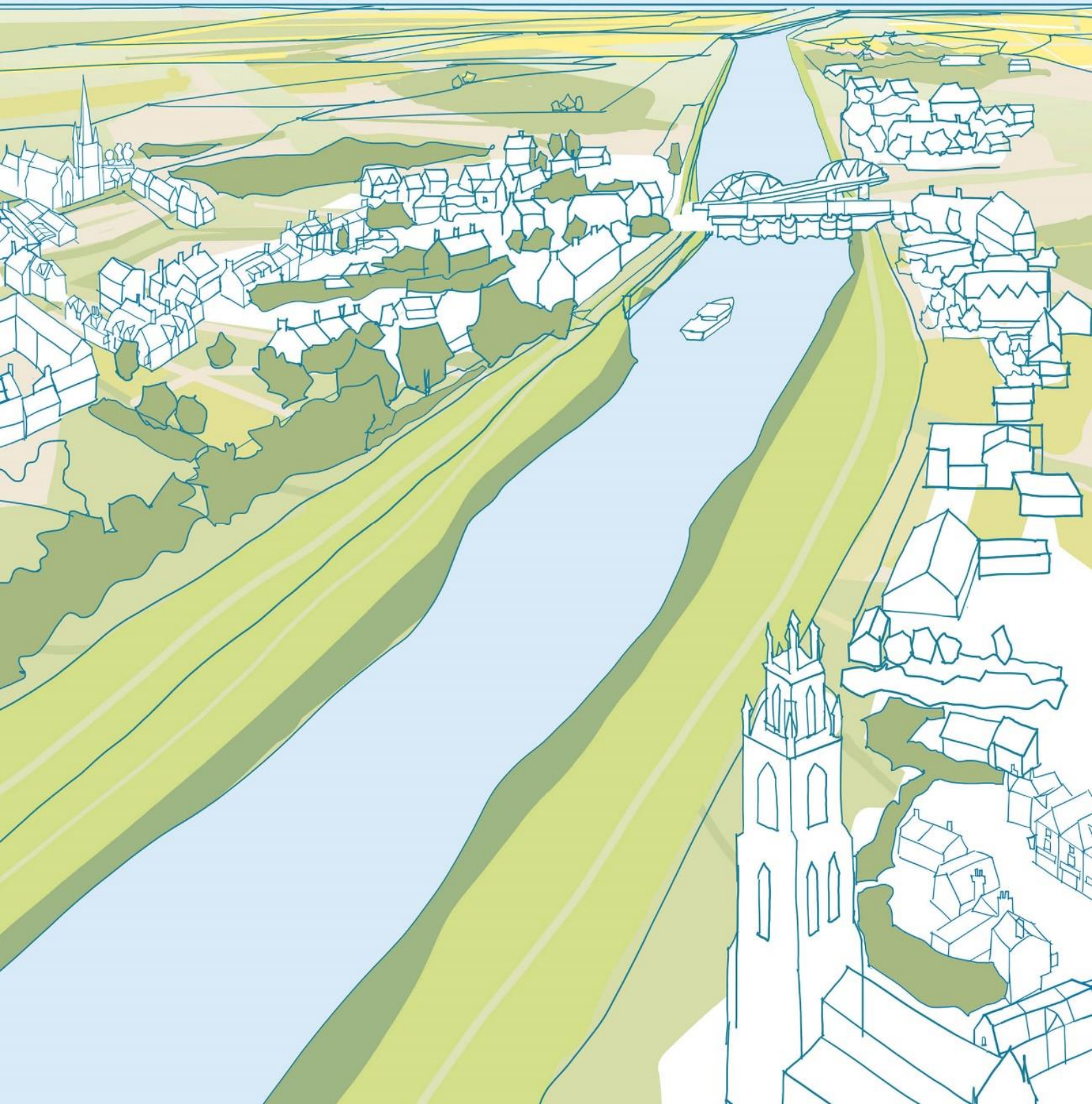


Witham East and West Fens

Environmental and agricultural baseline

2025



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1. Introduction

1.1 Aim and purpose of this document

This document presents a catchment-scale environmental and agricultural baseline for the Witham East and West Fens catchment. It is intended to support future choices, investments and actions for the Fens2100+ programme (hereafter referred to as the “Fens 2100+”). The environmental and agricultural baseline covers the following disciplines:

- Landscape
- Agriculture
- Ground conditions (soils and resources)
- Water Environment
- Biodiversity
- Cultural Heritage
- Population and Health
- Air Quality

1.2 Usage statement

This document should be read alongside the Witham East and West Fens catchment baseline evidence report and is intended to provide a strategic environmental and agricultural baseline which will inform the development of a future Sustainability Appraisal for the Fens 2100+. This document provides a proportionate level of detail required for a strategic catchment-scale baseline and excludes a detailed baseline analysis that may be required at project level to align with the Environment Agency’s Minimum Technical Requirements or Environmental Impact Assessment. An assessment of potential effects or impact(s) and their significance has not been provided.

1.3 Catchment context

The Witham East and West Fens catchment (hereafter referred to as “the catchment”¹) covers approximately 353km² (35300ha) of south-east Lincolnshire, located in the north of the Fens 2100+ study area. It extends from the base of the chalk hills of the Lincolnshire Wolds to The Wash and the tidal reach of the River Witham at Boston, known as The Haven.

The Environment Agency have permissive powers to carry out flood and coastal risk management activities on Main Rivers as well as certain non-Main Rivers known as critical ordinary watercourses. In addition, the Environment Agency are responsible for producing a national strategy for Flood and Coastal Erosion Risk Management (FCERM). The latest strategy published in 2020 contains ‘Measure 1.5.4’. This requires development of a long-term plan for managing future flood risk in the Fens. Ordinary watercourses are regulated by Internal Drainage Boards (IDBs) and the Lead Local Flood Authority (LLFA),



Figure 1: East and West Fens catchment (taken from Hobhole Pumping Station) © Hannah Smith

¹ The East and West Fens catchment is not strictly a hydrological catchment as there are movements of water both into and out of the area defined, that are not being considered in this report. However, the term ‘catchment’ has been used throughout the dialogue with the Environment Agency during establishment of the study areas and these areas are being defined for water management purposes. Therefore, the term catchment is used to describe the study area.

which is Lincolnshire County Council for the catchment. IDBs play a vital role in managing water levels and drainage across the catchment for agricultural and environmental purposes. The IDB's are responsible for managing the complex network of drains that feed into Main Rivers by pumps (see Figure 1).

Witham Fourth District Internal Drainage Board own and are responsible for managing the network of subsidiary drains throughout that catchment that are discharged by pumps into the Witham Haven. The IDB has a complicated task of managing flood risk whilst balancing agricultural water demands e.g. for irrigation and maintaining water supply rights to nature reserves.

The catchment is a largely flat landscape with a few undulations above the drained fenland. The majority of land is approximately 3mAOD. Areas of the catchment including those located south-west of Wainfleet are below sea level.

The land use within the catchment is primarily agricultural, predominantly arable agriculture and higher value cropping. The catchment is sparsely populated with scattered farmsteads and sparse tree cover. Field patterns tend to be larger in the south, with more intact hedgerows and occasional woodland. It is a highly productive agricultural area with approximately 31% of the land classified as Grade 1 agricultural land.

Parts of the catchment are designated as part of The Wash (shown in Figure 2), which is a Special Protection Area, Ramsar site and a Site of Special Scientific Interest. It is the largest estuarine system in the UK and intersects the RSPB Freiston Shore nature reserve. Other key land uses are summarised below.



Figure 2: The Wash © Mat Fascione and licensed for reuse under this Creative Commons Licence

1.3.1 Settlements

The historic market town and inland port of Boston is located within the south-east boundary of the catchment and is the largest settlement in the catchment (see Figure 3). The settlement is located at the intersection of A16 and A52. Several other market towns are located along the A16 and A52 in the catchment area notably: Wrangle; Friskney; and Sibsey.

1.3.2 Access and connectivity

The main arterial roads include the A16, which runs north across the catchment, linking Boston with Sibsey and Stickney and the A52 which runs north-east across the catchment, linking Boston with Skegness. Figure 4 illustrates the spatial distribution of transport and access routes in the catchment.

- The East Midlands rail line runs north-east across the catchment, linking Boston with Skegness.
- The National Cycle Route 1 (long distance route from Dover to Scotland) is located in the south-west of the catchment, running through Boston town centre.
- The King Charles III England Coast Path National Trail is located to the southern boundary of the catchment and is under construction south of Gibraltar Point.

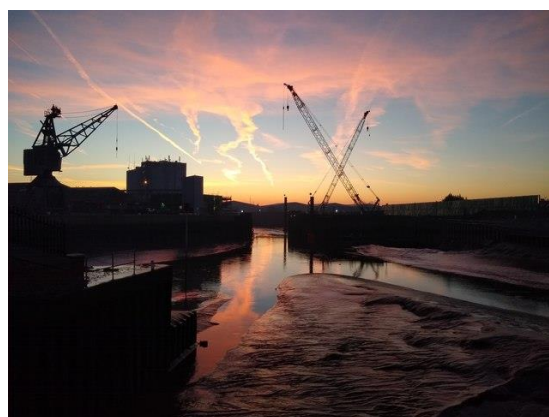


Figure 3: Boston Haven and Docks © Jeremy Halls and licensed for reuse under Creative Commons Licence

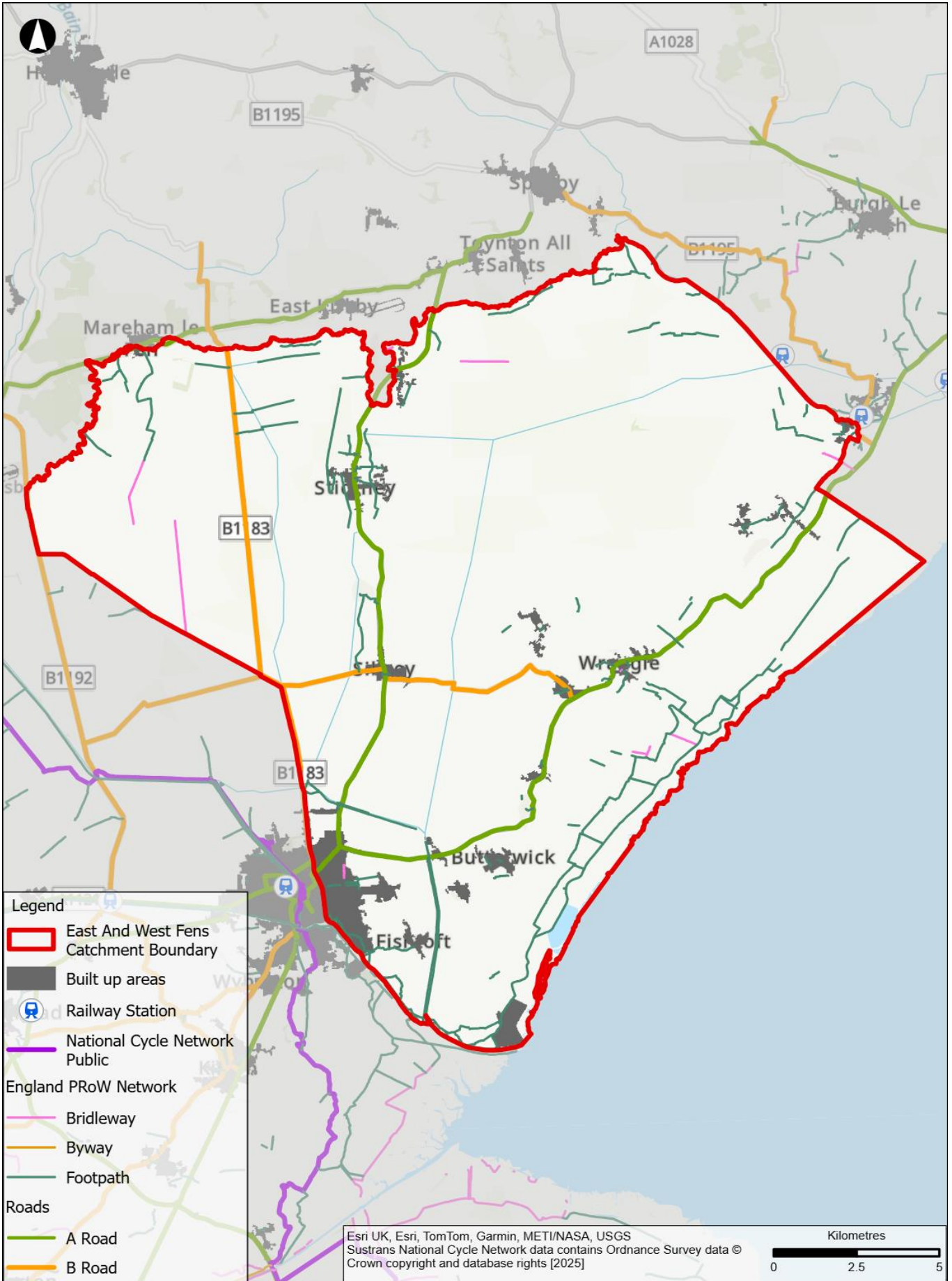


Figure 4: Local transport and access routes

1.3.3 Renewable energy infrastructure

A range of energy infrastructure [1] is also present in the catchment, with the Viking Link interconnector and Triton Knoll cables both crossing the catchment, bringing wind energy from the North Sea and Denmark into the UK. The 132Kv main distribution line linking Skegness sub-station to Boston also crosses the area, as well as several smaller local distribution lines. The area is also home to a range of solar farms, including the 50MW Low Farm, and 12MW Leverton Solar developments. Four farm-fed anaerobic digestion (AD) units are located in the catchment, including Dyson Farming's Carrington AD plant which supports the heating for strawberry greenhouses.

2. Overview of legislation and policy context

This section presents an overview of the legislative and planning policy that may be applicable to any future Flood and Coastal Erosion Risk Management (FCERM) intervention or project within the catchment. This includes national, regional and local policy which has been considered across the disciplines included within this document. A detailed baseline analysis may be required at project level to align with the Environment Agency's Minimum Technical Requirements or Environmental Impact Assessment.

2.1 Environment Act (2021)

The Environment Bill became an Act [2] (law) in November 2021, amending the Environment Act 1995 [3]. The Act provides targets and policy for improving the natural environment in relation to air quality, restoring natural habitats, increasing biodiversity, reducing waste and making better use of resources. Key aspects of the Environment Act 2021 which are relevant to the Fens 2100+ include but are not limited to:

- Provisions that require that at least a 10% net gain for biodiversity be demonstrated through a Biodiversity Net Gain assessment (using Defra's Statutory Biodiversity Metric);
- A new mandatory system of spatial strategies for nature through Local Nature Recovery Strategies (LNRS); designed as tools to encourage more coordinated practical and focused action and investment in nature;
- Measures to support new and existing internal drainage boards (amending the Land Drainage Act 1991); and
- Effective collaboration between water companies through statutory water management plans.
- Requirement for local authorities to report to Defra on local air quality and local air quality management within their local authority area. This also requires an assessment of compliance against the relevant air quality standards.

2.2 Agriculture Act (2020)

The Agriculture Act for England [4], represents a significant shift in agricultural policy post-Brexit. This legislation aims to reward farmers and land managers for delivering "public goods" such as improved air and water quality, thriving wildlife, and measures to tackle climate change. The Bill includes measures to phase out the Basic Payment Scheme (BPS) by 2028, which is proceeding as planned.

Key features of the bill include:

- Environmental Land Management Scheme: Farmers will be incentivised to provide environmental goods and services alongside food production. There will be three schemes:
 - the Sustainable Farming Incentive (SFI) will pay farmers to adopt and maintain sustainable farming practices that can protect and enhance the natural environment alongside food production, and also support farm productivity;
 - Countryside Stewardship (CS) will pay for more targeted actions relating to specific locations, features and habitats. There will be an extra incentive through CS Plus for land managers to join up across local areas to deliver bigger and better results; and
 - Landscape Recovery will pay for bespoke, longer-term, larger scale projects to enhance the natural environment.

- **Transition Period:** A seven-year transition period to move away from the EU's Basic Payment Scheme (BPS), which primarily rewarded the amount of land farmed, towards a system that rewards environmental benefits. This includes the phase out of the BPS by 2028, which is proceeding as planned. In 2024, the payments are for the first time delinked from land, meaning that farmers who were farming before 2024 will continue to receive the remainder of BPS through to 2027, even if they stop farming or dispose of land. These changes mean there will be a push towards farming being profitable at global market prices by 2028.
- **Support for Innovation:** Investments in new technology and research to boost productivity and sustainability in farming.

2.3 Flood and Water Management Act (2010)

The Flood and Water Management Act 2010 [5] is a significant piece of legislation in the UK aimed at improving the management of flood risk and water resources. Key aspects of this legislation include:

- **Risk Management Authorities:** The Act designates various authorities, including the Environment Agency, Lead Local Flood Authorities (LLFAs), and Internal Drainage Boards (IDBs), with specific responsibilities for managing flood risks;
- **Partnership and Cooperation:** It emphasises the need for these authorities to work in partnership and share information to effectively manage flood risks;
- **Sustainable Drainage Systems (SuDS):** The Act promotes the use of sustainable drainage systems to manage surface water and reduce flood risk;
- **Flood Risk Management Strategies:** Authorities are required to develop and implement strategies for managing flood risks, including mapping and assessing flood risks;
- **Reservoir Safety:** The Act includes provisions to improve the safety of reservoirs, ensuring they are regularly inspected and maintained;
- **Powers and Duties:** It grants new powers to authorities to carry out works to manage flood risks and imposes duties on them to maintain a register of structures or features that affect flood risk.

2.4 National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) [6] sets out the Government's planning policies for England and how these should be applied. It was last updated in December 2024. It aims to achieve sustainable development through a balanced approach that considers economic, social, and environmental objectives. Key aspects of Sustainable Development in the NPPF include:

- **Growth and Innovation:** Ensuring sufficient land is available to support economic growth, innovation, and productivity;
- **Infrastructure:** Coordinating the provision of infrastructure to support development;
- **Housing:** Providing a sufficient number and range of homes to meet the needs of present and future generations;
- **Community Well-being:** Fostering well-designed, safe, and accessible places that support health, social, and cultural well-being;

- Natural and Built Environment: Protecting and enhancing natural, built, and historic environments;
- Resource Efficiency: Using natural resources prudently, minimising waste and pollution, and mitigating climate change impacts;
- Meeting the challenge of climate change, flooding and coastal change: Supporting measures that ensure the future health and resilience of communities and infrastructure to climate change impacts, including flooding.

2.5 Environmental Improvement Plan (EIP) (2023)

The Environmental Improvement Plan for England (EIP) [7] details how the Government will work with communities and businesses to improve the environment compared to its current state. It is the first revision of the 25 Year Environment Plan (25YEP), providing interim targets to measure progress for improving the environment. Key aspects of the plan which are relevant to the Fens 2100+ include but are not limited to:

- Supporting the management of 70% of the countryside to adopt nature friendly land management practices by incentivising farmers;
- Updating a Green Finance Strategy setting out steps to leverage private finance to deliver the goals of the 25YEP;
- Deliver investment plan to improve coastal and flood defences, including £100 million on the most frequently flooded areas; and
- Reward farmers for actions to reduce risks and impacts from floods, droughts, and wildfires through our new future farming schemes.

2.6 Summary of key legislation, policy and guidance

A wide range of legislation is relevant to the different aspects of the environment and agriculture for Fens 2100+. Table 1 present a summary of the relevant key legislation, policy and guidance. This summary is not intended to be exhaustive and should be reviewed as part of any future interventions or projects.

