under the Creative Commons Licence.

There are data gaps regarding **pumping station condition**. There are 29 different pumped sub-catchments within the Lower Witham Fens, managed by four different IDBs. These comprise the Witham First District IDB, Witham Third District IDB, Witham Fourth District IDB, and Black Sluice IDB.

These pumping stations are essential for removing water from land within the catchment by moving it into the Main River system. However, a detailed assessment of pumping station condition was not undertaken within the Lower Witham Flood Resilience Project (2025). Some pumping stations in the catchment were constructed in the 1960s or earlier, and a lack of data about their condition represents a key vulnerability for the catchment.



Stixwold Pumping Station © Jonathan Thacker. Licensed for reuse under the Creative Commons Licence.



Holland Fen Pumping Station © J. Hannan-Briggs. Licensed for reuse under the Creative Commons Licence.

Embankments are in poor condition.

Analysis from the Lower Witham Flood Resilience Baseline Report (2025) indicates that approximately 46% of the embankments within the Lower Witham catchment are considered to have low to very low risk of failure. However, approximately 7% of the embankments were assessed to have a very high risk of failure.

Due to the age of many of the embankments in the Lower Witham catchment, many may not meet modern engineering standards and will inevitably have been subject to settlement, compaction, and erosion. They may have also been compromised by wildlife, vegetation or livestock over time. While a good quality embankment may withstand overtopping without structural failure, overtopping of an embankment which is already weakened and unable to resist erosion may cause a breach, resulting in a sudden and uncontrolled release of water and more widespread flooding.

Topographical surveys undertaken between 1998 and 2023 show a mean decrease in embankment elevation of 0.1m over this 25-year period. In some places, the elevation decreases were more significant, for example along a 250m stretch of the River Witham's left bank upstream of Southrey, which had lowered by between 0.5m and 1m.

Lowered embankment crests puts these crucial assets at greater risk of overtopping and structural failure.



Raised embankments on the River Witham near Woodhall Spa © Julian P Guffogg. Licensed for reuse under the Creative Commons Licence.



Cattle on the River Witham embankments near Fiskerton © Richard Croft. Licensed for reuse under the Creative Commons Licence.

Remedial works

Many of the existing assets in the catchment are of an age that a considerable investment of between £1-1.4 billion is required over the next 100 years. This investment would maintain the current defences' Standard of Service through refurbishment and replacement at the end of their foreseeable design life, routine maintenance and operational costs. It does not include adapting defences for increased frequency or severity of flooding due to climate change.

The following engineering interventions are considered likely within the catchment:

- Earthworks to top up low-spots.
- Low height flood walls.
- Seepage - sheet pile cut off.
- Cement soil mix wall.
- Rock armour at bank toe.



Sluice gate on the Timberland Delph © Chris. Licensed for reuse under the Creative Commons Licence.

Environment

Mapping shows the catchment is a distinctive historic and human-influenced wetland landscape, predominately rural in nature and dominated by agricultural use.

Due to the flat topography, there are several prominent features throughout the project area that contribute to the character of the landscape and stand as landmark features.

These features represent key views characterising the region and include Lincoln Cathedral; Boston Stump; church towers/spires; The Ryvita Factory, Billingham Water Tower, power network infrastructure and woodland at the fringes of the catchment.

Boston, within the Boston Borough Council jurisdiction and Lincoln, within the City of Lincoln Council are the only town and city respectively in the catchment.

There are further small villages and hamlets.

The catchment is located within four National Character Areas (NCAs) – these are areas of distinct and recognisable character.

The majority of the catchment is located within The Fens NCA which is notable for its large-scale, flat, open topography with extensive vistas to level horizons. The north-eastern extent of the catchment is characterised as the Central Lincolnshire Vale; a tranquil, rural and sparsely populated landscape. The very western edges of the catchment are partially located within the Northern Lincolnshire Edge within Coversands and Southern Lincolnshire Edge character areas, with long-reaching views.

Most of the waterbodies are Artificial or Heavily modified (with the exception of Dunston Beck) under the Water Environment Regulations.