Table 1: Summary of key environmental legislation and policy

Topic	Relevant Legislation, Policy and Guidance	Summary
Landscape	Guidelines for Landscape and Visual Impact Assessment [8]	Protection of landscape character and quality and the creation of Green Infrastructure.
	The European Landscape Convention (2006) [9]	
Agriculture	Autumn Budget 2024 [10]	The changes to Agricultural Property Relief (APR) and Business Property Relief (BPR) were announced in the Autumn Budget 2024. APR will be extended to include land managed under environmental agreements with the UK government, devolved governments, public bodies, local authorities, or approved responsible bodies. The 100% relief rate for APR and BPR will apply only up to a combined allowance of £1 million. These changes will be legislated in the Finance Bill 2024-25.
	Safeguarding our Soils - A	

Ground Conditions	strategy for England (2009) [11]	Protect best quality soils and agricultural land as well as the protection and restoration of peatland habitat.
	England Peat Action Plan [12]	
	Greater Lincolnshire Nature Partnership – Geodiversity Strategy (GLNP) [13]	
Water Environment	The Environment (Amendment etc.) (EU Exit) Regulations 2020 [14]	The key objectives of these acts/policies are to reduce and manage flood risk, improve water quality (so all water bodies achieve 'Good status' as set out in the Water Environment Regulations), prevent or limit groundwater pollution and promote the efficient use of water.
	Environmental Protection Act 1990 [15]	
	Water Resources Act 1991 [16]	
	The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (WFD) [17]	
	Land Drainage Act 1991 [18]	
	Water Act 2014 [19]	
	Water Resources (Abstraction and Impounding) Regulations 2006 [20]	
	Flood Risk Regulations 2009 [21]	
Nitrate Pollution Prevention Regulations 2015 (as amended) [22]		
Biodiversity	The Conservation of Species and Habitat Regulations 2017 [23]	<p>These pieces of legislation state the offences relating to protected species and the requirements for licenses to allow any damaging works to proceed. Specific actions which are prohibited by legislation can be made lawful on the approval and granting of a derogation license from Natural England (NE) and, or assent can be applied for when works are proposed within Special Site of Scientific Interest (SSSI) that could damage the interest features, or specific conditions are stated.</p> <p>In addition, the Habitats Regulations set out the requirement for the consideration of the potential effects of a plan or project upon European Sites through the Habitats Regulations Assessment (HRA) process.</p>
	Wildlife and Countryside Act 1981 (as amended) (WCA) [24]	
	Natural Environment and Rural Communities (NERC) Act 2006 [25]	
	The Countryside and Rights of Way Act 2000 [26]	
	The Hedgerows Regulations 1997 [27]	
	Protection of Badgers Act 1992 [28]	
	The Salmon and Freshwater Fisheries Act 1975 [29]	
	The Eels (England and Wales) Regulations 2009 [30]	
	The Invasive Alien Species (Enforcement and Permitting) Order 2019 [31]	

Cultural Heritage	Ancient Monuments and Archaeological Areas Act (1979) [32]	Protect nationally important archaeological remains, historic buildings, historic landscape features and remains of military aircraft and vessels that have crashed, sunk or been stranded and of associated human remains
	Planning (Listed Buildings and Conservation Areas) Act (1990) [33]	
	Protection of Military Remains Act (1986) [34]	
	Hedgerows Regulations (1997) [35]	
	Treasure Act (1996) [36]	
Population and Health	Countryside and Rights of Way Act (2000) [26]	Promote sustainable and healthy communities and social inclusion and community participation. The policies and guidance encourage a 'whole system' approach to engaging planning and environmental agencies in support of health, well-being and social care provision.
	Health and Social Care Act (2012) [37]	
	Lincolnshire Joint Strategic Needs Assessment [38]	
	Lincolnshire Joint Health and Wellbeing Strategy [39]	
Air Quality	Air Quality Standards Regulations 2010 (amended in 2016) [40]	Defines the policy framework for twelve air pollutants known to have harmful effects on human health or the natural environment. The Secretary of State for the Environment has the duty of ensuring compliance with the air quality limit values. The regulation sets out the national air quality standards for NO2, PM10 and PM2.5. It also provides guidance on how air quality should be considered to comply with the NPPF.
	Planning Practice Guidance (PPG) 2014 [41]	
	Defra Clean Air Strategy 2019 [42]	

2.7 Local plans

The East Lindsey District Council Local Plan and Boston Borough Council Local Plan cover the catchment as shown in Figure 5. The respective Local Plans set out the vision and strategic priorities for each area.

Figure 5: Local authority districts for the catchment

2.7.1 East Lindsey Local Plan

The East Lindsey District Council Local Plan was adopted in 2018 and covers the northern portion of the catchment. Chapters 9 and 10 of the local plan relates to inland flood risk and coastal East Lindsey respectively and are considered key aspects of the local plan for the Fens 2100+ project. Similarly, chapter 12 'Protecting and enhancing our natural environment' is a key consideration for the environment and agriculture.

The Local Plan identifies 29 Strategic Policies to support implementation. The following policies are considered key to the environment and agriculture:

- Strategic Policy 16 - Inland Flood Risk: outlines support for development that demonstrates an integrated approach to sustainable drainage and developments that seek to improve existing, or create new, flood defences;
- Strategic Policy 23 – Landscape: outlines the requirement to protect, enhance and manage an attractive and healthy working and living environment and also recognises the importance of access to the countryside and protection of distinctive character;
- Strategic Policy 24 - Biodiversity and Geodiversity: outlines the requirement for development to protect and enhance the biodiversity and geodiversity value of land and to minimise fragmentation. The policy also recognises the importance of linking up newly created habitats; and the value of ancient woodland and aged or veteran trees; and
- Strategic Policy 25 – Green Infrastructure: outlines the requirement to safeguard and deliver a network of accessible green infrastructure and recognises the importance of identifying new accessible green spaces and connecting into existing green infrastructure.

2.7.2 South East Lincolnshire Local Plan

The south of the catchment is under the jurisdiction of Boston Borough Council. The South East Lincolnshire Local Plan (2011-2036) (adopted 2019) was prepared jointly by Boston Borough Council and South Holland District Council.

The following policies are considered key to the environment and agriculture:

- Strategic Policy 3 – Design of New Development: outlines the requirement for new developments to respect and enhance the character of the landscape and the quality of an area. The policy also recognises the importance of using high quality and inclusive design and layout to make innovative use of local traditional styles and materials.
- Strategic Policy 4 – Approach to Flood Risk: outlines the requirement for development proposals to take account of flood risk issues and ensures that new development will be resilient to the potential consequences of flooding.
- Strategic Policy 28 – The Natural Environment: recognises the importance of protecting both national and locally-designated habitats and species; and the value of addressing gaps in the ecological network in the Local Plan area.
- Strategic Policy 29 – The Historic Environment: outlines the policy approach with respect to Listed Building and Conservation Areas within the Local Plan area. The policy also recognises the role of enabling development in securing improvements to heritage assets.

3. Methodology

This section presents an overview of the methodology used to develop the catchment-scale environmental and agricultural baseline. It has been produced using a desk-based review of publicly available information from a variety of sources.

3.1 Catchment study area

Figure 6 presents an overview of the study area used for the catchment environmental and agricultural baseline.

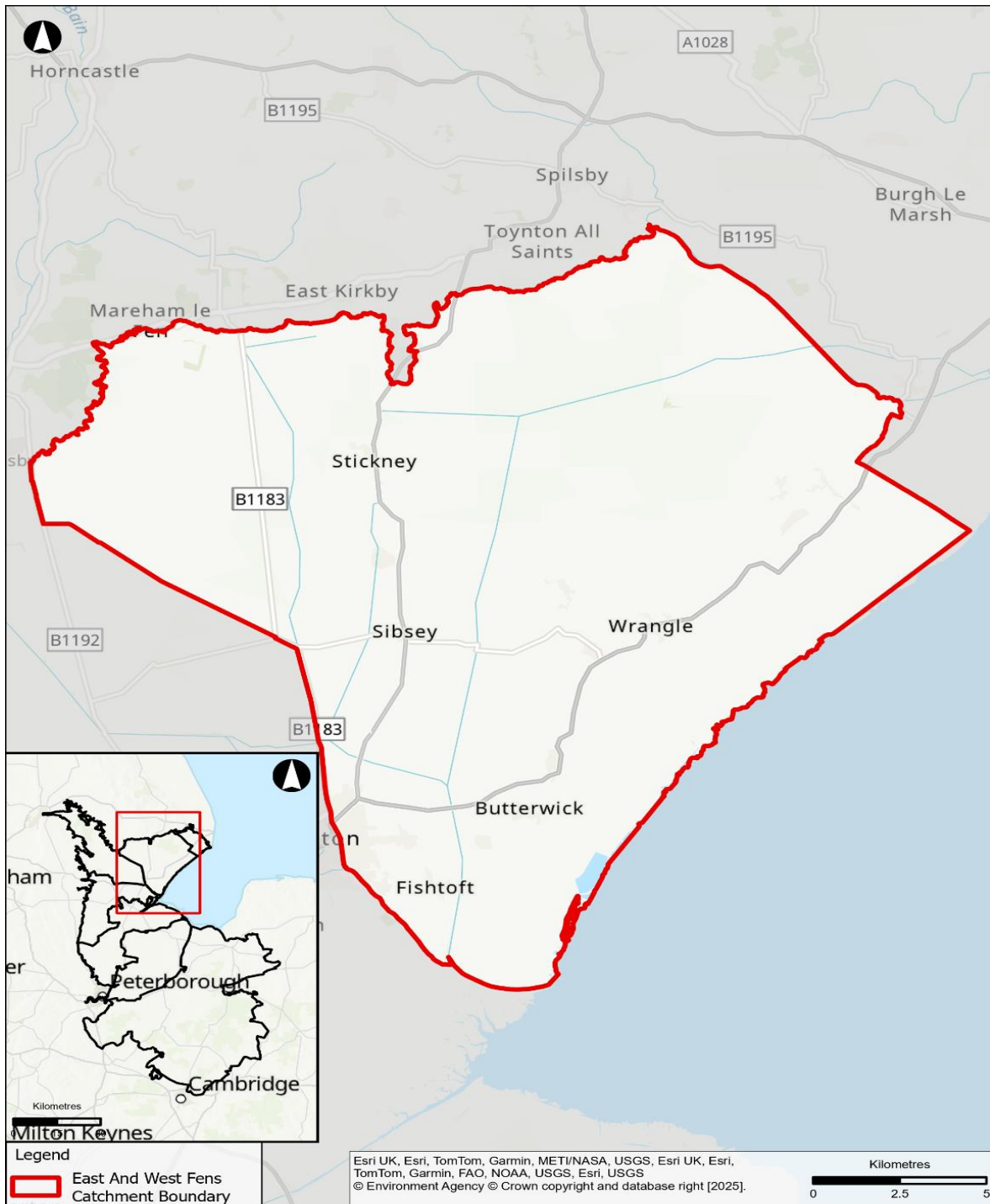


Figure 6: East and West Fens catchment

3.2 Limitations and Assumptions

The following limitations and assumptions have been made in the production of this catchment-scale baseline report:

- The baseline collated comprises a proportionate level of detail from publicly available data sources and it is reported at the geographical basis relevant to the data availability. Therefore, this report reviews and provides commentary of existing reports written by others. Arup accept no responsibility for any or omission in this report which is due to an error or omission in the original documentation we refer to. Arup have not independently verified the information and have assumed it to be accurate, complete, reliable, and current as of the date of such information;
- This baseline assessment has not been informed or verified by any field surveys or site visits conducted by Arup;
- Due to the strategic nature of this baseline report, engagement and consultation with external stakeholders or statutory consultees has not been undertaken to inform this report;
- This baseline assessment is currently limited to the catchment boundary that has been defined for the Fens 2100+ project by the Environment Agency. It should be noted that the zone of influence for any future interventions or projects as part of Fens 2100+ may extend beyond the study area identified in Figure 6; and
- Arup has used publicly available data to undertake a review of baseline conditions throughout the study area.

The following limitations and assumptions apply to the individual environmental and agricultural baseline chapters presented in this document:

- Landscape:
 - The landscape baseline excludes discussion on the significance of landscape and visual considerations.
- Agriculture
 - The agricultural baseline is based on the official data available which is produced at district level. There is no official data boundary that matches the catchment study area. Data reported within this baseline has been sense-checked against other sources such as published satellite data and been informed by local sector knowledge, to ensure that the estimates are as robust as possible.
 - As publicly available satellite derived data on land cover (and crops) improves over the next 5 years, the ability to analyse agricultural data at small spatial levels will improve. However, agricultural cropping is also subject to larger year to year variations, often due to extreme weather events, or longer-term changes in the market. Therefore, even if detailed data was available, e.g. for the 2023-'24 crop year, this would need to be treated with caution and averaged with other years.
 - The greenhouse and controlled environment agriculture data resolution is poor at national as well as regional levels, as Defra withdrew from collecting this data in the early 2010s. This baseline therefore uses the limited Defra data to sense-check local knowledge of the larger greenhouse units. The output per hectare in this sector is also extremely variable from crop to crop and farm to farm. The approach taken was to use conservative averages derived from Defra national data and to check this against feedback from individual growers undertaken by Collison and Associates.
 - The main additional assumption is that farms in the catchments do not, on average,

deviate much from regional and national averages of output for the enterprises they run. This is the only practicable way to produce the data, as individual farm level data is not available or published by any source. Our working assumption is that, given the higher productivity in general of the Fens that this produces a conservative estimate of the true value of farm output in the Fens.

- Ground conditions:
 - This baseline does not provide a review of available ground investigation data (borehole data etc.) beyond those specifically outlined or comprise the development of a catchment level ground model. Further, this baseline excludes discussion on the significance of mineral safeguarding designations, their specific extents or resource volume capability.
- Water Environment:
 - The water environment baseline excludes in-depth discussion on Water Framework Directive / Water Environment Regulations. Reporting of all Water Environment Regulations baseline data or delivery of any preliminary compliance assessments has been excluded.
- Biodiversity:
 - The biodiversity baseline excludes discussion on non-statutory designated sites (e.g. Local Wildlife Sites and Roadside Nature Reserves). Records of protected and notable species from Local Environmental Records Centres or flora or fauna records have not been obtained at this stage.
- Cultural heritage:
 - The cultural heritage baseline excludes discussion on the significance of heritage assets, the assessment of impact(s), and a detailed baseline analysis which would identify non-designated heritage assets and specific areas of archaeological potential.
- Population and health:
 - The population and health baseline is based on the official data available which is published at different spatial boundaries. There is no official data boundary that matches the catchment study area. The baseline collated comprises a proportionate level of detail from publicly available data sources and it is reported at the geographical basis relevant to the data availability. Different classes of administrative unit each have their own datasets in terms of the geographical scale at which they operate and these have been used to inform the baseline:
 - Lower Layer Super Output Area (LSOAs)
 - Middle Layer Super Output Areas (MSOAs)
 - Lower Tier Local Authority Areas
 - Upper Tier Local Authority Areas
- Air Quality:
 - The air quality baseline will exclude discussion on consideration of pollutants other than NO₂, NO_X, PM₁₀ and PM_{2.5}. No dispersion modelling has been carried out at this time.

4. Catchment-scale baselines

The following sections provide an overview of the environmental and agricultural baseline.

4.1 Landscape

This section outlines the baseline landscape characteristics for the catchment. Table 2 outlines the key terminology used in this section.

Table 2: Glossary of landscape and land use terminology

Terminology	Summary Definition
National Character Area	A National Character Area (NCA) is a natural subdivision of England based on landscape, biodiversity, geodiversity, and economic activity. Their boundaries follow natural lines in the landscape, not county or district boundaries. This makes them a good framework for decision-making and planning for future change [43].
Landscape Character Assessment	The process of identifying and describing the unique variations in the character of the landscape. It aims to explain the distinct combination of elements and features that make one landscape different from another [44].
Green and Blue Infrastructure	Refers to a strategic network of natural and semi-natural areas designed to deliver a wide range of environmental, social, and economic benefits.

4.1.1 Landscape character

National Character Area

The catchment is located almost wholly within the National Character Area (NCA) 46 The Fens [45]. The Fens National Character Area is a distinctive, historic and human influenced wetland landscape lying to the west of the Wash estuary. The NCA is notable for its large-scale, flat, open topography with extensive vistas to level horizons. The level, open topography shapes the impression of huge skies which convey a strong sense of place, tranquillity and inspiration.

Vegetation cover largely comprises meadows, coastal and flood plain grazing marsh, purple moor-grass and rush pastures and sparse woodland. Given the flat and open landscape, new planting can introduce inappropriate and visually intrusive elements.

The NCA has a distinctive hierarchy of rivers, drains and ditches which strongly influences the dominant rectilinear/geometric landscape pattern which is a consistent feature of the area. The drainage infrastructure (including the network of drainage ditches, embankments and pumping stations) provides an evident reminder of the area's reclaimed past.

Statements of Environmental Opportunity (SEO) for the NCA have been identified by Natural England² based on the unique characteristics and properties of the Fens. These priorities comprise the following which should be considered during future project stages:

- Manage the agricultural landscape and soils which allow the Fens to be a major provider of food and horticultural produce, while seeking to enhance opportunities for biodiversity.

² Statements of Environmental Opportunity are developed by Natural England and reflect their opinion on how best to secure environmental gains within each NCA.

- Manage the core wetland complexes and increase their connectivity by enhancing the Main Rivers, waterways and their associated riparian habitats and improve recreational access opportunities to the Fens.
- Plan for the creation of new coastal landscapes in the Wash area that are adapted and resilient to the impact of climate change, for the benefit of people and wildlife.
- Conserve, manage and enhance the Fens landscape and increase educational opportunities to access its geodiversity, archaeology and cultural heritage to enhance enjoyment and understanding for those who live work in and visit the Fens.

Seek partners to aid in the development and future provision of new, distinctive, Fenland economies. The northern boundary of the catchment is located within the NCA 44 Central Lincolnshire Vale [46]. The Central Lincolnshire Vale is a low-lying, gently undulating arable vale and the Wolds provides a prominent boundary to the east. The majority of land is used for arable farming with variable woodland cover.

The north-east boundary of the catchment is located within the NCA 42 Lincolnshire Coast and Marshes [47]. The Lincolnshire Coast and Marshes is a wide coastal plain bounded by the North Sea to the east and the Lincolnshire Wolds to the west. It features diverse landscapes including arable land and intertidal habitats and coastal dunes. The area is also internationally recognised for its biodiversity.

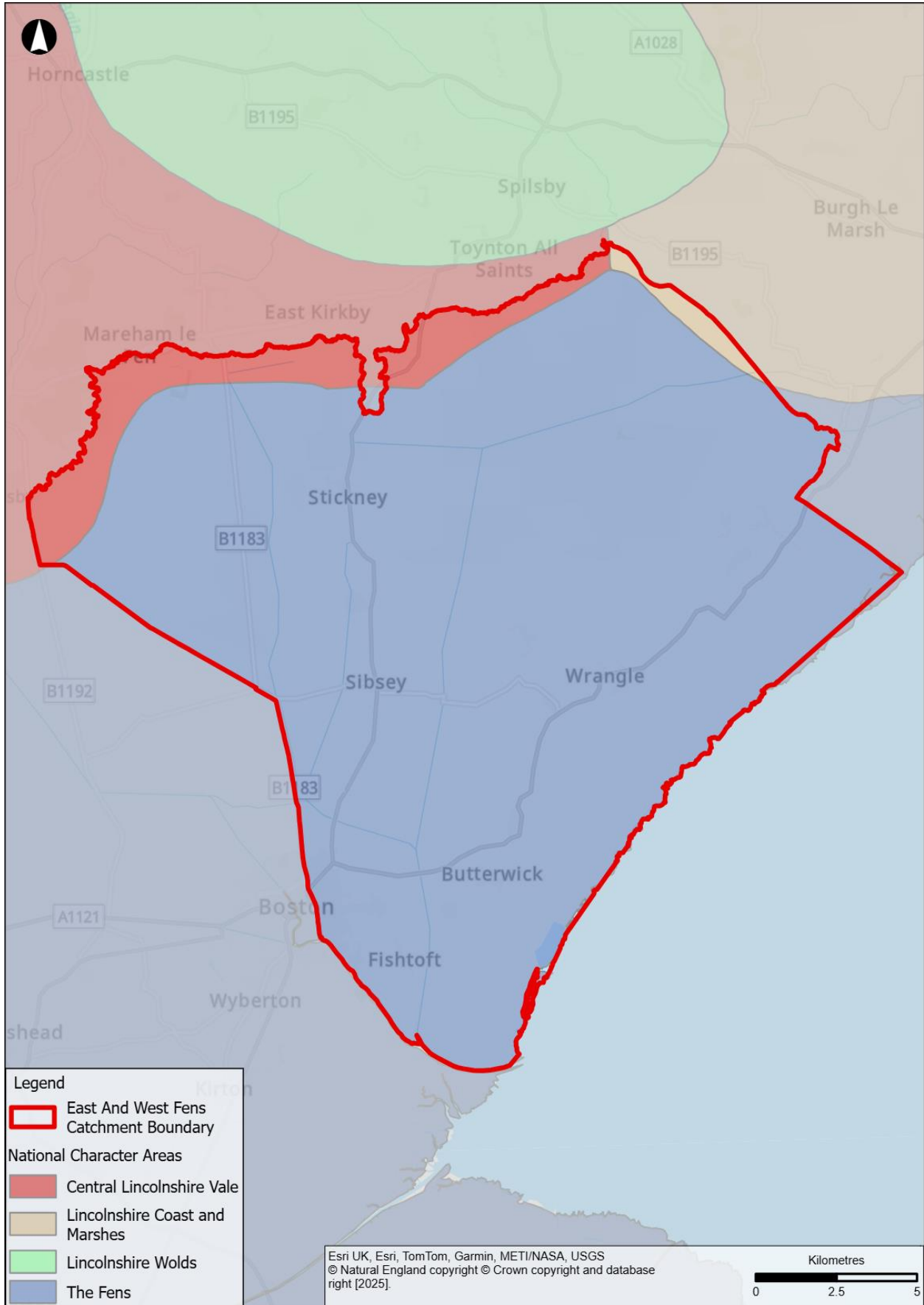


Figure 7: National Character Areas for the catchment

Landscape Character Assessment

The catchment falls within the East Lindsey District Council and Boston Borough Council. As such, the most up to date Landscape Character Assessments (LCA) are detailed below in Table 3. These are used as a material consideration when determining planning applications. Due to the age of both LCAs, they may require further review to ensure they remain accurate to inform ongoing works.

Table 3: Summary of Landscape Character Assessments for local authorities within the catchment

Local Authority	Date published	Landscape Character Assessment
East Lindsey District Council [48]	November 2011	The LCA study area is spread across three-character zones defined by the study, but the majority of the study area is located within Stickney to Sibsey Reclaimed Fen to the north of the catchment. The Sibsey Reclaimed Fen is an intensively farmed landscape on a low-lying drained fenland, with sparse tree cover. It is sparsely populated with widely scattered farmsteads and small linear hamlets. The Sibsey Reclaimed Fen is drained by a hierarchy of dykes forming an extensive grid network. Landscape Forces for Change to the Sibsey Reclaimed Fen include the re-shaping of the landscape by agricultural intensification, farm amalgamation and diversification, alongside residential and recreational development. Stewardship schemes are altering the appearance of field edges and dyke vegetation through changed land management practices.
Boston Borough Council [49]	July 2009	The LCA study area is spread across three-character zones defined by the study, but the majority of the study area located within Wrangle to Cowbridge Settled Fen. The Wrangle to Cowbridge Settled Fen is an evolving, intensively farmed landscape with a largely flat terrain, slightly elevated above the drained fenland to the west and reclaimed coastal marsh to the east. It features sparse tree cover, historic villages along the A52, and scattered hamlets, farmsteads and dwellings along minor roads. The area is characterised by winding roads, ditches and dykes, with a mix of geometric and irregularly shaped arable fields. Landscape Forces for Change to the Wrangle and Cowbridge Settled Fen include evolving agricultural practices and infrastructure, new amenity woodland from the Boston Woods project and expanding urban and village development that is reshaping settlement patterns and rural character.

4.1.2 Statutory designated landscapes

There are no statutory landscape designations (i.e. National Parks or National Landscapes³) within the catchment. The Lincolnshire Wolds National Landscape is located approximately 3.4km from the northern boundary of the catchment. There are no local landscape designations within the catchment. Potential areas for habitat enhancement or creation within the East and West Fens catchment comprises:

- Coastal habitat enhancement or creation – an area located in the Wash;
- Grassland habitat enhancement or creation – areas located in the Wash, along the River Witham and the Haven and small areas within Wrangle and Stickney; and
- Wooded habitat enhancement or creation – six areas located approximately within 20km north-east of Boston and one area located approximately 11km north of Boston.

Natural heritage and nature conservation designations can contribute to landscape character and landscape value outside of statutory and locally designated landscapes. Please see Section 4.5 Biodiversity and Section 4.6 Heritage for further information.

4.1.3 Green and blue infrastructure

Much of the catchment is covered by The Wash and Fens Green Infrastructure Plan [50], identifying plans to enhance access to green infrastructure, promote biodiversity and proposals for the creation of new habitat networks. The Plan includes habitat network maps that identify potential opportunities to create and enhance habitat networks across the catchment and wider Fens landscape.

Green Infrastructure mapping undertaken by Natural England [51] indicates that the catchment comprises sparse tree cover, however there is an area of 29.90ha area of accessible woodlands located immediately north of Boston.

The catchment falls within the boundary of the Greater Lincolnshire Local Nature Recovery Strategy [52] (LNRS) which is currently being developed to identify priorities and opportunities for nature recovery. This strategy will help map areas of existing high-quality habitats or areas of biodiversity, outline opportunities to recover or enhance biodiversity and identify local priorities to provide broader environmental benefits. The Greater Lincolnshire LNRS is part of Round 1 of the national rollout.

³ Following the government's Landscapes review of 2019, Areas of Outstanding Natural Beauty (AONB) became National Landscapes as of November 2023. A number of documents including legislation still refer to these as AONB. The statutory status of National Landscapes remains.

4.2 Agriculture

This section outlines the baseline agricultural land uses and productivity of the catchment.

Table 4 outlines the key terminology used in this section.

Table 4: Glossary of agriculture terminology

Terminology	Summary Definition
Agricultural Land Classification	A system used in England and Wales to assess and compare the quality of agricultural land. It categorises land into five grades based on its versatility and suitability for growing crops.
Countryside Stewardship (CS)	Countryside Stewardship is part of ELMS and recently has undergone changes in what in funds. It provides financial incentives to farmers, foresters, and land managers to improve and protect the environment. CS Higher Tier will open in summer 2025.
Entry Level Stewardship (ELS)	An agri-environment scheme in England under the previous Common Agricultural Policy (CAP) that provided funding to farmers and land managers for delivering environmental management on their land This is now closed to new agreements.
Environmental Land Management Scheme (ELMS)	ELMS are part of the broader agricultural policy reforms in England, transitioning from the EU's Common Agricultural Policy (CAP). It provides financial incentives and support to landowners for making changes to their land that produce environmental benefits. These schemes aim to promote sustainable farming practices, enhance biodiversity, improve water and air quality, and contribute to climate change mitigation. There are currently three ELMS Schemes.
Gross Value Added	An economic productivity metric that measures the contribution of a corporate subsidiary, company, or municipality to an economy, producer, sector, or region.
Soilscape	A soilscape is a classification used to describe the broad regional differences in soil types and their distribution across a landscape. Soilscales are helpful for understanding the general characteristics of soils in a region, including their carbon stock, which can inform land management, agricultural practices, and environmental conservation efforts.

4.2.1 Overview of soilscape within the catchment

Throughout most of the catchment, as across the whole of the Fens surrounding the Wash, the land is soilscape 21 [53]⁴. This soilscape is primarily grade 1 or 2 depending on its drainage. There is also a small area of soilscape 1 'Saltmarsh soils' suitable for 'Extensive grazing only' adjacent to the Wash seabank/coastline.

Soilscape 18 'Slowly permeable seasonally wet slightly acid but base-rich loamy⁴ and clayey soils'⁴ is found as a belt along the A16 north from Sibsey, and with an area across from New York to Stickford in the north of the catchment. These soils are classified as 'Mostly suited to grass production for dairying or beef; some cereal production often for feed. Timeliness of stocking and fieldwork is important, and wet ground conditions should be avoided at the beginning and end of the growing season to avoid damage to soil structure. Land is tile drained and periodic moling or subsoiling will assist drainage'. This soil is less productive than soilscape 21 due to its 'Impeded drainage'; and as such this is most of the grade 3 and 4 land in the catchment.

⁴ Loamy soils are composed of a balanced mixture of sand, silt and clay, offering excellent nutrient retention and water-holding capacity. Its structure and fertility make it highly suitable for most plant species and agricultural applications.

Adjacent to this area of soilscape 18 in the north-west of the catchment towards Coningsby, there is also an area of soilscape 15 '*Naturally wet very acid sandy and loamy soils*' which has a '*sandy and loamy*' texture, and which is '*Highly productive, where not stony, and suitable for cereals, roots, potatoes and vegetables but droughty and dependent on irrigation.*'

In the area of the catchment east of the A16 surrounding New Leake and towards Little Steeping the soilscape is 23 '*Loamy and sandy soils with naturally high groundwater and a peaty surface*'. Natural England's [54] 2008 peaty soils locations layer maps these areas as just over 69km² of peaty soils. Drainage of the lowland peat for agriculture has resulted in peat 'wastage' across the Fens. It is estimated that land levels have lowered by up to 5 metres over the last two centuries due to peat degradation with an estimate annual volume loss of 23,040 m³ per year for the Witham Fourth IDB district [55]. As such, most of this area can be assumed to have degraded to wasted peat soils, or to peat remnant mineral soils. The estimated carbon stock of peatland within the catchment is discussed further in the Natural Capital Technical Appendix. Natural England and DEFRA released an updated England Peat Map in 2025 which provides a national dataset of peat and peaty soils. The dataset was produced using remote sensing techniques and may contain local inaccuracies in data.

4.2.2 Overview of Agricultural Land Classification within the catchment

Across the catchment, around 318km² (90.9%) of land is classified as ALC Grade 1 and 2 land, with the majority of Grade 1 land located along the south-east boundary. Table 5 presents an overview of ALC classification.

Table 5: Overview of ALC classification within the catchment

	Grade 1	Grade 2	Grade 3	Grade 4	Non-agricultural
Area (km ²)	109.66	208.45	21.00	7.60	3.06
Percentage of catchment (%)	31.3%	59.6%	6%	2.2%	0%

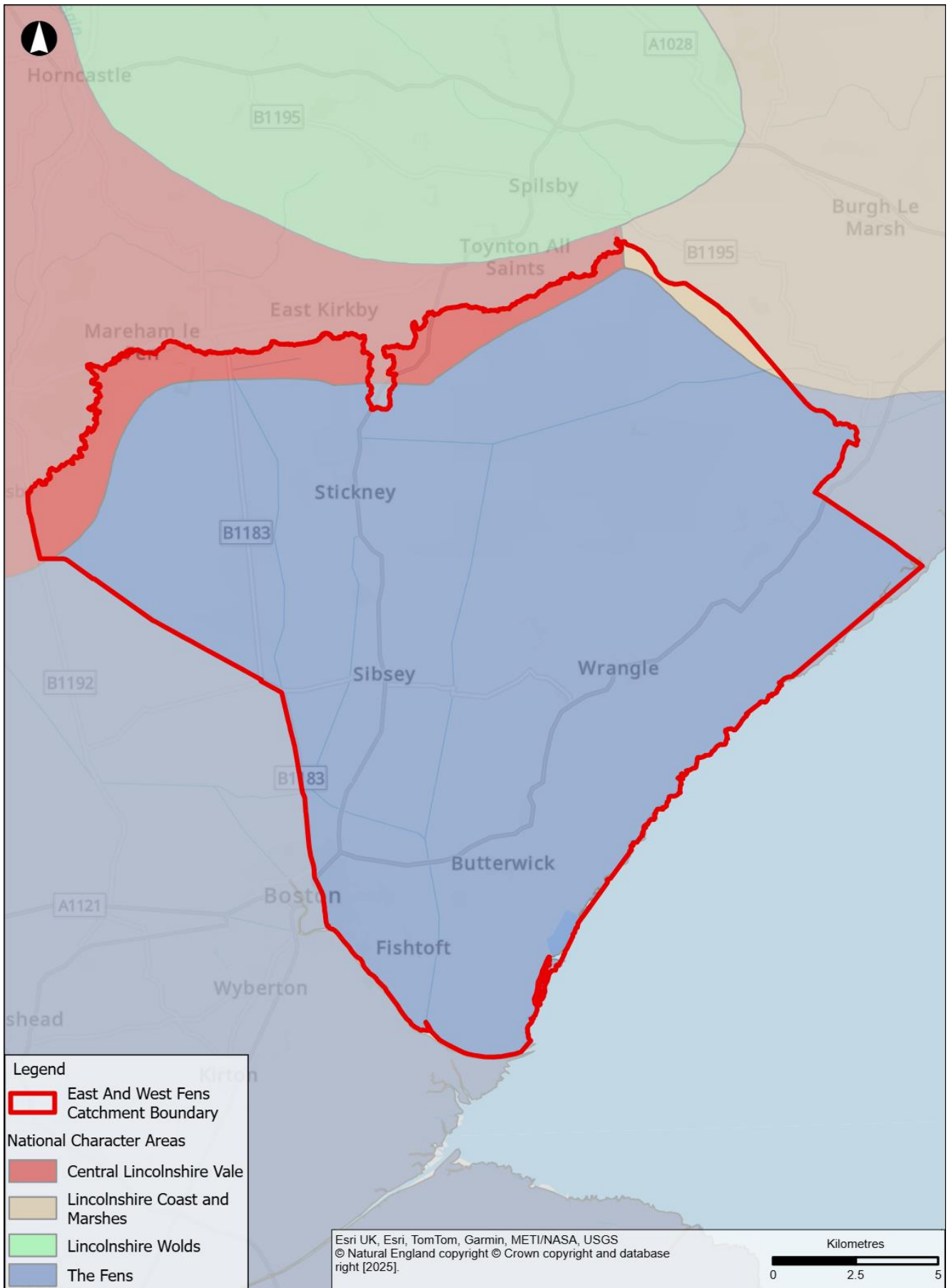


Figure 8: Agricultural Land Classification overview for the catchment

4.2.3 Agriculture and water management

The Witham Abstraction Licensing Strategy (ALS) covers the waterbodies within the catchment [56]. The ALS notes a high demand for spray irrigation water, particularly in the summer months, where water is transferred from the Lower Witham into the Witham Forth IDB jurisdiction. The ALS states that at Q30 flows, there is available water⁵, however at Q50 and beyond (Q70, Q95) there is restricted water availability.

Consequently, significant users of irrigation throughout the catchment have invested in irrigation reservoirs, to store winter abstracted water for summer irrigation use. With both field scale vegetable and greenhouse producers throughout the catchment operating reservoirs, e.g., Staples Vegetables Limited, or Dyson Farming.

The catchment has a long history of flooding which impacts both properties and farming. Recent events include:

- On 5th December 2013, a storm surge down the East Coast coincided with a high tide, to produce a 6.08m tidal surge along the coast and up the Haven in Boston town. Around 800 properties in Boston were flooded'

Flooding has major impacts on crops and to a lesser extent areas of land utilised for livestock grazing. Flood events can restrict the ability to establish new crops, reduce crop yields and quality, or can destroy crops once ready for harvest leading to direct agricultural damages and wider economic consequences for landowners.

4.2.4 Value of agriculture in the catchment

The Fens is an area of national agricultural importance due to its rich peaty soils. Farms across the catchment are mainly focused on the production of arable and grassland crops. Alongside arable agriculture, the catchment is also home to a number of intensive poultry units.

Approximately 287km² (82%) of land across the catchment is currently farmed. Land use is not published at catchment level, so the catchment's crop area has been proxied as its relative proportion of the East Lindsey, and Borough of Boston districts crop areas, and checked using satellite imagery of crop cover, to estimate the land use allocation as set out in Table 6.

Table 6: Estimated land use, crop areas and livestock populations on commercial agricultural holdings, 2023 [57]. Data provided by Collinson & Associates (Rounded to nearest decimal place).

	Total farmed area	Cereals	Arable crops excl. cereals	Grassland	Fruit and vegetables
Witham East and West Fens (km²)	287.7	136.0	62.6	39.60	26.7
Percentage of farmed land in the catchment (%)	n/a	47.3%	21.8%	13.8%	9.3%

⁵ The Environment Agency's Water Resources Geographical Information System provides a snapshot in time on water availability at four flow snapshots. From high to low, these are: Q30 (ie. the flow of a river which is exceeded on average for 30% of the time, therefore you would expect the river flow to be lower than Q30 on 256 days in an average year, i.e. a higher flow), Q50, Q70 and Q95. These are calculated for each integrated Water Framework Directive waterbody and looks at the balance between the flow in the river, the quantity needed to support the ecology and the water that can be licensed for abstraction.

Crops produce direct economic output, whereas grassland does not directly create economic value but instead supports the grazing of sheep and cattle, or the production of livestock feed or (AD) energy inputs. The agricultural value of crop areas (based on 2023 data⁶) for key agricultural outputs are:

- Fruit and vegetables – c. £51.1 million
- Poultry – c. £22.3 million
- Cereal production – c. £19.5 million
- Other arable – c. £14.6 million

Grassland does not directly create economic value but instead supports the grazing of sheep and cattle, or the production of livestock feed. The estimated overall economic output of crop and livestock is in the region of £125 million, highlighting the importance of the agricultural sector.

There are also several camping, caravan and holiday let sites operated by farming businesses in the catchment area due to the close proximity of the catchment to the Skegness holiday location accessible via the A52; as well as the Wash SSSI and RSPB nature reserve. Consequently, the level of income from farm diversification is believed to be at or above the 5.4% national average.

Within the catchment, there are a range of renewable energy enterprises in operation however, without the availability of accurate data on the revenues from the farm diversification enterprises in the catchment, the national average has been used to provide a conservative output figure.

However, without the availability of accurate data on the revenues from the farm diversification enterprises in the catchment, the national average is used to provide a conservative output figure. The gross annual agricultural output (including farm related diversification) in the catchment is therefore believed to be c.£140 million (in 2023 values).

4.2.5 Agriculture and the food chain

Farming is critical to the local economy within the catchment. The whole agri-food chain employs people at different stages of food production, from agriculture to food processing and packing and retail. In East Lindsey District a total of 3,500 people were directly employed in crop and animal production, hunting and related service activities sector in 2022, this is similar in Boston, with 3,000 people directly employed.

It is estimated that agriculture supported around 1,513 jobs across the catchment. These jobs have an estimated Gross Value Added (GVA) of £36,317 per job, whereas across the 2023 the agricultural GVA was around £29,613 per job [58].

Employment from direct agriculture also supports wider jobs across in the agri-food supply chain. In 2023, farmers purchased £21.086 billion of intermediate consumption (e.g. seeds); and invested £5.140 billion in fixed capital across the UK. Input and capital spending therefore was equivalent to £26.226 billion to generate £34.767 billion of gross output, or 75.4% of gross output. Spending by farmers in the catchment on inputs and capital can therefore be estimated as £105 million (2023). Given that approximately £300,000 of input spending is believed to support one FTE job in the agricultural input supply chain, this spending is equivalent to a further 351 jobs supported by farms.

Employment is also supported by the further processing, storage and distribution of food produced by agriculture. In 2022 Great Britain had employment in the food chain [59] of: agriculture (and fishing) of 469,000; food and drink manufacturing 445,000; food and drink and agricultural raw

⁶ Data provided by Collinson & Associates.

materials wholesaling 250,000. The freight logistics sector also employed 703,300 staff (road, rail and water freight), of which c.30% can be attributed to the food and drink supply chain. As such 210,990 jobs were associated with logistics in the end-to-end food chain, of which 40% is believed to be focused on the manufacturing and farm to factory gate end of the food chain or c.84,400.

It can be estimated that 75% of the food chain employment depends on domestic production. As such, every job on farm, can be estimated to support a further 1.25 additional jobs in the agri-food supply chain, with higher value crops such as fruit and vegetables, and potatoes providing a high multiplier.

This national figure however ignores differences between food types, with vegetables and fruit supporting higher supply chain multiples. Similarly, some 'other arable crops' such as potatoes or sugar beet, also disproportionately support more supply chain jobs.

Therefore, in the catchment, given the overrepresentation of fruit and vegetable production, and that of higher value crops such as sugar beet or potatoes, this supply chain job multiplier is believed to be higher, at two jobs per job supported on farm. When added to direct employment on farms, the agriculture and food production supply chain is thus estimated to support 4,890 (1,513 on farms, 351 in input supplies to farms and 2,036 in the wider supply chain).

The reliance on local employment in food processing, and related industries is demonstrated across the catchment with a number of small and medium food supply chain businesses present. A number of larger food chain businesses located in neighbouring areas also actively trade, source supplies from or add value to food produced in the catchment.

4.2.6 Agriculture and the environment

Within the catchment there is a large amount of land entered into various countryside stewardship agreements, primarily in the mid-tier; with most of the area included within such agreements being north of the railway line. There are significantly fewer field parcels on the highest grade (1) land included in stewardship, with this area being the focus within the catchment for brassica and high value crop production. Noteworthy agreements include Dyson Farming limited, which has more than 50 km² in mid-tier countryside stewardship.