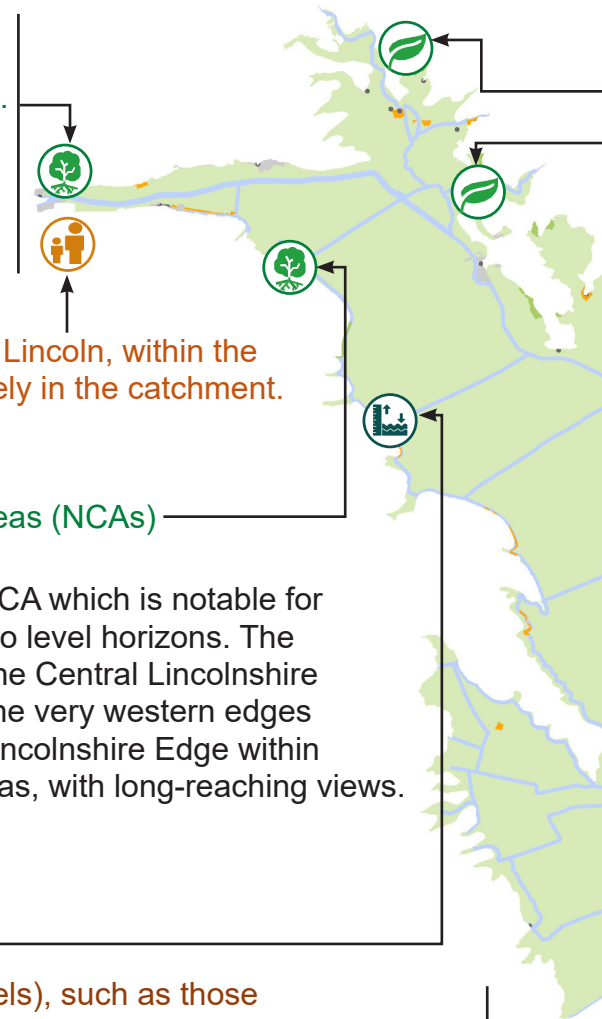
These waterbodies are currently impacted by diffuse pollution from agricultural and rural land management and physical modifications.

Peaty soils cover 8.4% of the catchment area












They are concentrated in the west of the catchment, near North Kyme.

Roddons (palaeochannels), such as those identified crossing Timberland Delph are an influential feature within the catchment.

Roddons are historic channels preserved as buried geological features. Prior to the drainage and canalisation of the catchment, an extensive river network and complex drainage network was present across the wider area. These relict, infilled channels comprise generally coarser grained materials (sand and gravels) and form slight topographic highs in comparison to the adjacent softer compressible clay and peat deposits.



Key

-  Air Quality
-  Biodiversity
-  Landscape
-  Population and Health
-  Water Environment
-  Heritage
-  Ground Conditions
-  Listed Buildings
-  Scheduled Monuments
-  Internationally Designated Sites
-  Nationally Designated Sites

There are four statutory designated nature conservation sites within the catchment, some overlap entirely or partially with other designations.

Bardney Limewoods National Nature Reserve (NNR) and Site of Special Scientific Interest (SSSI) represents the greatest concentration of small-leaf lime woodlands in the country.

There are 16 areas of designated Ancient Woodland, the largest of which is the Great South and Demerose Woods at Stainfield spanning ~1.28km² (128ha) and Nocton Wood at Dunston spanning ~1.03km² (9103ha).

Riparian habitat, or habitat along the banks and margins of rivers, is important given the ~300km of main river within the area, plus further ordinary watercourses and delphs.

Population is projected to increase in the region and with Lincolnshire having a slightly older population than England on average (5.3% more over 65s), the numbers of elderly residents are likely to increase.

The Boroughs within the Lower Witham Fens (comprising Lincoln, West Lindsey, East Lindsey, North Kesteven and Boston) average a 14.6% increase in households during this time.

There are no Air Quality Management Areas (AQMAs) within the catchment.

There are three AQMAs within 1km of the catchment, with one in (around the major road network in the city centre) and two in Boston comprising Haven Bridge (around the A16 trunk road) and Bargate Bridge (from Bargate roundabout to Spilsby Road).

The catchment includes superficial alluvium, Tidal Flats and notable bedrock formations.

Superficial geology is largely comprised of alluvium and pockets of peat with tidal flats dominating the catchment south of Branston Delph. The Lincoln Gap valley features mudstone, limestones, sandstones and siltstones, with the Oolite limestone ridge as a notable feature. Limestone becks are important tributaries of the Lower Witham. They are fed by the Lincolnshire limestone aquifer and support unique habitats.

The relative deprivation of the Lower Witham catchment shows great variation.

Some areas of Boston and Lincoln are amongst the 10% most deprived neighbourhoods in the country, whilst parts of North Kesteven (around Washingborough) are considered to be within the 10% least deprived neighbourhoods in the country. Overall, the percentage of households living in income deprivation was 11.8% in 2019, lower than both that of England (12.9%) and Lincolnshire (12%).

There are over 3,000 heritage assets within the catchment.

Over 800 are designated heritage and archaeological sites. Archaeological finds include the Witham Shield and long boat from the Iron Age discovered near Washingborough and Fiskerton.

Agriculture

The Lower Witham catchment is an area of national agricultural importance. Farming is critical to the local economy within the catchment.

Soilscape

The soil types in the area are of a peaty nature with naturally high groundwater levels. In the northern part of the Lower Witham catchment from Lincoln to Branston Delph, the soil is described as 'Fen peat soils' which have a drainage classification of naturally wet. In the central section of the catchment from Branston to Timberland Delph, this graduates to 'Loamy and Sandy Soils' maintaining a peaty surface.

Further south towards Boston, the loamy and sandy soils graduate to more clayey soil types of coastal flats with naturally high groundwater levels. These soils are capable of retaining moisture but also draining well, making them productive for cultivation.

Agricultural Land Classification (ALC)

Soils within the Lower Witham are capable of retaining moisture but also draining well, making them productive for cultivation. This is reflected in the land use of the area with 91% being occupied by non-irrigated arable land, with some pasture.

The ALC comprises the following:

24.9km² (2,487ha) of Grade 1 (7% of the catchment): excellent quality agricultural land commonly used to grow fruits, salad crops and winter harvested vegetables with high and less variable yields.

257.4km² (25,739ha) of Grade 2 (73% of the catchment): very good quality agricultural land which can support a wide range of agricultural and horticultural crops with a generally high but more variable yield than Grade 1.

61.5km² (6,147ha) of Grade 3 (17% of the catchment): good to moderate quality agricultural land with moderate limitations affecting choice of crops, timing and type of cultivation or level of yield. Yields are generally lower or more variable than on Grade 1 and 2 land.

2.4km² (239ha) of Grade 4 (1% of the catchment): poor quality agricultural land which has severe limitations which significantly restrict the range and level of yield of crops.

	Area (km ²)	Area (Ha)	Percentage of farmed land (%)	Estimated annual value* (£)
Cereals	135.1	13511	44.8%	£19.4 million
Arable crops (excluding cereals)	63.6	6360	21.1%	£14.8 million
Fruit and vegetables	38.4	3842	12.7%	£73.4 million
Grassland	14.4	1439	4.8%	Grassland does not directly create economic value but instead supports the grazing of sheep and cattle, or the production of livestock feed.

*Key land use, crop areas and livestock populations on commercial agricultural holdings and estimated annual value (£) for the Lower Witham catchment. Based on 2023 land and livestock data available from Defra.

Water availability

The Witham Abstraction Licensing Strategy notes that water is only available for the majority of the catchment during higher flows. These are flows equalled or exceeded for at least 30% of the time.

The catchment is characterised by a network of river channels embanked above the level of the surrounding land. Water is pumped or discharged by gravity into these river channels from low lying drains during high-flows and provide an irrigation source during low flows.

There is a high demand for spray irrigation in the catchment, particularly in summer.

Environmental stewardship

Approximately 55% of the catchment area is managed under government funded stewardship agreements, particularly in the Nocton Fen and around Barlings Eau and Timberland Delph. These agreements, such as the Countryside Stewardship scheme or the historic Entry Level Stewardship scheme, are designed to financially support farmers and other land managers to enhance the natural environment.