The majority of grazed areas are managing under historic Entry (ELS) or Higher-Level Stewardship (HLS) agreements, including Dyson Farming's Carrington Estate. It is believed many farms will replace these historic schemes with new Environmental Land Management Schemes agreements in the future.

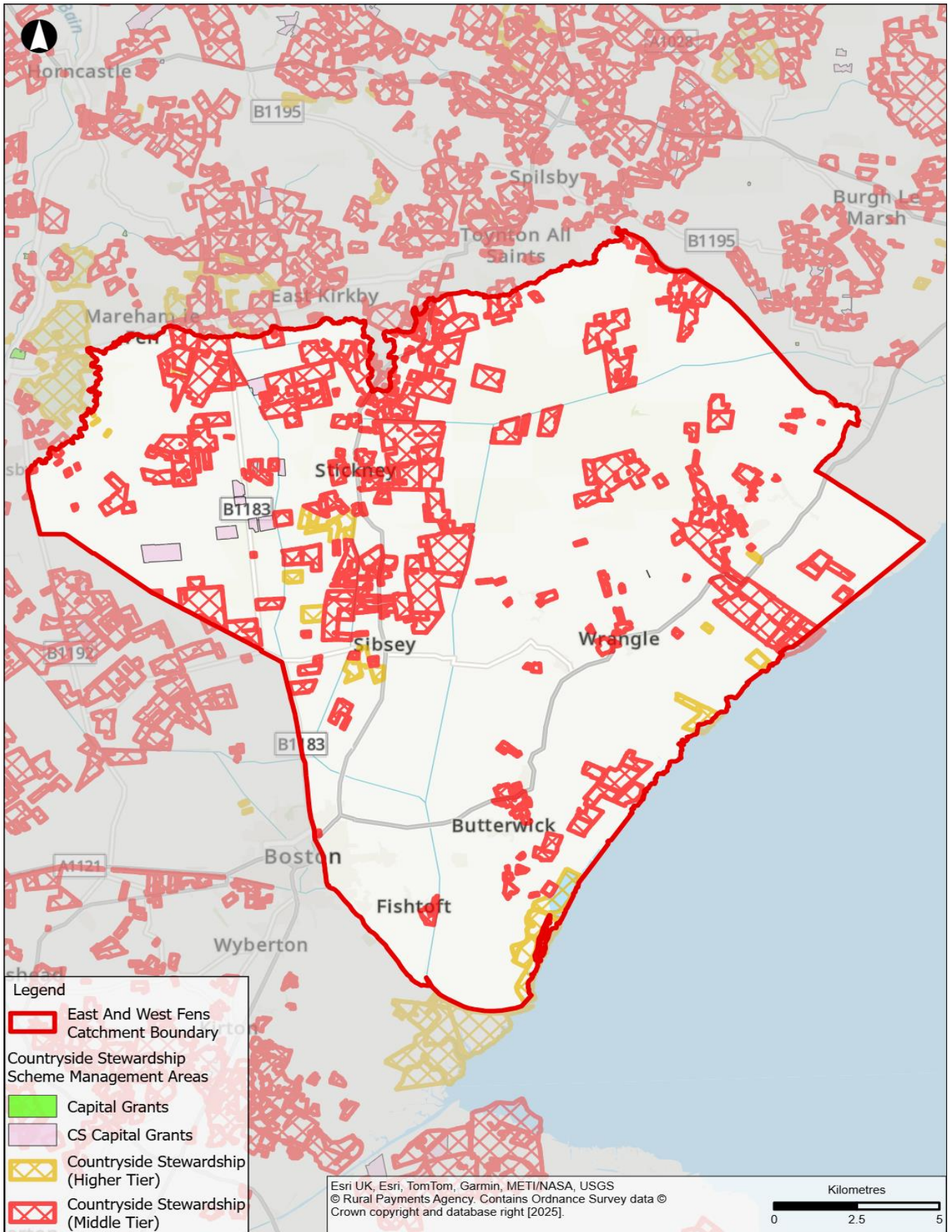


Figure 9: Extract from MAGIC [60] showing active Stewardship Agreements in the catchment

4.3 Ground Conditions

This section outlines the baseline ground conditions in the catchment. Table 7 outlines the key terminology used in this section. It should be noted that superficial deposits of a coastal or marine origin can be highly variable and complex in their composition, deposition and extent. Those presented here are intended to provide an insight into a variety of deposits that may be encountered within the catchment and may not represent the full variety and complexity of such deposits.

Table 7: Glossary of ground conditions terminology

Terminology	Summary Definition
Source Protection Zones (SPZs)	SPZs are defined areas around large and public potable groundwater abstraction sites to protect and safeguard drinking water quality. They constrain the proximity of any activities that may impact upon drinking water abstraction. [61]
Nitrate Vulnerable Zone (NVZs)	NVZs are areas designated as being at risk from agricultural nitrate pollution and include just over half of all land in England [62]. Nitrate pollution poses a risk to water quality through eutrophication which is harmful to aquatic life, disrupts biodiversity and damages sensitive habitats and has the potential to affect drinking water.
Engineered materials	Earthworks where the ground has been artificially realigned or adapted. These materials can be poorly sorted, containing an undefined mix of silts, sands, gravels and peats and other organic materials.
Palaeochannels / Roddons	A remnant reach of river bed representing areas of incised channel and tidal creek systems, cut contemporaneously into the underlying clay deposits and filled with "fossilised" silt and sand.
Buried valleys	An ancient, abandoned river or drainage network which has become partially or completely buried by more recent sediment.
Faulting	The process of rock masses breaking and moving along fractures in the Earth's crust causing displacement.

4.3.1 Catchment-scale designations

Source Protection Zones

Only the most eastern extent of the catchment, that adjacent to Wainfleet All Saints and proximal to the River Steeping falls within a Source Protection Zone (SPZ). This area is designated as Zone III – Total Catchment and is coincident with the underlying Spilsby Sandstone Formation. The definition of the zones is provided in Table 8.

Table 8: Source Protection Zone definitions as per Groundwater source protection zones (SPZs) - GOV.UK [63]

Designation	Definition
Inner Zone – SPZ1	<p>A groundwater SPZ1 is the area immediately around an abstraction point for domestic supply or for food production purposes. Groundwater in a SPZ1 is most vulnerable to pollution given the close proximity of the abstraction point and the water's intended use for human consumption. It is defined within the Environmental Permitting (England and Wales) Regulations 2016 as one of the following.</p> <ol style="list-style-type: none"> 1. The area within 50 metres of a point where the groundwater is abstracted for domestic supply or food production purposes. 2. The area where it takes groundwater that is intended to be used to supply water for domestic or food production purposes up to 50 days to travel to the groundwater abstraction point. <p>For any given abstraction point, whichever area is largest applies.</p>
Outer Zone – SPZ2	<p>A groundwater SPZ2 is the area around an abstraction point for domestic supply or for food production purposes that meets one of the following definitions.</p> <ul style="list-style-type: none"> • The area within 250 metres of the abstraction point if the maximum allowable annual volume, divided by 365, is less than 2,000 cubic metres per day. This is when this is authorised by either an abstraction licence under section 24 of the Water Resources Act 1991 or the right to abstract small quantities under section 27 of the Water Resources Act 1991 • The area within 500 metres of the abstraction point if the maximum allowable annual volume, divided by 365, is equal to or greater than 2,000 cubic metres per day. This is when this is authorised by an abstraction licence under section 24 of the Water Resources Act 1991 • The area where it takes groundwater that is used to supply water for domestic or food production purposes up to 400 days to travel to the groundwater abstraction point .For any given abstraction point, whichever area is largest applies.
Total catchment – SPZ3	<p>This is the area around a supply source within which all the groundwater ends up at the abstraction point. This is the point from where the water is taken. This could extend some distance from the source point.</p>

Nitrate Vulnerable Zone

The majority of the catchment is designated as a NVZ apart from some coastal areas, southeast of the A52 that connects Wainfleet All Saints with Boston. These are areas designated as being at risk from agricultural nitrate pollution and include just over half of all land in England.

Radon

The risk from radon is significantly influenced by the underlying bedrock geology. Areas within the catchment have a maximum radon potential of 3-5% [64], coincident with the underlying Spilsby Sandstone Formation.

4.3.2 Geology

The geology of the catchment is covered by the following geological maps:

- 1:50,000 Horncastle Sheet 115 Solid and Drift Geology 1995 [65]
- 1:50,000 Skegness Sheet 116 Solid and Drift Geology [66]
- 1:50,000 Boston Sheet 128 Solid and Drift Geology [67]
- 1:50,000 The Wash Sheet 129 Solid and Drift Geology [68]

The strata identified within the catchment including those designated as engineered materials, superficial deposits and bedrock geology are described below:

Engineered materials

The catchment is predominately an artificially drained and heavily engineered landscape. Much of the catchment has been altered by artificial realignment or adaption of pre-existing watercourses or the formation of new cuts (such as those at Hobhole) and drains and this has resulted in the creation of many associated earthwork flood embankments but also areas of cuts and adaptations to local infrastructure. The catchment also features several pumps to raise waters up gradient and includes aqueducts such as the Stone Bridge Aqueduct.

It is commonly observed that many raised flood embankments originate from the 1800s, if not earlier, and are dredging bunds. Some embankments now support roads and access tracks but have not necessarily been strengthened to accommodate for modern traffic loads.

Similarly, the composition of these earthworks is often of poor quality and have been identified as comprising of locally sourced materials, frequently including material from channel “digout” where new cuttings are being formed or from deepening and widening existing cuttings. Material from subsequent dredging activities is also locally incorporated to raise the embankments. These materials can be poorly sorted, containing an undefined mix of silts, sands, gravels and peats and other organic materials. These materials also present several engineering risks including settlement and shrinkage, susceptibility to scour and can be susceptible to seepage, all of which can contribute to failures (such as a recent collapse noted at Lade Bank Pumping Station in the riverward side of the bank. The slumping is close to the crest that is also used to carry a road (Figure 10)).



Figure 10: Photograph 1: Riverward collapse and slumping upstream of Lade Bank Pumping Station

In other areas, such as that along the Haven, proximal to Maud Foster drain and bordering with the South Forty Foot Drain catchment, efforts have been made to raise banks (Figure 11) and act

as a coastal defence.



Figure 11: Photograph 2: Raised banks along The Haven with a focus on protecting against high tides

Superficial deposits

The catchment exhibits a range of superficial deposits with a strong influence from Tidal Flat Deposits but also includes localised gravels and peats. It should be noted that superficial deposits of a coastal or marine origin can be highly variable and complex in their composition, deposition and extent and may represent frequent episodes of reworking and deposition.

An overview of the superficial materials that may be encountered within the catchment is presented in Figure 12.

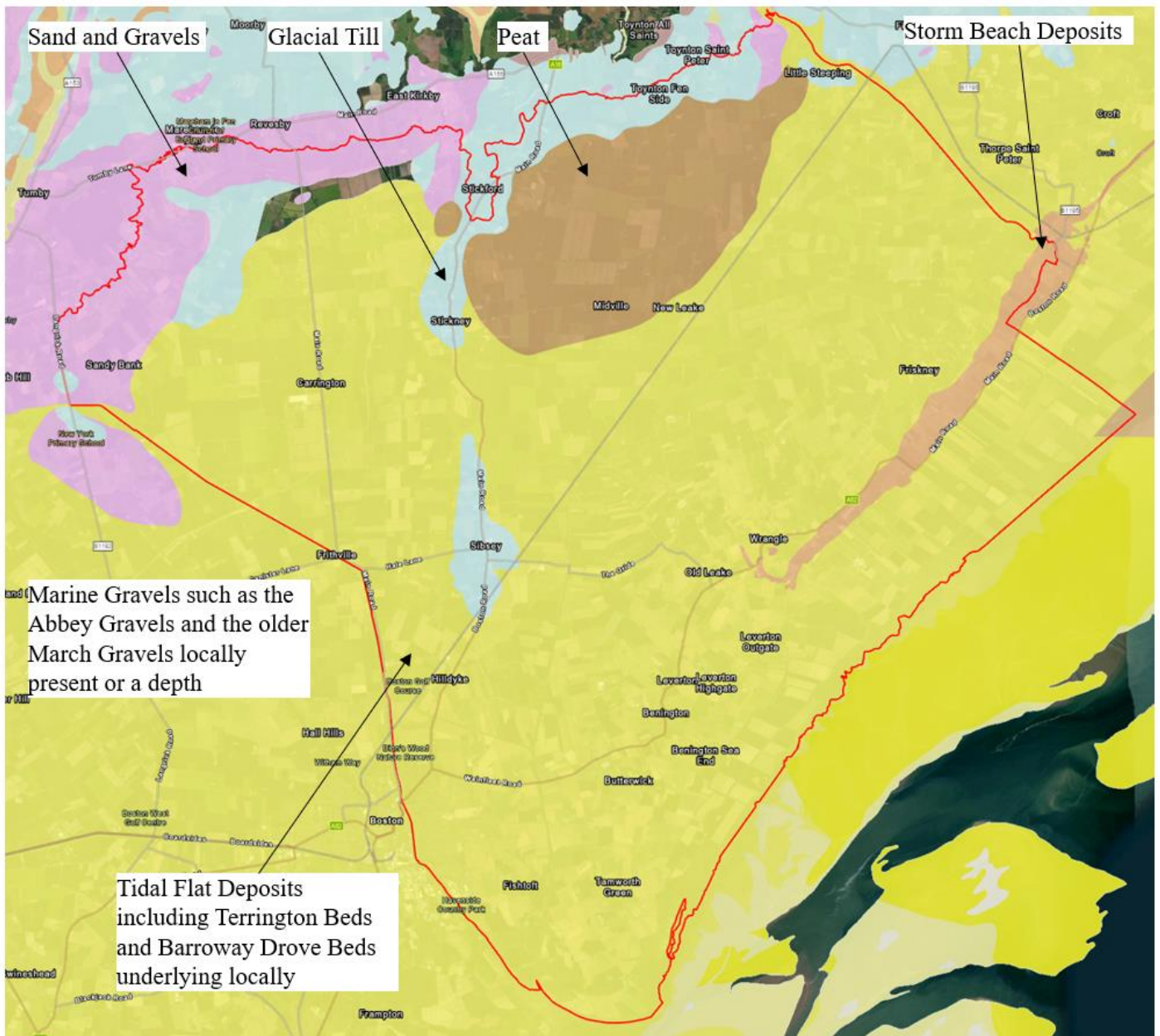


Figure 12: Simplified overview of superficial deposits in the catchment from BGS 1:50K Geological Mapping ©

Alluvium

Alluvium or Alluvial materials, derived from fluvial sources are commonplace across the catchment and will be subject to frequent periods of deposition and reworking. Alluvium is often grey or brown in colour but can be locally variable and is predominantly composed of cohesive materials including significant proportions of clay and silt. Alluvium may also locally contain sands and gravels and varying quantities of organic materials and shell fragments. All materials may be laterally restricted and may only be present as isolated lenses and horizons. The depth and thickness of Alluvium is also likely to be highly variable. Boreholes in the region such as TF30SE5 and TF40SW6 [69] describe alluvium to be between 2m-and 4m thick.

Storm Beach deposits

Storm Beach deposits represent high-energy or powerful storm events and are currently mapped on the BGS GeoIndex as a linear extent, orientated southwest to northeast and located approximately 7km inland of the existing coastline. The associated storm waves deposit a traceable landscape by linear ridge of high ground low rounded ridges, typically consisting of coarse materials such as gravels, cobbles and boulders. These deposits represent events where tidal levels have exceeded the levels reached by normal spring tides. Within the catchment this deposit has been utilised to support the A52 which connects Boston with Skegness.

Tidal Flat deposits

Tidal Flat deposits that can include the following: Terrington Beds, Nordelph Peat and the Barroway Drove Beds cover a broad extent of land within the catchment.

- **Terrington Beds**

The Terrington Beds cover a broad extent of land along the coastal edge of The Wash and are noted to extend in land as far as Little Steeping and Burgh le Marsh. They typically comprise of pale brown silts, fine grained sands and interlaminated reddish-brown clays. They are often extensive, near to horizontal and can facilitate the creation of marshy land and areas of unconsolidated sediment, mainly of mud and/or sand [70]. Borehole TF31SE15 describes these as thin brown silts and grey silt with occasional peat.

- **Barroway Drove Beds**

The Barroway Drove Beds may underlie the Tidal Flat deposits or crop locally in the catchment and are widespread between Peterborough and The Wash. They frequently comprise primarily of clay and silt but can locally contain peats and organic materials such as roots and rootlets such as that shown in TF30SE41 and TF40NW11. Whilst the Barroway Drove Beds may contain Peat, they can also be sandwiched by Peat above (Upper Peat) and Peat below (Lower Peat) which can also be display repeating smaller layers or lenses of Peat [71]. The 1:50,000 Geological Sheet for Horncastle, notes marine and estuarine deposits in the vicinity of Midville and Fodder Dyke.

- **Peat and Nordelph Peat**

Peat is shown on the Geoindex in the vicinity of Midville and west of Little Steeping. It is, however, not explicitly mapped on the available 1:50,000 Geological Sheet for Horncastle but is displayed on the adjoining 1:50,000 Geological Sheet for Skegness suggesting some break in continuity between the sheets. On the Horncastle sheet, much of the area is identified as Marine and Estuarine deposits, whilst on the Skegness sheet, the peat is designated as the Nordelph Peat.

Nordelph Peat is reported as up to 3m thick in places [71] and is evidenced in local boreholes. TF35NE5, located along Fodder Dyke, near Midville describes varying very soft to locally firm brownish grey and grey silty clays with varying amounts of organic matter and localised peat materials. The peat materials are described as firm dark brown amorphous and locally fibrous with occasional silty laminations from 0.20mbgl to 4.15mbgl, below that becoming notably sandier to a depth of 8.00mbgl at which it transitions into variable glacial materials.

Peat is also locally present below the surface or not at crop, such as the in TF46SW6 that identifies peat and peaty layers from 1.20mbgl to 1.80mbgl. Peat is likely to be locally present, either underlying the material grouped as Tidal Flat deposits or intermixed within these deposits. The peat in the catchment is likely degraded as a result of land drainage practices, oxidisation and shrinkage of buried peat. This can have implications on the effectiveness of the land drainage network and infrastructure in the area. Peat degradation is discussed in Section 4.2.1.

Marine Gravels

Marine Gravels are reported within the catchment including younger sands and gravels such as the Abbey Gravels and older Marine Gravels such as the March Gravels. TF51SW13 likely encountered both of these gravels, with marine sands and alluvial material described from 2.50mbgl to 11.70mbgl and older marine deposits from 11.70mbgl to 17.00mbgl.

Glacial Deposits

Glacial Till and Glaciolacustrine Deposits are present to the northwest of the catchment but are also locally present across the catchment and may be concealed beneath the Tidal Flat Deposits and the Marine Gravels. They may not always be continuous across the catchment and may have localised lateral extents. Glacial Till is described in TF35SE3/A at Sibsey as a firm to very stiff grey-brown slightly gravelly to gravelly silty clays with gravels of chalk and is encountered to a depth of at least 12mbgl, the base of which is not proven here.

4.3.3 Bedrock Geology

Beneath the superficial soils, the catchment is underlain by a variety of differing bedrock geologies comprising the Amphill Clay Formation, the Kimmeridge Clay Formation and the Spilsby Sandstone Formation from southwest to northeast. The anticipated bedrock geology of the catchment is presented in Table 9 and a simplified geological map is presented in Figure 13.