Climate change

Climate change will increase the risks of fluvial and coastal flooding, as well as drought. Flooding and drought events can restrict the ability to establish new crops, reduce crop yields and quality, or destroy crops once ready for harvest leading to direct agricultural damages and wider economic consequences for landowners. The geographical location of the catchment means a disproportionate impact may be felt on supply chains.



Crop spraying near Martin Dales, situated in the south of the catchment © J. Hannan-Briggs.
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Natural capital

Natural capital refers to elements of the natural environment that provide valuable goods and services to people, underpinning wellbeing and economic prosperity.

The benefits provided by natural capital assets such as freshwater, soils, air and species of plants and animals are known as 'ecosystem services'.

These ecosystem services are vitally important for human wellbeing and include provision of raw materials, food production, carbon sequestration, temperature regulation, crop pollination, as well as enabling recreation and cultural activities. Some of the services provided by nature do not directly benefit humans, but support the provision of other ecosystem services, for example in the case of water and nutrient cycling, and soil formation.

Together these services provide many benefits to society and the economy including improved physical and mental health through recreation; temperature regulation; flood protection; and provision of clean water.

The monetary value of benefits provided from ecosystem services can be estimated using information about the quantity, quality and location of natural capital assets, as well as societal use. Values may be underestimated due to lack of information, or complexity in assigning a monetary value.

Key ecosystem services that are difficult to quantify include biodiversity; pollination and seed dispersal; soil quality; and cultural benefits from education, volunteering, amenity, aesthetics and a sense of place. These services cannot be given a financial value, but are nevertheless vitally important for underpinning our society and the natural world.

Natural capital in the Lower Witham catchment has an annual value of

£29.6 million

Climate regulation

In some cases, the poor condition of the environment can compromise the benefits that it would otherwise provide. For example, peaty soils in healthy condition can continue to form peat and therefore sequester carbon, but when degraded they start to release carbon back to the atmosphere.

Enclosed farmland and woodland within the catchment sequesters a total of 7,300 tonnes of CO₂ equivalent per year. However, this is far outweighed by the 77,400 tonnes of CO₂ emitted by the degraded peatland in the catchment, making the land a net source of carbon.

The impact of climate change driven by this process gives a negative value (or cost) for climate regulation.*

Overall, the net release of CO₂ equivalent across the catchment has an annual cost of

£20.2 million

*This assessment only takes account of land-based emissions, and therefore excludes emissions from industry, transport or other sources.



£3.5 million

Recreation

The welfare value of approximately 906,000 visits by adults each year to publicly accessible green spaces within the catchment. The welfare value of a further 230,000 visits made by children each year cannot be quantified but is likely to be significant.



£0.9 million

Physical health

£875,000 in healthcare treatment costs can be avoided every year due to improved physical health through approximately 470,000 active visits to publicly accessible green spaces in the catchment. Active visits involve at least 30 minutes of exercise.



£30.7 million

Agriculture

The 317km² (31,700ha) of enclosed farmland in the catchment provide several ecosystem services, but the service with the largest annual value is food production. Arable and livestock yields from the catchment have a combined annual value of £30.7 million.



£0.5 million

Air Quality

The removal of approximately 1,870 tonnes of air pollutants by vegetation in the catchment avoids the costs of damages to health. This has an annual value of £546,000 per year.



£0.1 million

Water quality

Based on a willingness-to-pay approach, the 2km of watercourse with 'Good' water quality within the catchment is worth approximately £300,000, as an alternative to having poorer water quality.



-£20.2 million

Climate regulation

The value of climate change regulation in the catchment is negative because the habitats across the catchment release more carbon than they sequester overall. Each year, 6,440 tonnes of CO₂ equivalent are released, costing approximately £1.9 million per year through the detrimental effects of climate change.



£0.0 million

Hazard regulation

In the catchment, an estimated 95,400m³ of floodwater is temporarily stored in areas of woodland. The assessment does not provide a monetary value for this benefit, however the cost of creating a flood storage reservoir to store a similar amount of water is estimated at £48,000 per year.