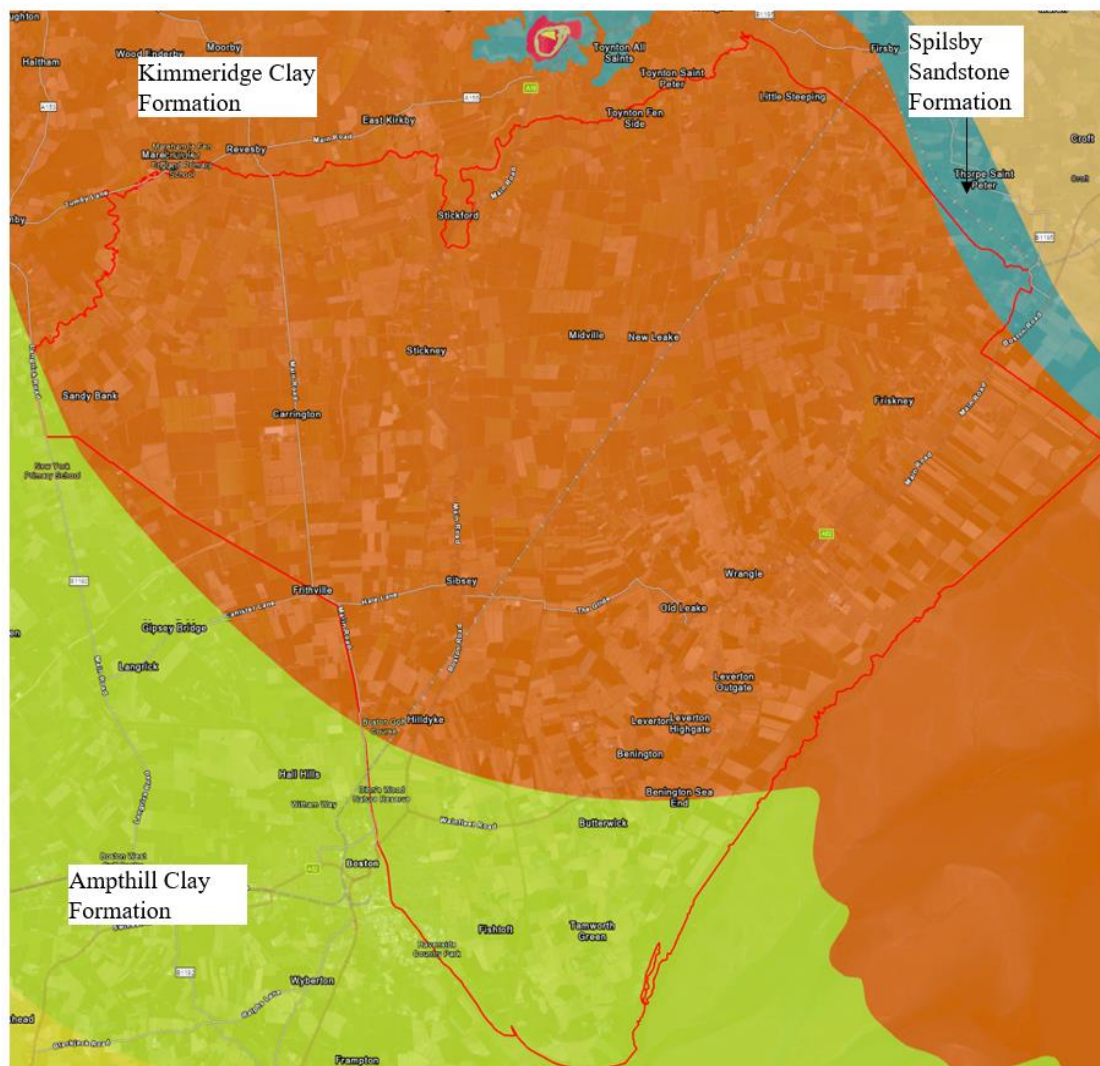


Figure 13: Simplified overview of the bedrock geology underlying the catchment from BGS 1:50K geological mapping

Table 9: Summary of Bedrock Geology within the catchment

Formation	Members (if applicable)	Description [69]
Spilsby Sandstone Formation	Upper Spilsby Sandstone Member	Grey or brown sandstone with iron oolites and underlain by yellow and white calcareous sands and green glauconitic sands and phosphatic nodules.
	Lower Spilsby Sandstone Member	Glauconitic and calcareous sands and sandstone and phosphatic nodules.
Kimmeridge Clay Formation		Mudstone, siltstone and cementstones, may be calcareous or kerogen-rich and locally fossiliferous [72]
Spilsby Sandstone Formation	Upper Spilsby Sandstone Member	Grey or brown sandstone with iron oolites and underlain by yellow and white calcareous sands and green glauconitic sands and phosphatic nodules.
	Lower Spilsby Sandstone Member	Glauconitic and calcareous sands and sandstone and phosphatic nodules.
Amphill Clay Formation		Mudstone, often calcareous or silty with argillaceous limestones and marls [73]. Fossiliferous material can also be expected. Fissured clays are also expected with selenite (gypsum) crystals reported. Overconsolidated, high plasticity, frequently fissured and susceptible to shallow slope angle failure.

4.3.4 Regional structure

Palaeochannels / “Roddons”

An influential feature of significance in the Fens is the presence of palaeochannels which are locally referred to as “roddons” or “silt-filled creeks” such as those well documented in the Peterborough district. The influence of anthropogenic changes and involvement such as agriculture and engineered drainage, has caused these former channels to become positive topographical features. As the land surrounding, which is notably cohesive and susceptible to shrink, the more granular material infilling the former channel remains proud. These features, whilst subtle, can form ridges up to 1m high [71].

It is also noted that the roddons would not be able to facilitate or be re-used as channels in the event of future marine transgression events, and due to compaction, settlement and peat wastage that has occurred between them, they may be capable of funnelling or concentrating water flow between them [92]. A summary of the encountered roddon structures scale across the Fens is provided in Table 10.

Table 10: Summary of the identified roddon hierarchy

Roddon Hierarchy	Dimensions	Description
Major “Trunk” Roddon	2m to >1km	Predominantly fine sand, consistent of grain size from mouth to upper extents, likely representative of being deposited under uniform depositional conditions
Tributaries	1m to >10m	Predominantly silt
Minor Tributaries		Predominantly clay

LiDAR imagery for the catchment shows a prominent occurrence of roddons which are of varying scale. Figure 14 shows a range of roddon sizes in the vicinity of Medlam Drain. The smallest roddons are likely to be 1m to 5m wide but major roddons or those largest, measure at approximately 1km wide.

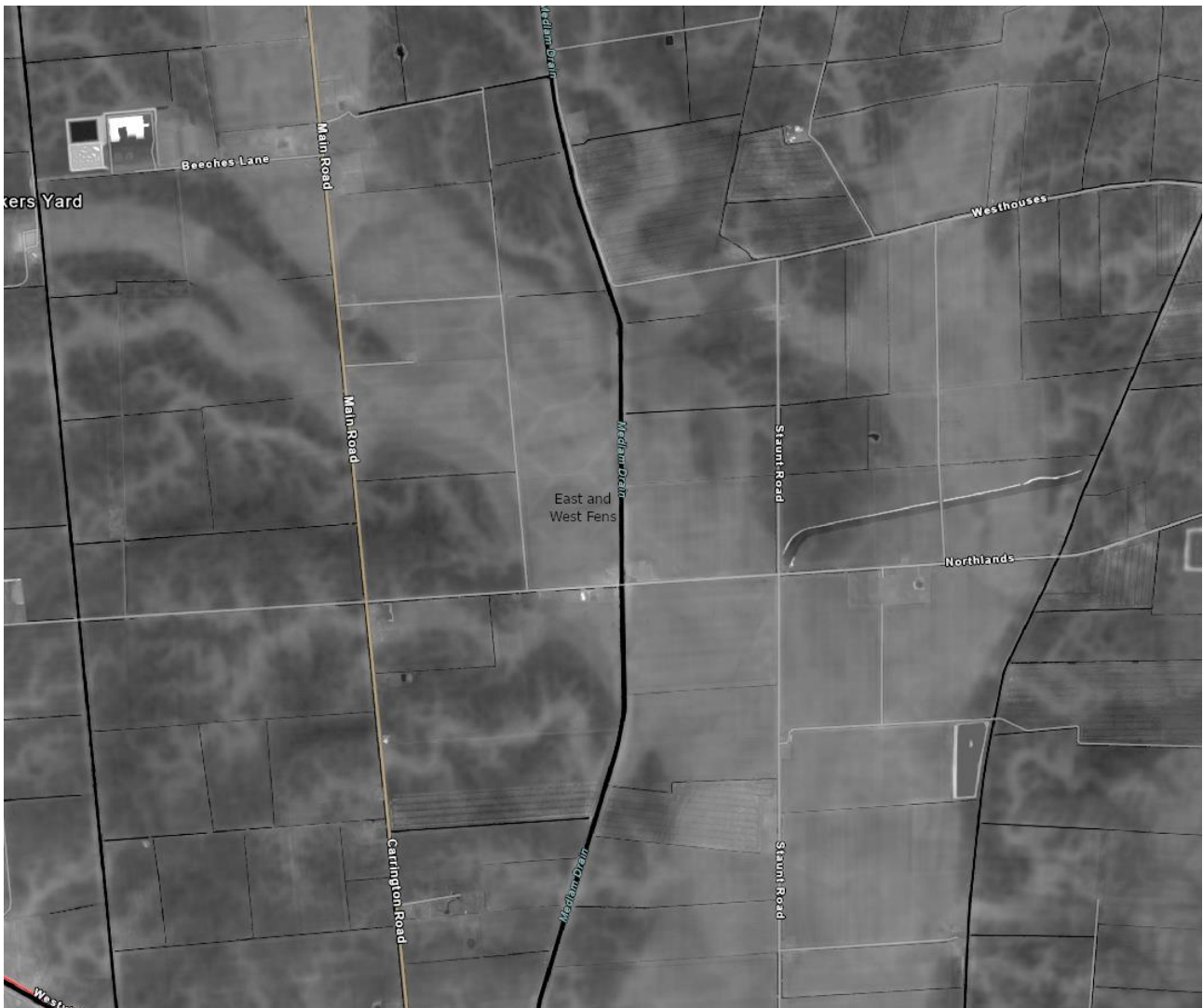


Figure 14: LiDAR imagery extract from the catchment showing varying scale roddons

Buried Valleys

There is a potential for buried valleys to present in the region, including one identified in close proximity to Wainfleet All Saints and another that runs through southeast Boston, due northeast to southwest, before turning due east [74]. The buried valley here is suggested as being preglacial and would likely be infilled with a mix of materials potentially including a mix of sands and gravels and Glacial Till. Buried valleys present the risk of encountering much deeper than anticipated superficial materials which in themselves, may be influential on settlement or act as preferential pathways for groundwater migration. A borehole [Borehole ID TF46SE18] [69], undertaken near Burgh-le-Marsh, north of the catchment but on the same suspected buried valley, indicates superficial materials, a mix of sands and gravels and Glacial Till, down to a depth of 25mbgl.

Faulting

Faulting is typically absent within the catchment apart from small areas of faulting (which is likely to be subtle). Faulting could also be present at depth or masked by superficial deposits.

4.3.5 Hydrogeology

A summary of aquifer designations for geologies at outcrop and underlying the site has been prepared using information from the GeoIndex [69]. Magic Maps and hydrogeological Mapping [75].

Superficial Geology Aquifers

A summary of the superficial aquifers is presented in Table 11.

Table 11: Summary of encountered superficial deposit aquifer designations within the catchment

Formation	Superficial Aquifer Designation
Alluvium	Secondary A
River Terrace Deposits	
Marine Gravels including March Gravels	
Silt-infilled creeks	Secondary (Undifferentiated) Very small yields and often poor water quality
Glacial Till	
Tidal Flats Deposits including Terrington Beds and Barroway Drove Beds	Unproductive. Low permeability that can however confine underlying aquifers.
Glaciolacustrine	
Peat	

Bedrock Geology Aquifers

A summary of the bedrock aquifers is presented in Table 12.

Table 12: Summary of encountered bedrock geology aquifer designations within the catchment

Formation	Bedrock Aquifer Designation
Spilsby Sandstone Formation	Secondary A
Kimmeridge Clay Formation Amphill Clay Formation	Unproductive. Low permeability that can however confine underlying aquifers.

4.3.6 Geotechnical Appraisal – engineered structures

Earthworks

Earthworks constructed within the East and West Fens catchment to facilitate the transportation and containment of surface waters may be locally subject to failures and degradation. Many earthworks are not built to modern engineering standards, commonly composed of dredgings and localised digout and in many cases they perform as required despite this. The composition and distribution of the materials can be highly variable and as a result can present the risk of localised failures. These failures can be divided into five main risks. These include:

- Slope failure of the embankment side slopes under extreme groundwater conditions where slopes are formed out of low shear strength materials are steep gradients on poor foundations;
- Settlement due to consolidation of the foundation soil and internal deformation due to self-weight consolidation and external loading;
- Overtopping;
- Excessive seepage; and

- Animal activity leading to increased seepage, settlement and instability.

Earthwork slope instability

Slope instability of the embankments side slopes could take the form of shallow surface slips where the embankment is not particularly high and the slopes are steep, or deeper, rotational failures where the embankments are taller with slopes that are less steep and poor foundation soils (i.e. peat). The cause of slope instability is due to high groundwater conditions within the embankment and the foundation soil during flood conditions coupled with the embankments being built out of low strength soils with overly steep side slope angles over poor foundation soils also with low strength.

Poor vegetation cover can also present a risk to shallow slope instability. If vegetation was well-maintained, it can help to stabilise the shallow soils through root cohesion and control of moisture content. For example, a ranker sward comprising of shallow or predominantly tap-rooted vegetation offers poor resistance compared to a species-rich grass sward.

Slope instability is often a very localised feature and where it does occur it might only impact of a few metres to a few 10's of metres of linear embankment. It can result in potential loss of containment by increasing the risk of seepage due to the reduced seepage pathways through the embankment. Also, further scour or erosion of the embankment can occur where bare soil is exposed either on the riverward face or the landward face should, overtopping occur.

Embankments formed out of high plasticity clay may also be susceptible to shallow slope instability due to shear strength loss caused by cyclical wetting and drying of the soil.

Settlement and deformation

Settlement can occur from a range of causes. The embankment can settle due to consolidation of the foundation soil due to ongoing drainage activities and long-term creep settlement of organic rich soils. Settlement can over time lower the crest and where the foundation soil comprises contrasting soils which consolidate by different amounts, differential settlement can occur across the embankment.

Settlement may occur due to internal consolidation of the embankment where this was inadequately compacted. At a shallow depth with embankments where clay soils are present, these can be susceptible to changes in moisture and can readily change in volume leading to shrinkage and swelling. Overtime this can lead to differential settlement at the surface and becomes particularly obvious where embankments support roads in the form of cracking and undulation of the pavement.

Seepage

Seepage can occur in earthworks or structures that are composed of granular soils or have more permeable layers such as sands and gravels. It can also occur where there are palaeochannels beneath the embankment or where there are burrowing animals. The composition of earthworks in the region can be variable, so the risk of seepage can be highly variable.

Seepage essentially undermines the effectiveness of any structure designed to retain water and can result in the removal of material, particularly fines and ultimately leading to reduction in mass soil strength with the potential to induce slope failure or ultimately, breaching.

Overtopping

Overtopping of embankments is identified as a risk, particularly if low spots are present due to settlement. Where embankments are poorly vegetated (either due to a lack of soil binding vegetation or surface cover), there is additional risk from scour during an overtopping event which could lead to a breach and effective loss of containment.

Animal activity

Animal activity presents several risks to earthworks including the establishment of burrows through and within earthworks but also from disturbance to surface soils and vegetation. Burrowing can encourage instability and promote seepage whilst animal movement on the surface, can lead to the removal of protective vegetation.

Aggressive groundwater conditions

Acid groundwaters could be encountered in areas that are rich in pyritic minerals such as the fossiliferous strata, such as Ampthill Clay and Kimmeridge Clay Formations. Those that promote mobility of groundwaters or where groundwater levels can fluctuate as to promote oxidation, would be anticipated to have a greater potential to create aggressive (acidic) groundwater conditions and would potentially have a detrimental impact on concrete foundations and sub-structures. Peat also has the potential to increase acidity in groundwaters.

4.4 Water environment

This section outlines the baseline water environment in the catchment, focusing primarily on surface water bodies considered within the Water Environment Regulations / Water Framework Directive. Analysis of the groundwater bodies present within the catchment has focused on their overarching statuses at this stage. Further information regarding the hydrogeology baseline condition of the catchment, including details of the various aquifers and source protection zones and drinking water safeguard zones present, is provided in the Ground Conditions (soils and resources) baseline, above. An overview of flood risk and key flood risk management infrastructure within the catchment is provided in the Witham East and West Fens catchment baseline report and the flood risk technical appendix. Table 13 outlines the key terminology used in this section.

Table 13: Glossary of water environment terminology

Terminology	Summary Definition
Main River	Designated 'Main Rivers' are usually larger rivers and streams with the highest flood risk. The Environment Agency, using its permissive powers, can carry out maintenance, improvement, or construction work on Main Rivers to manage flood risk and protect the environment. As these powers are permissive only, the Environment Agency is not obliged to carry out either maintenance or new works on Main Rivers.
Flood Zone	Areas classified by the probability of river or sea flooding, excluding the presence of flood defences.
AIMS	Asset Information and Maintenance programme dataset detailing flood risk management assets. The dataset is owned by the Environment Agency but includes assets also owned or operated by third parties.
River Basin District	The area of land (and sea) comprising one or more neighbouring river basins together with their associated groundwaters and coastal waters. There are 10 river basin districts in England.
Management catchment	A sub-category of a river basin district, a management catchment comprises a number of water body catchments in one management unit at which actions are applied.
Operational catchment	A sub-category of a management catchment, an operational catchment groups water body catchments together for economic appraisal.
Water Framework Directive (WFD) or Water Environment Regulations (WER)	Legislation designed to halt the deterioration in status of water bodies in Europe (WFD) and England (WER) and achieve good status for rivers, lakes and groundwaters.
River Basin Management Plan (RBMP)	RBMPs are produced for each river basin district and set the legally binding, locally specific environmental objectives for water regulation and planning activities.

4.4.1 Catchment overview

The Main Rivers within the catchment comprise the West Fens Catchwater Drain, East Fens Catchwater Drain, Hagnaby Beck, Stone Bridge Drain, and Maud Foster Drain (see Figure 15).

- The West Fen Catchwater drains a sub-catchment from Chapel Hill in the West, Kirkby Fenside in the North, down to Cowbridge through a variety of drainage channels including Castle Dike, Newham Drain, Mill Drain, Twenty Foot Drain and Frith Bank.
- The East Fen Catchwater drains the higher ground around Toynton All Saints and Spilsby and flows in a south-westerly direction towards Northlands where it joins the West Fen Catchwater to form the Stonebridge Drain.
- The Stonebridge Drain becomes the Maud Foster Drain at Cowbridge. The Maud Foster Drain flows southward through the town of Boston and outfalls to The Haven estuary via the Maud Foster Sluice since 1807.
- A catchwater is an artificial channel that runs along the edge of a lowland area, along a contour, to intercept water running off higher ground and aids the drainage of the Fen. The catchwater will tend to flow into a 'highland carrier' which is an embanked channel, that carries this 'highland water' across the Fenland area. The East and West Fen catchwaters are part of the Main River network which act as a highland catchwater to separate these upland flows from the fenland drainage system. A complex network of fenland drainage channels, such as Hobhole Drain, are managed by the IDB to drain the catchment since the land was identified as fit for arable, meadow or pasture in the 1600s.
- The East and West Fen and the drainage system between Revesby and Boston is navigable via Cowbridge Lock.

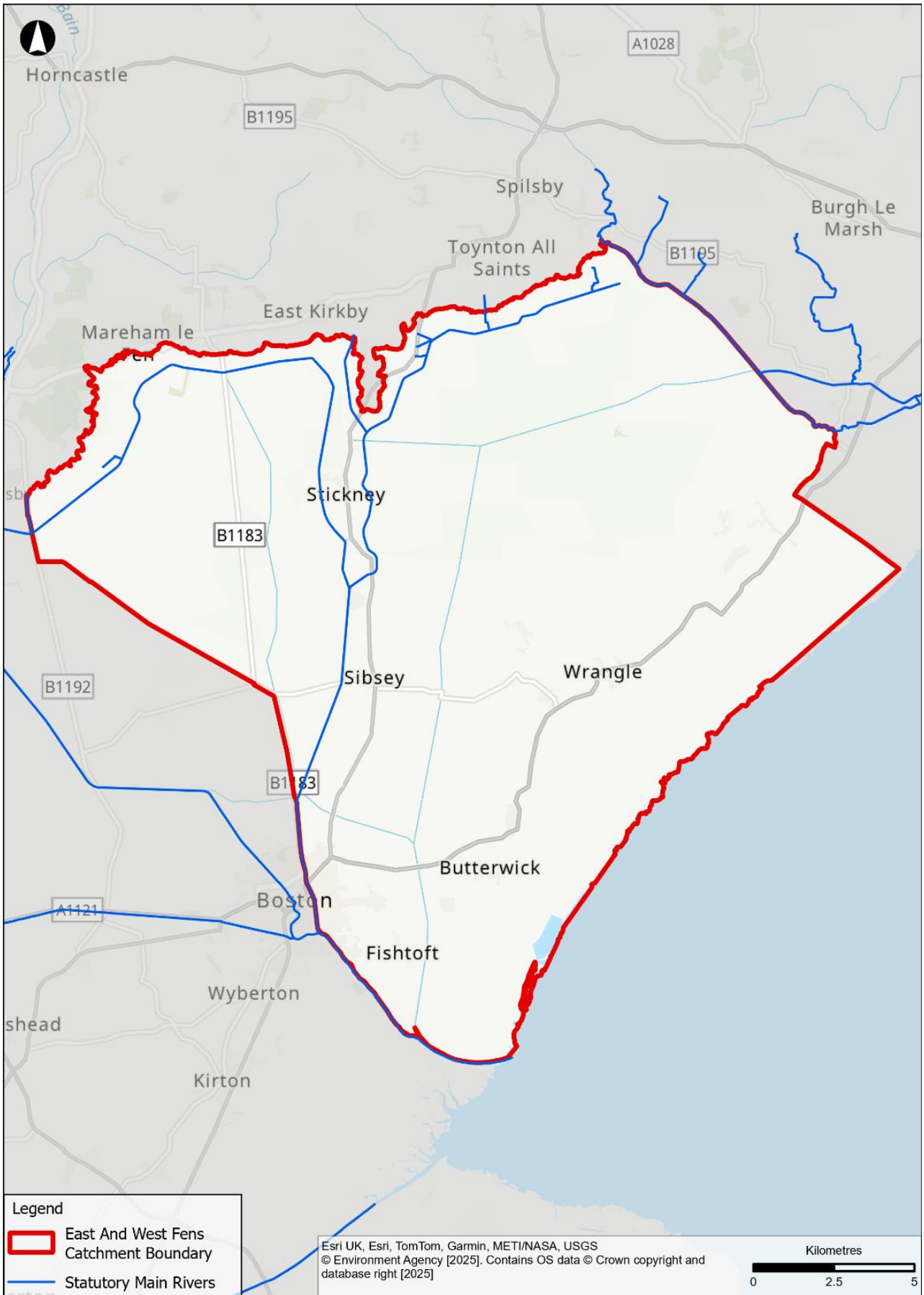


Figure 15: Main Rivers in the catchment

4.4.2 Water Environment Regulations (WER) / Water Framework Directive (WFD)

Surface water bodies

The catchment is located within the Anglian River Basin District (RBD), which extends from Lincolnshire in the north to Essex in the south, and Northamptonshire in the west to the East Anglian coast. The RBD is subdivided into 14 Management Catchments, including the Witham management catchment within which the Fens East and West operational catchment is located.

The majority of the catchment falls within the 'East & West Fen Drains' river water body catchment, which encompasses the lowland drainage network outside of Boston (including the West Fen Drain, Cowbridge Drain, and Hobhole Drain). The northern upland area of the catchment and far south-western extent around Boston fall within the 'Maud Foster and Fen Catchwater Drains' river water body (which comprises the Main Rivers of West Fens Catchwater Drain, East Fens Catchwater Drain, Stone Bridge Drain, and Maud Foster Drain).

Parts of the south-eastern extent of the catchment extend into coastal water bodies which are not defined as WER/WFD surface water bodies. These are areas of lowland fen which transition into the 'Wash Outer' coastal water body and the 'Wash Inner' transitional (TRaC) water body extents located downstream.

The location and extent of these surface water body catchments relative to the catchment boundary is shown in Figure 16. An overview of these surface water bodies and their current statuses is then provided in Table 14.

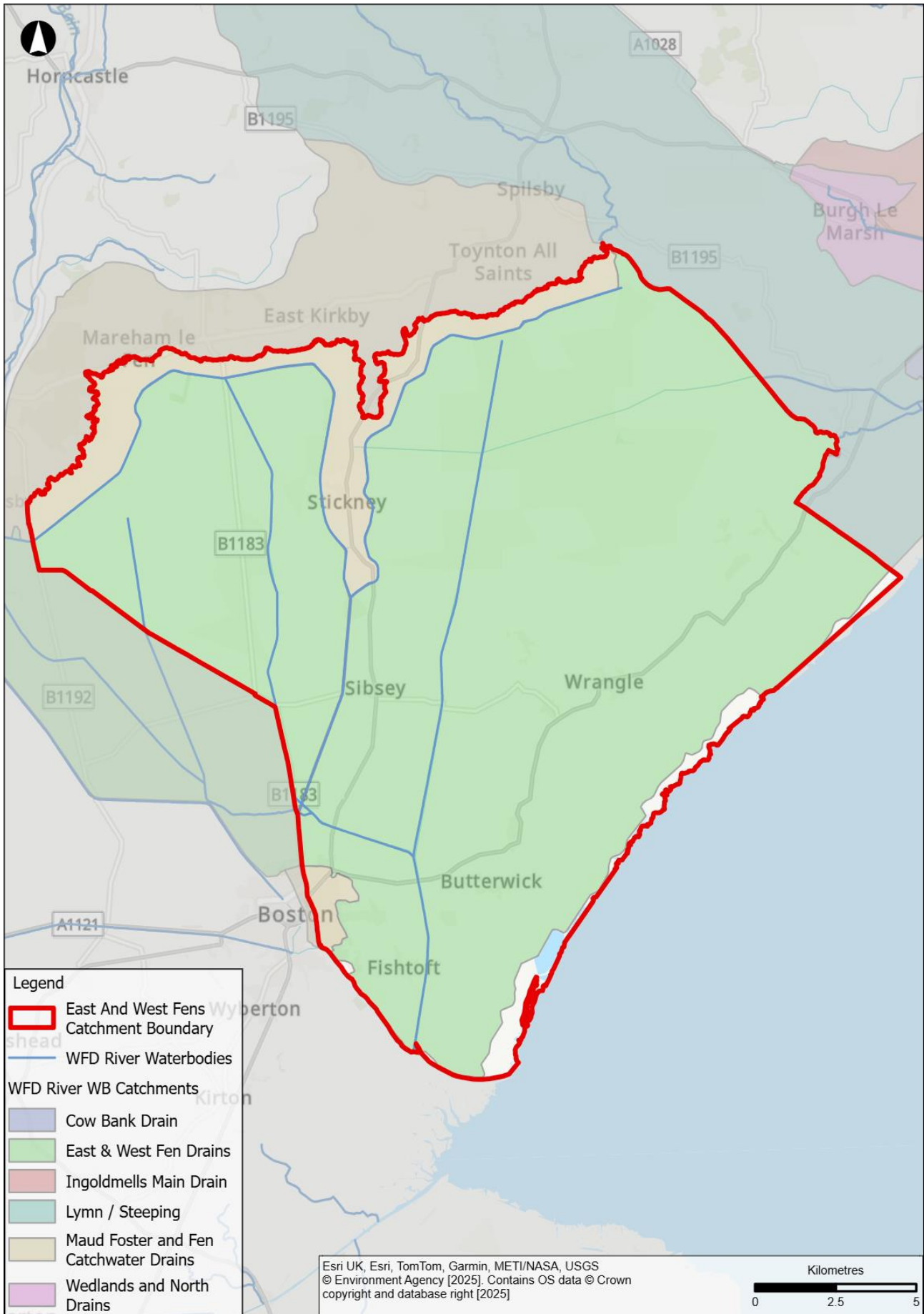


Figure 16: WER/WFD surface water bodies in the catchment

Table 14: Summary of WER/WFD surface water bodies within the catchment and their latest Cycle 3 (2022) status classifications

Waterbody Name	Waterbody ID	Waterbody Type	Hydromorphological Designation	Catchment area (km2)	Overall Status	Ecological Status	Biological quality elements	Physico-chemical quality elements	Hydromorphological Supporting Elements	Supporting Elements	Chemical Status
East & West Fen Drains	GB205030056405	River	Artificial	371.8	Bad	Bad	Bad	Moderate	Supports Good	Moderate	Fail*
Maud Foster and Fen Catchwater Drains	GB205030056465	River	Artificial	99.9	Moderate	Moderate	Bad	Moderate	Supports Good	Good	Fail*

* Note: Chemical Status is assessed once per RBMP Cycle (every 6 years) and so was last assessed in 2019 (and is recorded as 'does not require assessment' within the latest interim Cycle 3 2022 status classifications)

Existing pressures on status

The Environment Agency's 'Reasons for Not Achieving Good' (RNAG) dataset identifies the key pressures and activities that are currently considered to be limiting the status of each of the different status elements that are not currently achieving their 'Good' status objective. Each RNAG is linked to a 'Surface Water Management Issue' (SWMI), which have been identified via the catchment management planning process. These comprise the main issues that are deemed to limit the uses and potential benefits of managing the water environment in the river basin district in a sustainable way.

The latest RNAG identified for the river water bodies present within the catchment are summarised in Table 15. The current RNAGs identified for the river water bodies in the catchment are primarily related to diffuse and point source pollution from agricultural land and water industry sewage discharge, respectively, and physical modification and flow pressures associated with land drainage for agriculture and rural land management affecting the fish status.

Table 15: Summary of RNAG for waterbodies within the catchment

Number of RNAGs per Surface Water Management Issue (SWMI)							
Water body	Physical modifications	Pollution from wastewater	Pollution from towns, cities and transport	Changes to the natural flow and level of water	Invasive non-native species	Pollution from rural areas	Pollution from abandoned mine
East & West Fens Drains	3	0	0	0	0	0	0
Maud Foster and Fen Catchwater Drains	2	3	0	1	0	6	0
TOTAL	5	3	0	1	0	6	0

Mitigation Measures

The Mitigation Measures assessment for the river water bodies within the catchment identifies 24 measures to contribute to achieving status objectives for flood protection and land drainage uses comprising:

- Removal or re-location of set-back embankments;
- Restoration of lateral connectivity with the water bodies surrounding floodplain e.g. flood plain spillways;
- Managed realignment of flood defence assets;
- Activity to create new habitat where it did not exist before;
- Removal of hard engineering structures that modify the natural flow and sediment regime, including weirs, locks, floodgates, sluices, and erosion control structures;
- Removal/softening of hard engineering structures that modify natural bank profile;
- Preserve and/or restore existing in stream and riparian/shoreline habitats;
- Restore or increase in-channel morphological diversity e.g. riffle and pool creation and bar creation etc;
- Rehabilitation of degraded bankside habitats to improve their physical structure and the condition of the riparian zone. Bank rehabilitation includes bank reprofiling, the creation of

aquatic ledges and removal of hard bank protection etc.;

- Re-opening of covered culverts;
- Bed of culvert altered to allow decreased flow conditions and to allow longitudinal connectivity of both biota and sediments;
- Installation of structures designed to facilitate and improve the passage of migratory (e.g. salmon and sea trout) and non-migratory fish where structures cannot be removed;
- Modification of structure to prevent/reduce fish entrainment e.g. screens;
- Retro-fitting existing structures to accommodate niche habitats, as opposed to more substantial structural modifications that would be likely to deliver greater hydromorphological change but may not be possible given the use;
- Structural changes to locks, sluices, weirs, beach control;
- Good practice management of in channel and riparian vegetation works or maintenance practices (e.g. macrophyte cutting), carried out in a manner that considers the impacts of the activity upon ecology and hydromorphology;
- Action(s) to reduce the extent and spread of invasive non-native species, including actions on our own assets;
- Leaving habitat or parts of natural habitat while undertaking operations or maintenance in a water body;
- Implement an active sediment management strategy (develop and revise) which could include a) substrate reinstatement, b) sediment traps, c) allow natural recovery minimising maintenance, d) riffle construction, e) reduce management in flood risk areas;
- Ensure best practice techniques are applied when undertaking maintenance activities to minimise impacts to the habitat;
- Ensure best practice is applied when undertaking maintenance works e.g. coffer dam placement, working during appropriate flow conditions;
- Appropriate channel maintenance strategies and techniques, e.g. remove woody debris only upstream of, or within, areas of urban flood risk;
- Implement a downstream flow regime that does not impact the ecology (applies to rivers and reservoirs); and
- Raise public awareness of the impacts and responsibilities of landowners.

Water Environment Regulations Protected Areas

Under the WER/WFD, 'Protected Areas' were defined as areas requiring additional protection because of their sensitivity to pollution or due to their particular economic, social or environmental importance. These include designated water bodies (or parts of water bodies) or catchment areas that are abstracted from for human consumption, support economically significant aquatic species, are recreational waters, are sensitive to nutrient enrichment or support habitats or species of international conservation importance.

The specific environmental designations, measures and actions for these Protected Areas have been established under previous European Directives and their associated domestic legislation / regulations, which set out the requirements to ensure the protection of the area's water environment or protection of wildlife that is directly dependant on that water environment. Where a WER/WFD water body falls within or forms all or part of one of these designated Protected Areas, the water body is subject to additional environmental objectives (and associated monitoring regimes, risk assessments, and regulations) in accordance with the relevant legislation.

The WER/WFD Protected Areas present within the catchment are summarised in Table 16.

Table 16: WER/WFD protected areas present within the catchment

Protected Area Type	Protected Area Name (code)	Relevant waterbody
Nitrates Directive	Witham Drains NVZ (S716)	East and West Fen Drains; Maud Foster and Fen Catchwater Drain
	Coningsby (G178)	East and West Fen Drains; Maud Foster and Fen Catchwater Drain
Shellfish Water Directive	West Wash (UKSW4)	East and West Fen Drains; Maud Foster and Fen Catchwater Drain
Special Area of Conservation	The Wash & North Norfolk Coast (UK0017075)	East and West Fen Drains
Special Protection Area	The Wash (UK9008021)	East and West Fen Drains
Ramsar Site	The Wash (UK11072)	East and West Fen Drains

Groundwater bodies

Groundwater bodies are the principal units of groundwater as defined in the WER/WFD, and are considered to be hydraulically connected, distinct entities of groundwater.

The majority of the catchment is not located within a WER/WFD groundwater body. However, a small portion of the north-eastern extent of the catchment is partially located within the 'Bain Sands and Gravels' groundwater body, within the 'Witham Bain and Gravels' operational catchment. The status of the groundwater body is summarised in Table 17.

Table 17: WER/WFD groundwater body within the catchment and their latest Cycle 3 (2019) status classifications

Water Body Name	Waterbody ID	Surface Area (km2)	Overall Status	Quantitative Status	Chemical (GW) Status
Bain Sands and Gravels	GB40503G000100	80.99	Good	Good	Good

4.5 Biodiversity

This section outlines the baseline biodiversity in the catchment. Table 18 outlines the key terminology used in this section.

Table 18: Glossary of biodiversity terminology

Terminology	Summary Definition
Priority Habitat and Species	Priority habitats and Species are those identified as being of principal importance for the conservation of biodiversity. These habitats are listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006.
Critically Endangered	Critically Endangered species are defined by the IUCN as species that face an extremely high risk of extinction in wild habitats.
Endangered	Endangered species are species which have been defined by IUCN as very likely to become extinct in their known native ranges in the near future.
Biodiversity Net Gain (BNG)	Biodiversity Net Gain (BNG) is a world-leading government strategy to create and improve natural habitats by making sure development has a measurably positive impact.
International Union for Conservation of Nature (IUCN)	International Union for Conservation of Nature is a membership union comprised of government and civil society organisations and is regarded as the global authority on the status of the natural world and the measures needed to safeguard it.
Local Nature Reserves (LNR)	Local Nature Reserve are statutory designated areas under Section 21 of the National Parks and Access to the Countryside act 1949.
National Nature Reserves (NNR)	National Nature Reserves are areas of land declared under the National Parks and Access to the Countryside Act 1949 or Wildlife and Countryside Act (1981).
Special Areas of Conservation (SAC)	Special Areas of Conservation are protected areas in the UK designated under the Conservation of Habitats and Species Regulations 2017 (as amended) in England and Wales (including the adjacent territorial sea).
Special Protection Areas (SPAs)	Special Protection Areas are protected areas for birds in the UK classified under the Conservation of Habitats and Species Regulations 2017 (as amended) in England and Wales (including the adjacent territorial sea).
Sites of Special Scientific Interest (SSSI)	Sites of Special Scientific Interest are protected areas within England. They are designated (legally protected) to maintain and protect a specific aspect of biological or earth heritage interest.

4.5.1 Designated nature conservation sites

There are five statutory internationally / nationally designated nature conservation sites within or partially within the catchment, some of which overlap in entirety or partially with other designations. These comprise:

- The Wash - Special Protection Area (SPA), Ramsar site, and Site of Special Scientific Interest (SSSI);
- The Wash & North Norfolk Coast - Special Area of Conservation (SAC); and
- Havenside – Local Nature Reserve (LNR)

The location of each designated site is shown in

Figure 17 and a summary provided in

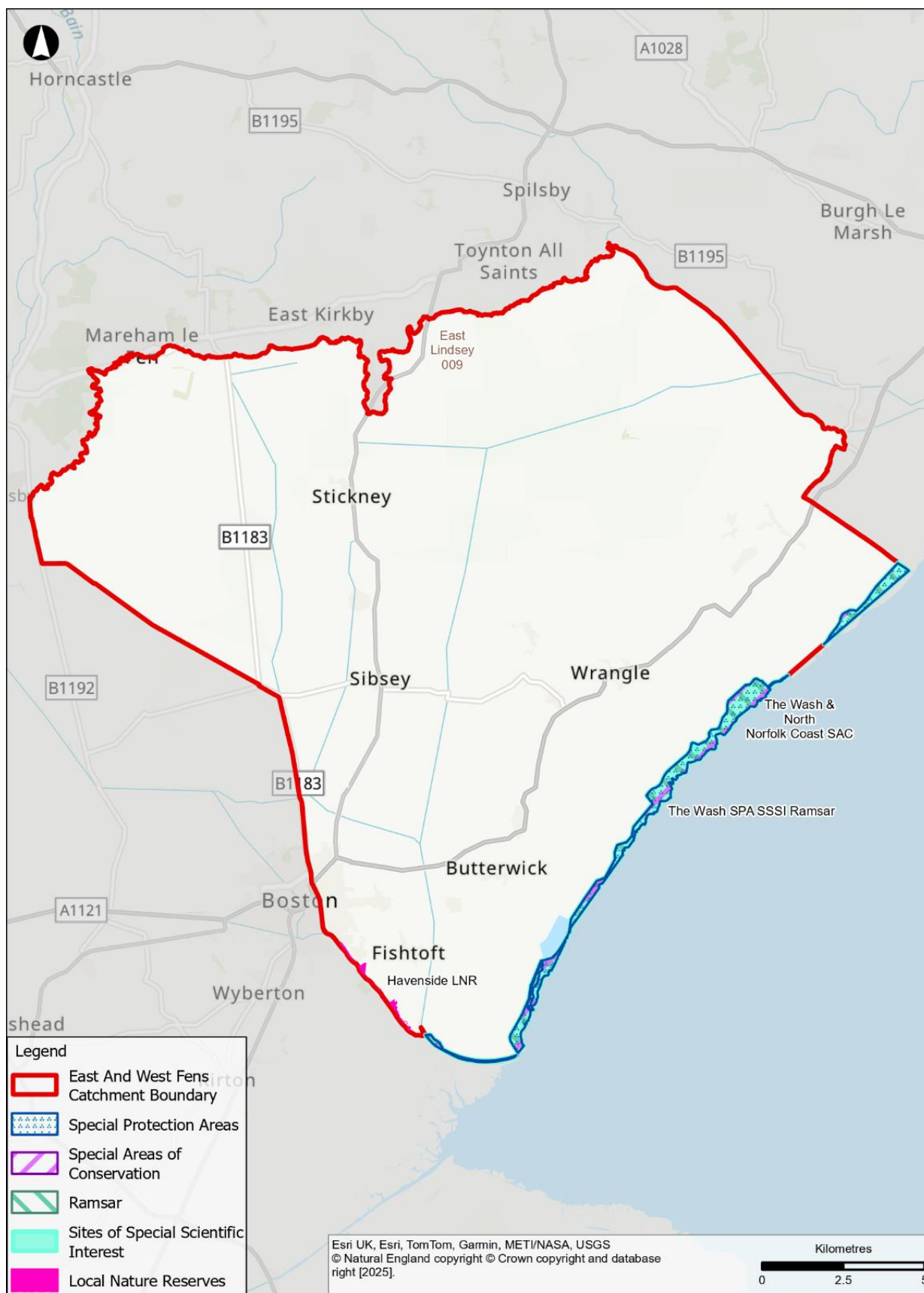


Table 19.