£0.8 million

Renewable energy

An estimated 58,100MWh of renewable energy is generated each year within the catchment. This has an annual value of approximately £811,000.



£13.2 million

Water supply

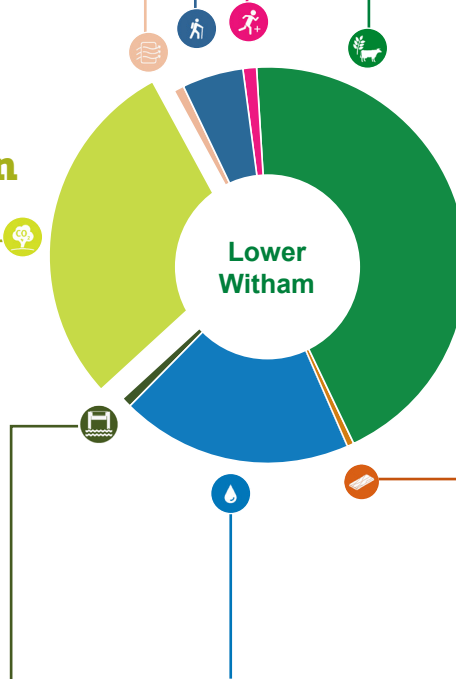
The annual value of approximately 2.9 million m³ of water which is abstracted from the catchment each year, for public water supply and other uses such as irrigation.



£0.08 million

Timber

National data can be applied to the Lower Witham catchment to estimate a yearly timber production volume of 2,493m³, which is valued at approximately £84,000 per year.



Flood economic damage scenarios

To understand the potential economic impact of flooding over the next 100 years, two scenarios have been explored which describe different approaches to managing flood risk assets. These are the 'Maintain' and 'Do Nothing' scenarios.

Maintain

The 'Maintain' scenario represents the continued maintenance of the existing flood defences. This assumes sufficient investment to maintain the existing flood defences for 100 years. All flood defences would continue to provide the same Standard of Service that they currently offer. There is no allowance for increasing the Standard of Protection offered by existing assets or for climate change adaptation, such as increasing the height and resilience of flood defences, or increasing the capacity or performance of pumping stations.

In this scenario, the majority of the Lower Witham catchment from Lincoln to Chapel Hill would have a greater than 3.3% chance of flooding each year, with the remaining catchment having between a 1% and 3.3% chance of flooding each year. However, flood extents and probability are likely to increase with time due to the effects of climate change.

Do Nothing

The 'Do Nothing' scenario is a hypothetical scenario, used to understand the benefits of investment in flood defences by considering the consequences of investment being withdrawn. In this scenario, all flood risk management activities would stop, including maintenance of existing flood defences.

In this scenario, tidal inundation would occur in the Lower Witham system up to a level of 5.1m AOD.

Further, river and surface water flooding would inundate a large area in the centre of the Lower Witham catchment which rely on pumping stations as much of the area is unable to drain to the embanked River Witham. When considering the impact of rainfall, less the impact of evapotranspiration and infiltration, of 500mm per year on water levels, they are expected to rise by 0.5m per year.

Again, this water would be unable to drain to the River Witham and result in permanent flooding of land, properties and infrastructure across much of the Lower Witham. The Lower Witham catchment between Lincoln and Chapel Hill comprises a series of confined flood compartments which would continue to fill until they start overtopping the outer embankments and equalise with the River Witham.

This limiting level is taken as 4.2m AOD, which is the level of low spots found on the current embankments confining these flood cells. The flood compartments on either side of the River Witham between Chapel Hill and Boston are unconfined and would likely fill until they overtop to adjacent compartments, over causeways or higher ground.