Figure 17: Overview of Designated sites for nature conservation within the catchment

A summary of the designated sites can be found in Table 19 below.

Table 19: Designated sites within the catchment

Site Name	Designation	Citation / Overview and key features
The Wash	SPA Ramsar site SSSI	<p>The Wash overlaps with the catchment for less than 1-2% of the protected areas total as the site is associated coastal intertidal mudflats and saltmarshes.</p> <p>SPA – The Wash Special Protection Area (SPA) covers 622 km² and forms part of the larger Wash and North Norfolk Coast Special Area of Conservation which encompasses the largest embayment in the UK, as well as extensive intertidal sand and mudflats, subtidal sandbanks, biogenic and geogenic reef, saltmarsh and a barrier beach system unique in the UK. The Wash SPA supports non-breeding including a large number of species such as: bar-tailed godwit; bewick's swan (<i>Cygnus columbianus bewickii</i>) and black-tailed godwit (<i>Limosa limosa islandica</i>).</p> <p>Ramsar site – The Wash is Britain's largest estuarine system, fed by four rivers. It has extensive saltmarshes, intertidal banks, and deep channels. It is crucial for migrant wildfowl and wading birds, supports a shellfish fishery, and hosts large populations of common and grey seals. The sublittoral area includes diverse marine communities.</p> <p>SSSI - Covers the same area as the SPA and Ramsar, and is of international biological interest. The intertidal mudflats and saltmarshes are crucial winter-feeding areas for waders and wildfowl, supporting large numbers of migrant birds. The saltmarsh and shingle communities are botanically significant, and the mature saltmarsh is a valuable bird breeding zone. The Wash is also an important breeding ground for common seals (<i>Phoca vitulina</i>).</p>
The Wash & North Norfolk Coast	SAC	<p>The Wash & North Norfolk Coast overlaps with the catchment for less than 1% of the protected areas total as the site is associated coastal subtidal sandbanks mudflats and shallow bays.</p> <p>SAC - The Wash & North Norfolk Coast Special Area of Conservation (SAC) is one of the UK's premier marine areas, featuring extensive subtidal sandbanks, diverse mudflats, and large shallow inlets and bays. It supports significant biogenic reefs formed by Ross worm (<i>Sabellaria spinulosa</i>) and is home to diverse benthic communities, including brittlestars and commercially important fish species. The site also includes the largest single area of glasswort (<i>Salicornia</i>) vegetation in the UK and extensive Atlantic salt meadows. Additionally, it is a crucial habitat for common seals (<i>Phoca vitulina</i>) and otters (<i>Lutra lutra</i>), contributing to its high ecological value. The unique Mediterranean and thermo-Atlantic halophilous scrubs further enhance the site's biodiversity.</p>
Havenside	LNR	<p>The Havenside completely overlaps with the catchment.</p> <p>LNR – Havenside Local Nature Reserve (LNR) comprises of 18.91ha of a superb mix of rough grassland with scrub and brambles, cattle grazed meadows, shallow seasonal ponds, estuary and mud flat. The reserve is linear, overlooking the salt stretch of the River Witham.</p>

4.5.2 Priority habitats and other habitats

A habitat map for the catchment was created using Arup's suite of earth observation tools. Initially, habitats within the catchment that are listed on the Priority Habitat Inventory (PHI) were mapped. The PHI describes the spatial extent of 25 priority habitats in England. They were extracted from the existing East and West Fens map tiles to highlight areas specifically designated by Natural England.

In cases, where a single area has multiple priority habitat designations (indicative of coexisting habitats in the PHI) both habitats were kept as a separate category. For example, "Coastal floodplain and grazing marsh" and "Coastal floodplain and grazing marsh; Coastal saltmarsh" were kept as two discrete classes in accordance with the PHI.

Following mapping of the PHI areas, OS open map data was used to identify features such as roads, buildings, trees and intertidal zones. Remaining habitats were then identified using a combination of earth observation imagery and publicly available datasets. The imagery was segmented into polygons and each polygon was assigned to a habitat type based on classification rules using Living England, Corine Land Cover, European Space Agency (ESA) World Cover datasets.

The habitats (including priority habitats) that have been identified within the boundary of the catchment are shown in **Figure 18** and presented in Table 20. Arable and horticultural is the most common habitat type throughout the catchment.

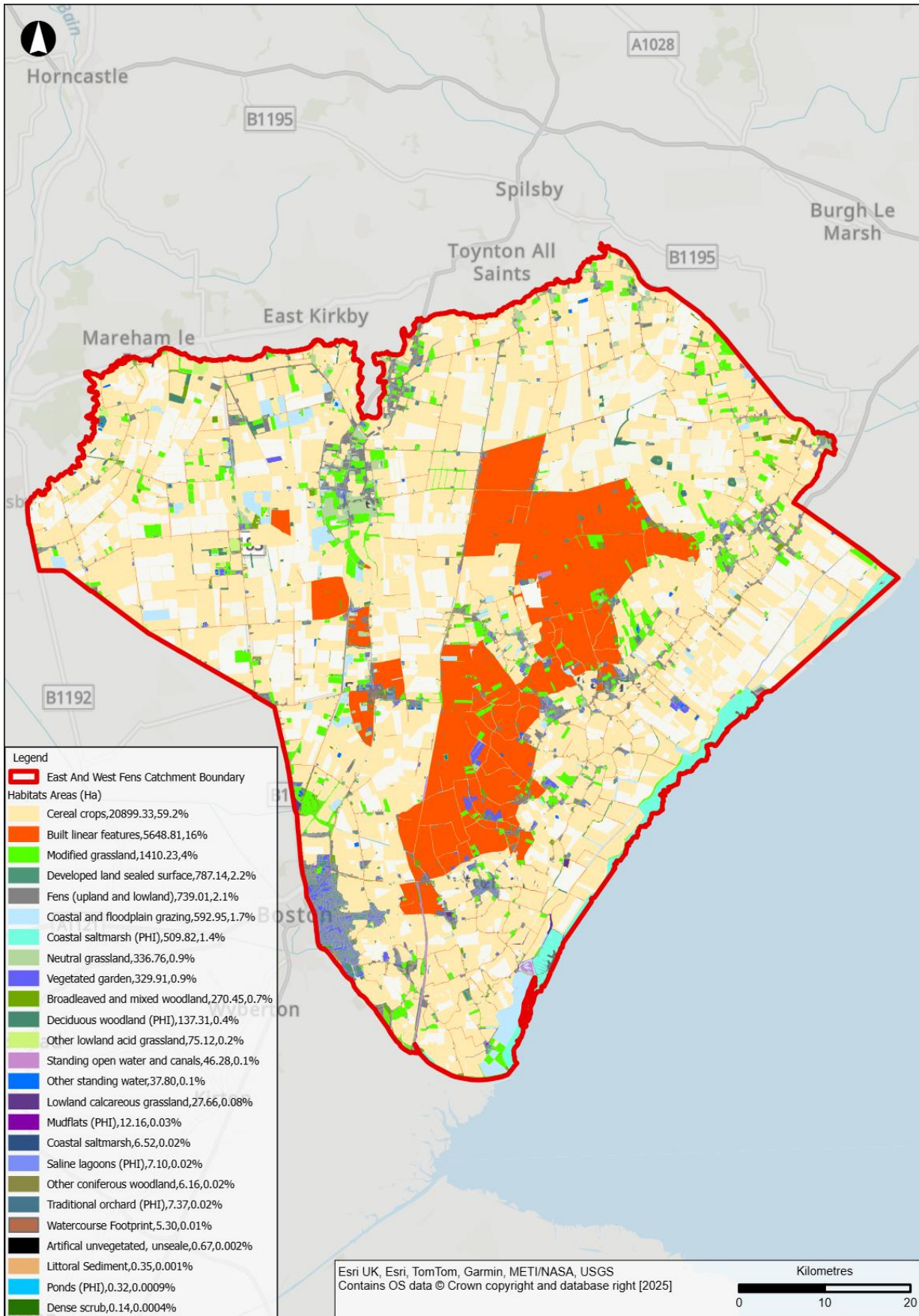


Figure 18: Habitat map for the catchment developed using earth observation

Table 20: Habitat types identified within the catchment

	Habitat Type	Area within the catchment (ha)	Habitat Description [76]	Context within the catchment study area
Coastal	Coastal saltmarsh (PHI)	711.33 ha	Coastal saltmarshes in the UK, are the vegetated upper portions of intertidal mudflats. They lie between mean high water neap tides and mean high water spring tides, with the lower limit defined by pioneer saltmarsh vegetation and the upper limit one metre above the highest astronomical tides. Saltmarshes are found in sheltered locations such as estuaries, saline lagoons, behind barrier islands, at sea loch heads, and on beach plains. Their vegetation consists of halophytic species adapted to regular tidal immersion, showing clear zonation based on inundation frequency. Pioneer species like glassworts can withstand up to 600 tides per year, while upper marsh species endure occasional inundation.	This habitat is limited to the southeastern boundary and is adjacent to a much larger extent of habitat immediately outside of the study area. Coastal saltmarsh habitats are key parts of the designated sites that overlap with the catchment.
	Coastal and floodplain grazing marsh (PHI)	592.99 ha	This habitat is a combination of coastal and floodplain grazing marsh and coastal saltmarsh (descriptions of these habitats is described in detail in the habitat descriptions for the individual habitats.	This habitat is limited to small isolated patches across the catchment.
	Mudflats (PHI)	12.18 ha	Mudflats are intertidal habitats formed by sediment deposition in low-energy coastal environments like estuaries. Their sediment is mainly silts and clays with high organic content, and sand content increases near estuary mouths. Mudflats are linked to other coastal habitats such as soft cliffs and saltmarshes, often appearing between subtidal channels and vegetated saltmarshes. They can be several kilometres wide in large estuaries but have been reduced by land reclamation. Mudflats dissipate wave energy, reducing erosion and flooding risks, and play a crucial role in nutrient chemistry and contaminant sequestration. They are highly productive but have low species diversity.	This habitat is limited to small, isolated patches across the catchment.
	Saline lagoons (PHI)	7.10 ha	Saline lagoons are partially separated from the sea, retaining seawater at low tide and varying in salinity from brackish to hyper-saline. They support diverse flora and fauna, including rare invertebrates and important bird habitats. These lagoons can be separated by natural barriers like sand or shingle, rocky sills, or artificial constructions, with water exchange influenced by channels, percolation, or overtopping.	This habitat is limited to small, isolated patches across the catchment.
	Coastal saltmarsh	6.56 ha	This is an area of coastal saltmarsh identified from publicly available sources but not identified on the PHI.	This habitat is limited to small, isolated patches within the catchment.

	Littoral Sediment	0.35 ha	This is an area of littoral sediment identified from publicly available sources.	This habitat is limited to small, isolated patches within the catchment.
Aquatic / semi-aquatic	Fens (upland and lowland)	755.44 ha	This is an area of lowland fens habitat identified from publicly available sources.	This habitat is limited to isolated patches across the catchment.
	Standing open water and canals	47.83 ha	This is an area of standing open water and canals identified from publicly available sources.	This habitat is limited to isolated patches across the catchment.
	Ponds	38.36 ha	This is an area of ponds identified from publicly available sources.	This habitat is limited to isolated patches across the catchment.
	Watercourse Footprint	5.30 ha	This is an area of watercourse identified from publicly available sources.	This habitat is limited to isolated patches across the catchment.
	Ponds (PHI)	0.32 ha	Ponds are permanent or seasonal standing water bodies up to 2 hectares in size, supporting species of high conservation importance and exceptional biotic assemblages. These ponds are crucial for biodiversity, hosting rare species and high ecological quality, and are identified using standard survey techniques. They play a significant role in the landscape, with around 20% of the UK's 400,000 ponds potentially meeting priority habitat criteria.	This habitat is limited to isolated patches within the catchment.
Grassland	Modified grassland	1452.90 ha	This is an area of modified grassland identified from publicly available sources.	This habitat is scattered throughout the entire catchment, with the highest concentration located in the northern western area.
	Neutral grassland	354.92 ha	This is an area of neutral grassland identified from publicly available sources.	This habitat is scattered throughout the entire catchment, with the highest concentration located in the northern central area.
	Other lowland acid grassland	75.13 ha	This is an area of other lowland acid grassland identified from publicly available sources.	This habitat is located primarily in the southern central area within the catchment.
	Lowland calcareous grassland	27.71 ha	This is an area of lowland calcareous grassland identified from publicly available sources.	This habitat is limited to isolated patches within the catchment.
Scrub and Heathland	Dense scrub	0.15 ha	This is an area of dense scrub identified from publicly available sources.	This habitat is limited to isolated patches within the catchment.

Woodland	Broadleaved and mixed woodland	275.42 ha	This is an area of broadleaved and mixed woodland identified from publicly available sources.	This habitat is scattered throughout the entire catchment.
	Deciduous woodland (PHI)	137.39 ha	Lowland mixed deciduous woodland grows on a range of soil conditions, from very acidic to base-rich, and includes most semi-natural woodland in southern and eastern England, and parts of lowland Wales and Scotland. These woodlands, often ancient and small (less than 20ha), complement upland oak and ash types. They show great variety in canopy and ground flora species, with <i>Quercus robur</i> being the common oak. The National Vegetation Classification places most of this type in W8 and W10, with lesser amounts in W16. Locally, they may form mosaics with other types, including beech woodland and wet areas. Canopy variations include field maple, lime, elm, hornbeam, wych elm, ash, and oak, with occasional birch and alder stands.	This habitat is limited to isolated patches, within in the central northern region of the catchment.
	Other coniferous woodland	6.17 ha	This is an area of other coniferous woodland identified from publicly available sources.	This habitat is limited to isolated patches within the catchment.
Agricultural	Arable and Horticultural	29289.37 ha	This is an area of arable land / horticultural land identified from publicly available sources. Further analysis of agricultural land use is available in the catchment Agricultural Baseline. It is noted that there are likely to be some variation between landcover datasets used. The agricultural baseline has identified that the agricultural landuse in the catchment is dominated by arable crops.	This habitat is dominant and widely dispersed across the entirety of the catchment.
	Vegetated garden	333.11 ha	This is an area of vegetated garden identified from publicly available sources.	This habitat is scattered throughout the entire catchment. Generally, the areas are adjacent to residential areas.
	Traditional orchard (PHI)	7.38 ha	Habitat structure, rather than vegetation type, topography, or soils, defines traditional orchards. These orchards are similar to wood-pasture and parkland but differ in tree species (mainly Rosaceae), denser tree arrangement, smaller habitat patches, and wider dispersion. They include nut plantings like hazel and walnuts. Management focuses on fruit and nut production through grafting and pruning, unlike wood-pastures where timber is the main product. Grazing or cutting herbaceous vegetation is integral, and scrub, often in hedgerows, plays a similar ecological role. Ponds and wetlands are common for livestock watering.	This habitat is extremely sparse and is limited to isolated patches. This habitat is not a key part of the designated sites that overlap with the Steeping catchment.

Developed Land	Built linear features	816.77 ha	This is an area of built linear features identified from publicly available sources.	This habitat is located across the catchment and is associated with agricultural areas adjacent to watercourses.
	Developed land sealed surface	787.98 ha	This is an area of developed land sealed surface identified from publicly available sources.	This habitat is located across the catchment and is associated residential communities such as West End.
	Artificial unvegetated, unsealed	0.68 ha	This is an area of artificial unvegetated unsealed surface identified from publicly available sources.	This habitat is limited to isolated patches within the catchment.

4.5.3 Key species

The key species identified as qualifying species for the protected areas and designated sites within the catchment are presented in Table 21. Only species that are relevant to protected areas are included in the following table (i.e. The Wash Ramsar site supports a nationally important population of common seal). Therefore, this table is intended to highlight some of the key species and not as an exhaustive list.

Table 21: Key species within the catchment

Species Common Name	Scientific Name	Relevant Protected Area or Key Habitats
Common seal	<i>Phoca vitulina</i>	The Wash & North Norfolk Coast SAC, The Wash Ramsar, The Wash SSSI
Eurasian oystercatcher	<i>Haematopus ostralegus</i>	Havenside LNR, The Wash Ramsar, The Wash SSSI, The Wash SPA
Common redshank	<i>Tringa totanus</i>	The Wash Ramsar, The Wash SSSI, The Wash SPA
Grey plover	<i>Pluvialis squatarola</i>	The Wash Ramsar, The Wash SSSI, The Wash SPA
Red knot	<i>Calidris canutus</i>	The Wash Ramsar, The Wash SSSI, The Wash SPA
Sanderling	<i>Calidris alba</i>	The Wash Ramsar, The Wash SSSI, The Wash SPA
Black-tailed godwit	<i>Limosa limosa islandica</i>	The Wash Ramsar, The Wash SSSI, The Wash SPA
Common tern	<i>Sterna hirundo</i>	The Wash Ramsar, The Wash SSSI, The Wash SPA
Little tern	<i>Sterna albifrons</i>	The Wash Ramsar, The Wash SSSI, The Wash SPA
Curlew	<i>Numenius arquata</i>	The Wash Ramsar, The Wash SSSI, The Wash SPA
Dunlin	<i>Calidris alpina alpina</i>	The Wash Ramsar, The Wash SSSI, The Wash SPA
Black-headed gull	<i>Larus ridibundus</i>	The Wash Ramsar, The Wash SSSI, The Wash SPA
Common scoter	<i>Melanitta nigra</i>	The Wash Ramsar, The Wash SSSI, The Wash SPA

4.5.4 Critical habitat screening

A critical habitat screening exercise has been conducted based on the criteria outlined in International Finance Corporation Performance Standard 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources (2012) [77].

Critical habitats are defined as areas with high biodiversity value based on criterion 1 to 5 as outlined in the IFC guidance note. This screening has specifically focused only on Criterion 1 in Performance Standard 6 as defined below (see Figure 19).

International Finance Corporation Performance Standard 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources.

Criterion 1: Critically Endangered and Endangered Species.

Species threatened with global extinction and listed as CR and EN on the IUCN Red List of Threatened Species shall be considered as part of Criterion 1. Critically Endangered species face an extremely high risk of extinction in the wild. Endangered species face a very high risk of extinction in the wild.

As described in footnote 11 of Performance Standard 6, the inclusion in Criterion 1 of species that are listed nationally/regionally as CR or EN in countries that adhere to IUCN guidance shall be determined on a project-by-project basis in consultation with competent professionals.

Thresholds for Criterion 1 are the following:

- a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species ($\geq 0.5\%$ of the global population AND ≥ 5 reproductive units GN16 of a CR or EN species).
- b) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in GN72(a).
- c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species.

Figure 19: Critical habitat Criterion 1

The results of the critical habitat screening are presented in Table 21.

Table 22: Overview of IUCN Global Red List species identified within the catchment

Common Name and Status (IUCN Global Red List)	Scientific Name	Habitat and ecology	Population Trend	Relevance to the East and West Fens catchment
Allis Shad (Critically Endangered)	<i>Alosa alosa</i>	Wetlands (inland), Marine Neritic, Marine Oceanic	Decreasing	The species is native to the northeastern Atlantic ocean and considered rare within most of its range. The species is considered possibly extinct with the East and West catchment (IUCN 2025).
European Eel (Critically Endangered)	<i>Anguilla anguilla</i>	Wetlands (inland), Marine Neritic, Marine Oceanic, Marine Intertidal, Artificial/Aquatic & Marine	Decreasing	European Eel has been recorded at multiple locations on the West Drain, Stone Bridge Drain, Cow Bridge Drain, Hobhole Bank, Newham Drain, Firth Bank Drain, Bell Water Drain, Fodder Dike Bank, and East Fen Catchwater Drain therefore assumed to be present in catchment (EA Ecology and Fish Data Explorer 2025). Barriers to migration may be present in catchment.
<u>Balearic Shearwater</u> (Critically Endangered)	<i>Puffinus mauretanicus</i>	Marine Neritic, Marine Oceanic, Marine Coastal/Supratidal	Decreasing	The fully migratory species congregates off the Atlantic coasts of southwest Europe during the summer and autumn, after breeding in the Mediterranean (IUCN 2024). Since the 1990s, an apparent increase in Balearic Shearwaters in north-west European waters, including north-west France and south-west Britain, was noted (BirdGuide 2021).
White-clawed Crayfish (Endangered)	<i>Austropotamobius pallipes</i>	Wetlands (inland), Artificial/Aquatic & Marine	Decreasing	Chalk streams have been identified as highly suitable habitats for white-clawed crayfish due to the high calcium levels (Lincolnshire Wolds, 2018). Native white-clawed crayfish have been in decline since the introduction of the non-native American signal crayfish (Lincolnshire Wolds, 2018).
Freshwater Pearl Mussel (Endangered)	<i>Margaritifera margaritifera</i>	Wetlands (inland)	Decreasing	It is possible that some scattered individuals are present within the catchment however the only viable populations are in Scotland.
Glistening waxcap (Endangered)	<i>Gloioxanthomyces vitellinus</i>	Grassland	Decreasing	The IUCN red list distribution indicates that this species range falls within the East and West Fens catchment however the presence of this species is unconfirmed at present.