£4.2 billion

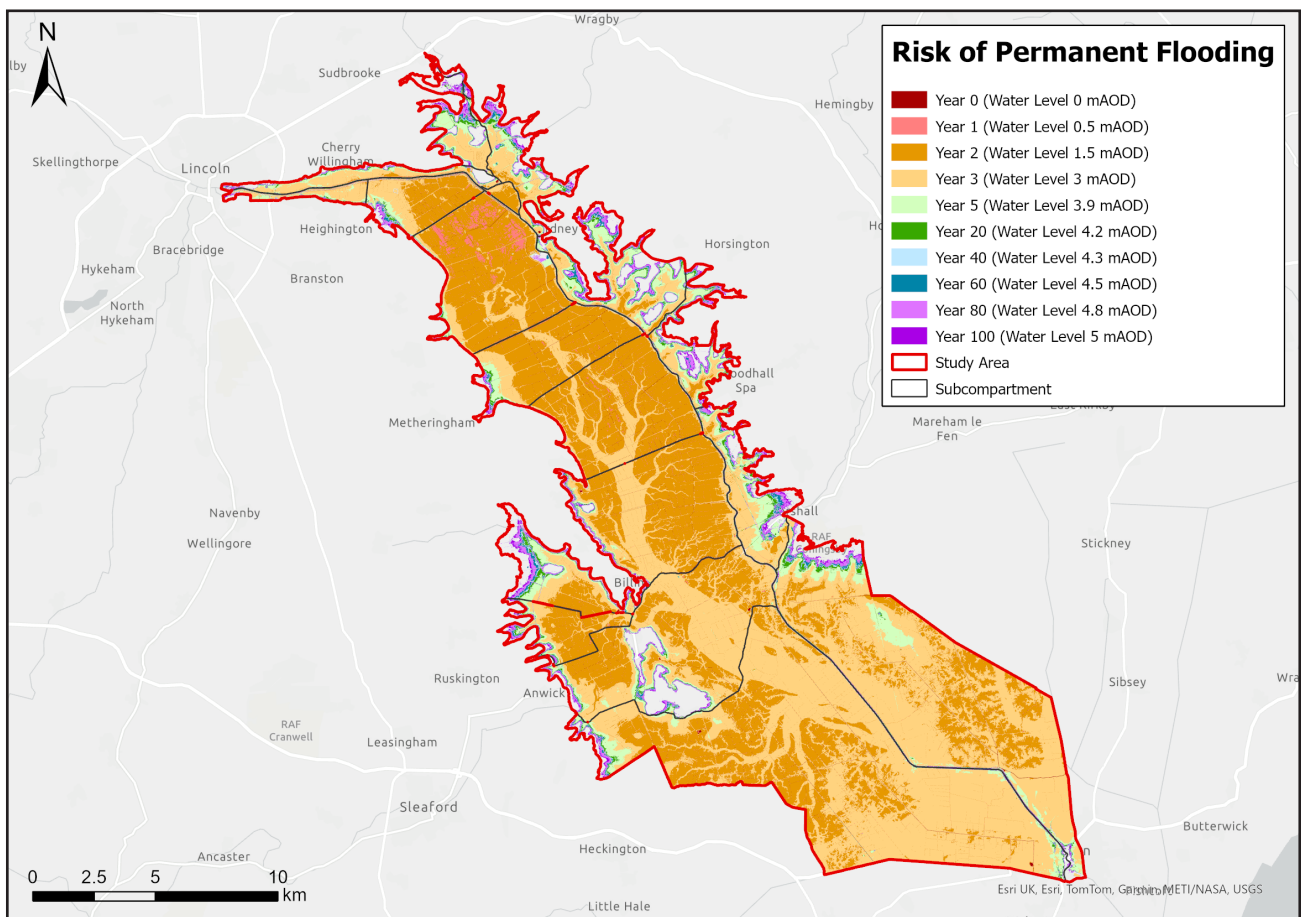
the economic benefits of current flood risk management activities



The economic analysis estimates the damages that would be expected to occur in each of the 'Do Nothing' and 'Maintain' scenarios. The economic benefit of maintaining the existing flood defences is the damages avoided in the 'Maintain' scenario compared to 'Do Nothing'.

The Total Impact framework to the left shows the range of damages considered.

The results of the assessment show that there is a total of £4.6 billion of economic damages in a 'Do Nothing' scenario (excluding losses to the local economy), compared to only £396 million of economic damages in a 'Maintain' scenario. As such, the economic benefits of current flood risk management activities are valued at £4.2 billion.



Risk of permanent flooding over time, in a 'Do Nothing' scenario

Economic damages and benefits of flood protection

If all flood risk management activities ceased ('Do Nothing'), total damages in the catchment over the next 100 years would be almost £4.6 billion, with nearly £4.4 billion of this in the first ten years.

£3.3 billion

Properties

Captures the impacts of flooding on residential and non-residential buildings, through damage to building fabric and structure.

9,282 residential and 999 non-residential properties would be written off under a 'Do Nothing' scenario.

£1.1 billion

Losses to the local economy

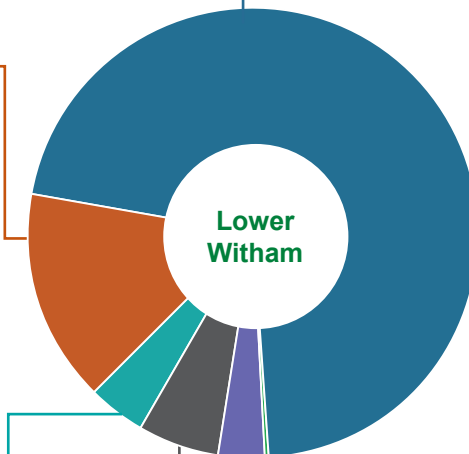
Losses to the local economy have been considered in terms of Gross Value Added (GVA). This considers the cost to the local economy of 10,813 jobs being lost across the catchment under a 'Do Nothing' scenario. GVA is a local / regional benefit so cannot be included in application for Grant in Aid funding.

£677 million

Agriculture

Flooding of farmland can lead to immediate and long-term crop losses. Damages capture loss of crops and livestock and associated loss of profits.

271km² (27,095ha) of agricultural land written off in the 'Do Nothing' scenario



£6 million

Environment and recreation

Loss of 7.6km² (763ha) of designated environmental sites across the catchment will lead to losses of ecosystem services such as carbon sequestration, flood regulation, biodiversity, recreation and non-use values.

£188 million

Transport

The cost of the loss of road infrastructure, and railway network as a result of permanent flooding.

Loss of 10km of road infrastructure
300m of rail infrastructure

£268 million

Isolated land

The consideration of isolated land and properties is unique to the 'Do Nothing' scenario which considers permanent inundation of the catchment, rather than infrequent extreme flood events. It accounts for areas of land which may not be directly flooded, but are abandoned because flood waters cut-off the area from the existing road network.

£155 million

Utilities

Captures the impacts of flooding to power, water supply, and gas networks. This includes damage to 517 substations, 3,293 pole towers and 457km of power transmission infrastructure.

Lower Witham	Do Nothing Damages	Maintain Damages	Maintain Benefits
Damages to properties and associated indirect damages	£3.3 billion	£367 million	£2.9 billion
Agricultural losses	£677 million	£29 million	£679 million
Environment and recreational losses	£6 million	-	£6 million
Transport damages	£188 million	-	£188 million
Utilities damages	£155 million	-	£155 million
Land lost due to isolation	£268 million	-	£268 million
TOTAL Excluding losses to the local economy	£4.6 billion	£396 million	£4.2 billion
Losses to the local economy	£1.1 billion	-	£1.1 billion

£4.2 billion

total benefits of maintaining current flood defences for the next 100 years

Total investment needed:

£1-£1.4 billion

to sustain the current Standard of Service for 100 years (excluding the impact of climate change).

The investment needed to sustain the existing flood defences has been estimated with no allowance for improvements in protection or adaption to the impacts of climate change. These investment needs have been developed based on three types of assumed costs:

- Ongoing and routine maintenance and operational costs;
- Infrequent asset refurbishment costs; and
- End of life asset replacement costs.

The costs have been developed based on data for various assets across the wider Fens 2100+ study area, collated from the Environment Agency and IDBs.

All damages and benefits are shown for a 100-year period, except for GVA, which is for 10 years.

These have been used to determine the average costs for each type of asset, including for maintenance, operation and asset replacement. Asset refurbishment costs are only included where these have been provided for specific assets. The range of costs reflects the uncertainty in the assumptions made at this stage.

The flood risk, asset condition, economic and total investment analyses given within this baseline report demonstrates the critical importance of a strategic plan for the future of flood risk management within the Lower Witham catchment. Future stages of the Fens 2100+ Partnership will build on this evidence to set out an investment strategy for the region.

Glossary of terms and acronyms

Agricultural land Grades 1 and 2

Land classified as Grade 1, using the UK's Agricultural Land Classification (ALC), has little or no limitations and will consistently achieve high yields for most crops. Grade 2 has reduced flexibility compared to Grade 1 and yields are generally high but can be more variable compared to Grade 1.

Agri-environmental schemes

Agri-environment schemes provide funding to farmers and land managers to farm in a way that supports biodiversity, enhances the landscape, and improves the quality of water, air and soil.

Annual Exceedance Probability (AEP)

This is the probability of a certain sized flood event occurring in a single year.

Asset Information Management System (AIMS)

A database with information about flood defence assets currently owned, managed and inspected by the Environment Agency.

Benefits

The positive quantifiable and unquantifiable changes that a flood risk management scheme is expected to produce, i.e. damages avoided.

Capital funding

Funding secured for the creation of new assets or the major refurbishment of existing assets to maintain or increase current standards of protection.

Carbon sequestration

The process of capturing and storing greenhouse gases from the atmosphere. In the context of natural systems this is via plant vegetation and soil processes.

Catchment

For the purposes of the Fens programme, the catchment study area has been defined by land at or below the 6m AOD contour, which may differ slightly from the hydrological catchment.

Climate mitigation

Actions taken to limit the effects of climate changes by reducing carbon emissions or enhancing carbon sinks.

Damages

The value of negative social, economic and environmental impacts caused by flooding.

Ecosystem services

Services provided by the natural environment which benefit people. They provide outcomes that provide positive benefits to human wellbeing.

Flood risk management assets

In the context of this report this refers to a structure built and maintained specifically for flood risk management purposes, for example embankments, flood defence walls and pumps.

Main River

A statutory designation of watercourse, usually applied to larger streams and rivers. The Environment Agency have permissive powers to carry out maintenance, improvement and construction works on these watercourses, although usually the main responsibility for these lies with the riparian owner.

Maintenance funding

Funding secured for maintenance activities to existing assets to sustain the existing standard of protection. Sometimes this is referred to as revenue funding.

Maladaptation

Actions or strategies that, while intended to address a problem, ultimately increase vulnerability or harm, either in the short or long term.

Mean High Water Spring (MHWS)

The average height of high-water level during spring tides, placing this area at risk of permanent inundation.

Natural capital

Refers to elements of the natural environment that provide valuable goods and services to people, underpinning wellbeing and economic prosperity.

Ordinary watercourse

Any watercourse which is not designated as a Main River. Within the Fens the IDBs manage these watercourses on behalf of the riparian owners.

Ordnance Datum (OD)

The Ordnance Datum is the basis for all the land heights that appear on Ordnance Survey maps. It is essentially the mean sea level at Newlyn in Cornwall, and is sometimes called Ordnance Datum Newlyn (ODN).

Representative Concentration Pathways (RCPs)

These are climate change scenarios used to project future greenhouse gas concentrations. They were formally adopted by the Intergovernmental Panel on Climate Change (IPCC) and describe different climate futures based on the amount of greenhouse gases emitted.

Resilience

The capacity for people and places to plan for, protect, respond to and positively recover from flooding and coastal change.

Risk Management Authorities (RMAs)

Refers to the authorities which take a strategic lead on the management of flooding and have permissive powers to carry out the works. These authorities include the Environment Agency, LLFAs, district councils, IDBs, highway authorities and water companies.

Soilscape

A classification used to describe the broad regional differences in soil types and their distribution across a landscape.

Standard of Protection (SoP)

At a given point in time, the AEP of a flood event which an asset is able to withstand. SoP will vary over time.

Standard of Service (SoS)

Defined physical characteristics that a flood risk infrastructure asset is required to achieve. For example, the height of a protective barrier or throughput of a pump.