4.6 Cultural heritage

This section outlines the cultural heritage baseline in the catchment. Table 23 outlines the key terminology used in this section.

Table 23: Glossary of cultural heritage terminology

Terminology	Summary Definition
Designated heritage asset	A World Heritage Site, Scheduled Monument, Listed Building, Protected Wreck Site, Registered Park and Garden, Registered Battlefield or Conservation Area designated under the relevant legislation.
Non-designated heritage asset	A building, monument, site, place, area or landscape identified as having a degree of significance meriting consideration in planning decisions, because of its heritage interest. It includes designated heritage assets and assets identified by the local planning authority (including local listing).
Historic environment	All aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged, and landscaped and planted or managed flora.
Historic Landscape Character	<p>The Historic Landscape Character of Lincolnshire is interpreted on two scales: Character Area and Character Zone. There are 10 Character Area's across the county. Character Areas are large, regional parts of the county's landscape and are known as, for example, 'The Fens', 'The Wash', and 'The Southern Cliff'. Each Character Area comprises between two and five Character Zones, for example, 'The East Fen' and 'The West Fen' are the two Character Zones of 'The Fen's' Character Area.</p> <p>Character Zones can still cover large parts of the landscape and are assessed in greater detail than Character Areas which communicate the broad trends of the component Character Zones. The major urban centres of exclude the major urban centres of Lincoln, Scunthorpe, and Grimsby are excluded and have their own urban assessments.</p>
Saltern	Salterns are associated with salt making. The process of extracting salt from seawater (or other naturally occurring brine) in the fens and marshlands of Britain during the Iron Age and Roman, Early Medieval, and Medieval periods was principally through evaporation. The excavation of pools in which to hold water for evaporation resulted in the production of large amounts of waste material (e.g. clay or sand) which was deposited in large mounds near the pools. These mounds are the 'salterns'. In Lincolnshire salterns are known to have been sufficiently large and numerous to create areas of elevated and dry ground, effectively pushing the coastline away from nearby settlements. Some surviving salterns (and their associated settlements) are designated scheduled monuments, although most are not. They are, however, an important archaeological and heritage resource. Lincolnshire's salterns contribute to Historic England's Farmstead and Landscape Statement for the Lincolnshire Coast and Marshes (National Character Area 42).
Setting of a heritage asset	The surroundings in which a heritage asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve. Elements of a setting may make a positive or negative contribution to the significance of an asset, may affect the ability to appreciate that significance or may be neutral.
Significance (for heritage policy)	The value of a heritage asset to this and future generations because of its heritage interest. The interest may be archaeological, architectural, artistic or historic. Significance derives not only from a heritage asset's physical presence, but also from its setting. For World Heritage Sites, the cultural value described within each site's Statement of Outstanding Universal Value forms part of its significance.

4.6.1 Archaeological and historical background

The catchment historic environment is best understood through the evidence of the long interaction of people, the land and the sea which can be read in the settlements, fields, place names and the layers of soil in this area.

The coastal zone of Lincolnshire changed dramatically throughout the Prehistoric period. During the Palaeolithic (1,000,000BCE-10,000BCE), the fenlands and intertidal zones of the catchment had not yet formed [78] and did not emerge until after the last Ice Age approximately 10,000 years ago at the start of the Mesolithic (10,000BCE-4,000BCE) period. As the ice sheets retreated and sea levels rose, the vast plains of Doggerland (which once linked Britain with north-western Europe) were submerged and a coastline more akin to that of Lincolnshire and The Wash today emerged [79].

For most of the Later Prehistoric (4,000BCE-43CE) period the catchment would have been an expanse of marshes and creeks, influenced by seasonal inundation by the sea, rivers such as the River Witham, and the run-off of surface water. These characteristics are reflected in areas of Peat deposit, which formed when sea levels were lower, and the large expanses of Tidal Flat (Clays and Silts) Deposits [80] which comprise most of the superficial geology of the catchment. The fenland and coastal landscape of the catchment would have been an excellent resource for Prehistoric people for fishing, fowling, and foraging, and for the provision of materials such as rushes and reeds. Although not yet identified within the catchment to date, in other parts of the fens ritual deposits and raised walkways and trackways of Bronze Age and Iron Age (800BCE-43CE) date have been recorded.

There is an absence of evidence for occupation and settlement activity throughout much of the catchment during the Iron Age and Roman (43CE-410CE) periods, however, it is possible that the origins of Medieval salt production within the catchment date to these periods. This absence of evidence is likely associated with climatic changes at the end of the Late Prehistoric which saw the lowering of water levels within the catchment and the contraction and drying of surfaces. These surfaces would likely have been more suitable for settlement and other occupational activities during the Iron Age and Roman periods but were latterly submerged as levels rose again, enclosing any remains beneath more recent deposits.

The Domesday survey suggests that, by the end of the Early Medieval (410CE-1066CE) period, settlement and population density was reasonably high within the catchment. This observation is further supported by the presence of several Early Medieval and Medieval manor houses and religious houses. Many of the settlements in the catchment are recorded in Domesday, mostly with 25 households or more in c.1086 [81].

There is a string of settlements in the south-east of the catchment, located along the route of the possible Medieval road from Boston to Wainfleet – the approximate route of which is traced by the A52 and has potentially even earlier origins as a coastal routeway through the fen edge and intertidal zone. The marshland of the catchment would have provided excellent seasonal grazing for Early Medieval and Medieval communities and remains of field systems are recorded close to several of the settlements suggesting that the available areas of high, drier land were utilised for small-scale arable and subsistence farming.

It is likely that the wealth of the catchment during the Medieval period was drawn at least in part from salt production. Part of The Tofts, a distinctive character zone of salterns and one of the largest human-made Medieval features in Britain [78], extends into the catchment from the neighbouring Steeping catchment. There is further isolated evidence of salterns in the south-west of the catchment, where the River Witham (known as The Haven after it passes through Boston) empties into The Wash. The remains of several shrunken and deserted Medieval village sites, and potentially 'lost' hamlets are recorded throughout the catchment. These are typically in proximity to the principal settlements and manors of the Townlands character zone, which is a band of settlements strung along the higher ground traced by the A52.

Starting in the 15th Century and increasing throughout the Post Medieval (1540CE-1901CE) period, human intervention began to substantially re-shape and re-purpose the landscape of the catchment. The first coordinated schemes for coastal land reclamation and fenland drainage began in the 17th Century [82]. The purpose of these schemes was to allow the rich and fertile soils of the catchment to be used year-round for intensive agriculture.

Increasingly extensive and complex systems of dykes, banks, canals, drains, and water control structures were built throughout the catchment and the wider fenlands of Lincolnshire during the later Post Medieval period. In creating the drier agricultural lands, the large areas of peat dried, shrank, and desiccated over time, reducing the effectiveness of the drainage systems.

Technological advances in water control and engineering of the 19th Century only made the problem more acute [82] as its increased effectiveness at draining water from these areas led to further drying and shrinkage. This now means that the form and extent of the Prehistoric creeks are now visible using LiDAR and aerial imagery as what was an infilling of silt is now raised above the contracted superficial geology (these features are known as 'roddons', see Section 4.2.9 for further information).

During the Second World War a large number of concrete pillboxes, gun emplacements and other defences were constructed across the southern part of the catchment.

4.6.2 Historic Landscape Character

As discussed in the Landscape baseline, the catchment is situated within The Fens NCA. Four of Lincolnshire's Historic Landscape Character (HLC) areas are present in catchment including: The Fens, The Wash, The Wolds, and The Clay Vale. Figure 20 shows the HLC areas within the catchment.

- **The Fens HLC**

The centre of the catchment is part of the The Fens HLC area, with a number of nucleated settlements, including Stickney and Sibsey. These settlements are found on ridges of slightly higher, drier ground. Linear and ragged linear settlements are also a characteristic settlement of this part of the catchment, either formed by the infilling of previously dispersed settlement areas with built development, or because of their proximity to main roads. Other small settlements in this central part of the catchment typically comprise isolated farmsteads associated with the reclamation of the fens and planned enclosure of the 18th and 19th Century. Areas of reclaimed land are divided into a pattern of rectilinear fields separated by drains rather than hedges and used for intensive farming.

- **The Wash HLC**

The southern edges of the catchment are part of The Wash HLC area, specifically the Townlands which is a string of settlements along the A52, and the Reclaimed Coastal Fringe character zones. The settlements are surrounded by intensively farmed arable fields with some smaller areas of pasture surviving close to historic settlements. Settlement density in the Reclaimed Coastal Fringe is very low and typically comprises individual 19th and 20th Century farmsteads and isolated barns and other agricultural buildings. Although predominantly agricultural in land use, which includes the grazing of outlying saltmarsh areas, it is most keenly characterised by the network of active and relict earth sea-banks and its confined and small straight minor roads and trackways which follow the field and drainage morphology of the area, a product of the organised and recent pattern of land division within the zone.

- **The Clay Vale HLC**

Only a small part of the catchment, in its northern reaches, are located in The Clay Vale HLC area, specifically The Limewoods character zone; this is characterised by a gentle rolling topography and the presence of woodland islands within a rural landscape of fields

and villages. The Witham Abbeys character zone, which is characterised by planned enclosures and nucleated settlements.

- **The Wolds HLC**

Only a small part of the catchment, in its northern reaches are located within the Wolds HLC area, specifically the Splisby Crescent character zone which is characterised by arable cultivation. Grazing land is limited to small fields in close proximity to settlements and to areas within the boundaries of the surviving landscape parks of historic estates. The settlement pattern in the zone is strongly nucleated in the west and the north, with few isolated farm complexes, but is more dispersed in the east as the land drops towards the coastal marshes. Historic cores are generally aligned along roadways, many of which link the high Wold settlements with the coastal grazing marshes and fens.

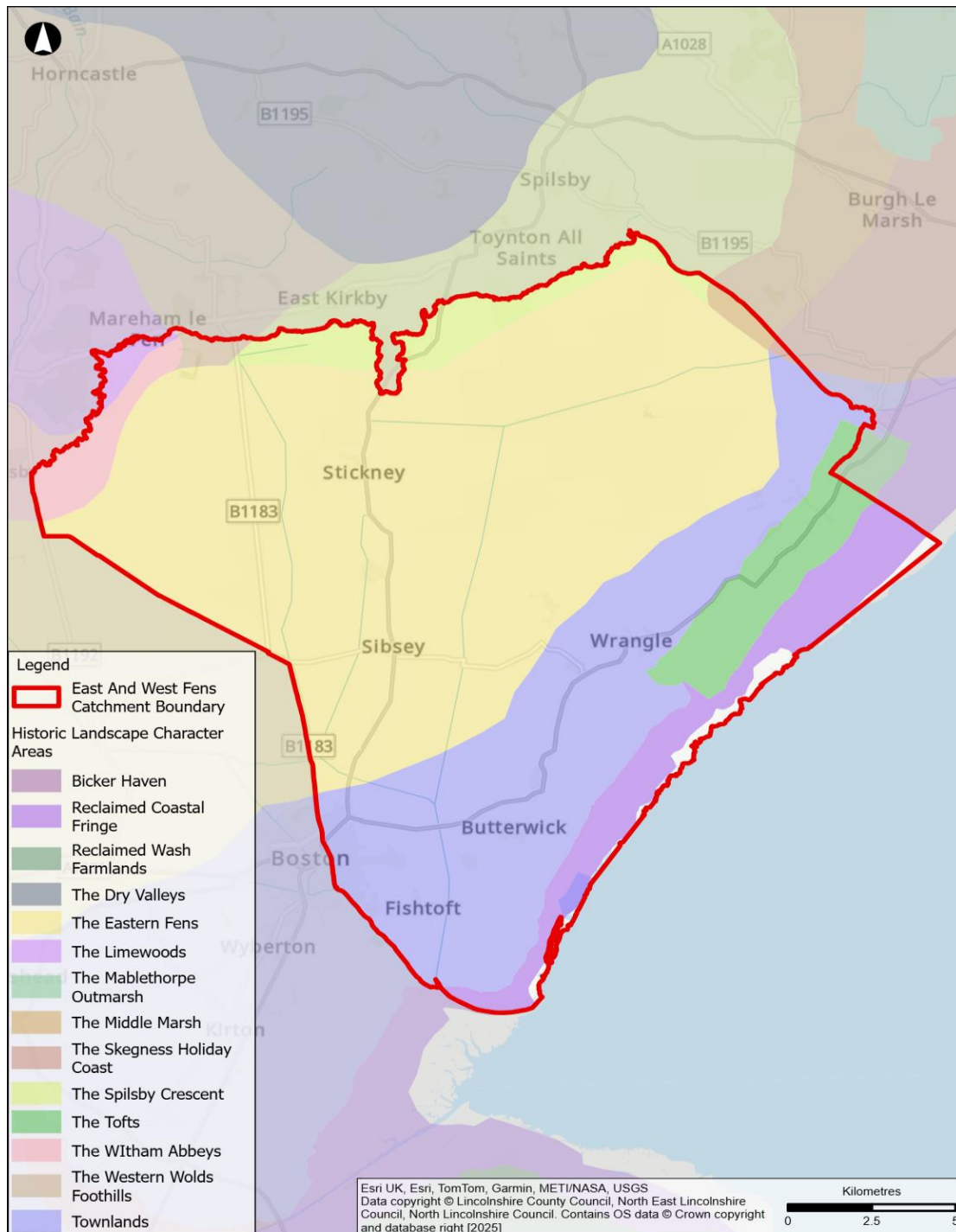


Figure 20: Historic Landscape Character areas within the catchment

4.6.3 Designated heritage assets

In total, 199 designated heritage assets are located in the catchment including:

- 11 scheduled monuments - The majority of the scheduled monuments are a mixture of ecclesiastical and high-status medieval sites, including Revesby Abbey, Kings Hill Motte and Bailey castle, Rochford Tower – a medieval fortified house, moated manorial sites and churchyard crosses. There are also several scheduled monuments reflecting agricultural and building practices specific to the fens, including the dylings and Sibsey Trader Mill, as well as a post-medieval duck decoy pond.
- 13 Grade I listed buildings - The majority of these listings include churches and crosses,

high status houses and windmills; and

- 10 Grade II* listed buildings.

There are 161 Grade II listed buildings and the following four conservation areas are also present, three of which are located in the town of Boston:

- Wrangle Conservation Area
- Boston Conservation Area (part of)
- Skirbeck Conservation Area, Boston.
- Spilsby Road Conservation Area, Boston.

There are no World Heritage Sites, registered park and gardens, registered battlefields, or protected wreck sites within the catchment. Figure 21 sets out the designated heritage assets within the catchment.

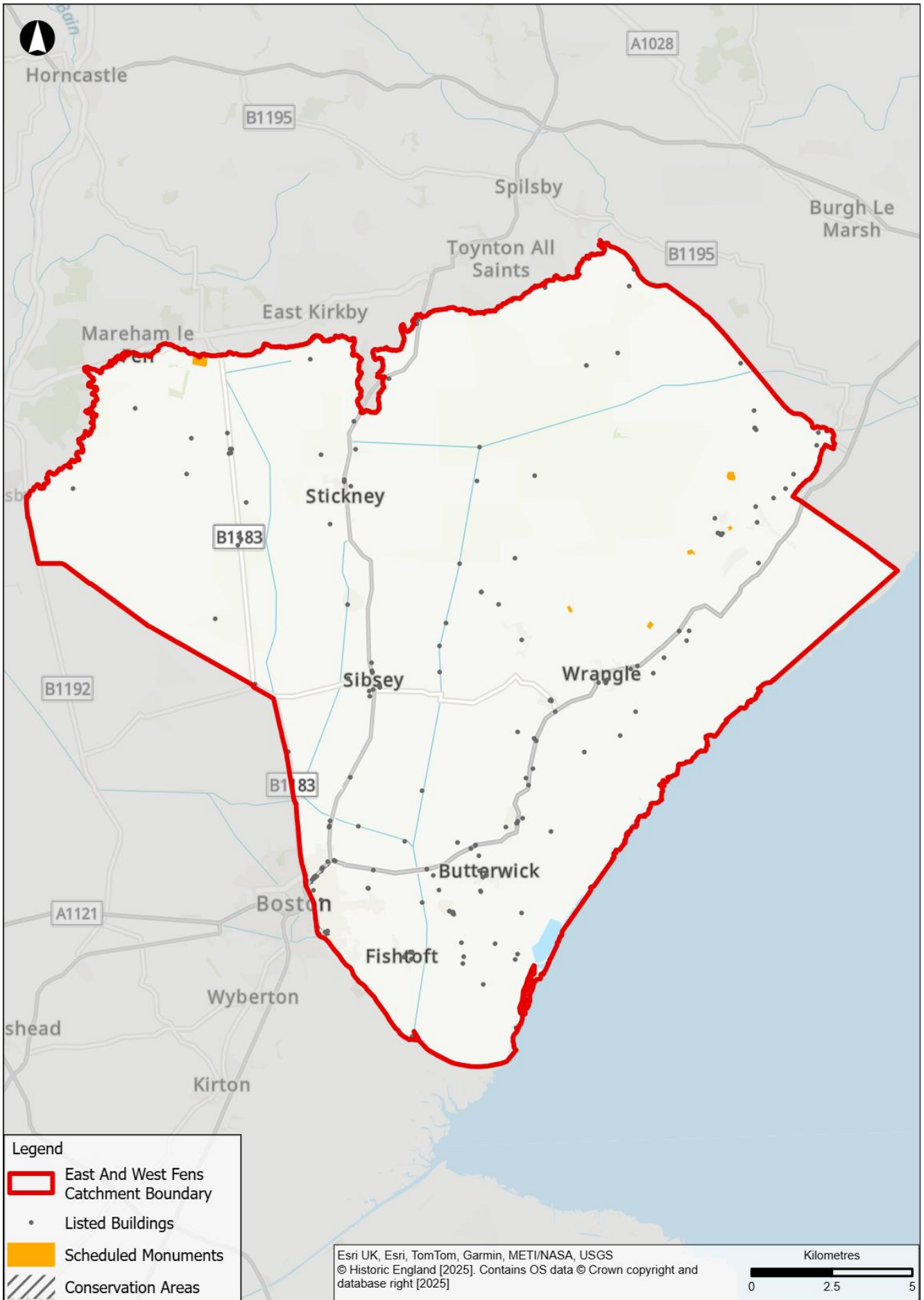


Figure 21: Designated sites for heritage within the catchment

4.6.4 Non-designated heritage assets

While specific non-designated heritage assets have not been identified as part of this study, the following are known or likely to be present:

- Unrecorded archaeological features and remains and palaeoenvironmental deposits are likely to be present throughout the catchment. Because of the waterlogged and anaerobic environments of the catchment, it is likely that ecofacts and composite, organic, and inorganic artefacts will survive;
- Unrecorded archaeological remains of Prehistoric and Roman date are buried deep beneath the fertile and rich topsoil of the catchment within the Peat and Tidal Flat Deposits which comprise its superficial geology;
- Many of the settlements of the catchment have Medieval and potentially Early Medieval origin. Recorded and unrecorded archaeology associated with these periods of occupation are likely to survive within and in proximity to the towns and villages of the catchment, particularly within the Townlands character zone;
- The remains of Medieval salterns are present throughout in the southern part of the catchment, which are both a landscape feature of interest and have archaeological importance;
- Many of the isolated farms, farmsteads, and farm buildings of the catchment, if not listed buildings, are likely to be non-designated built heritage assets and are typically late Post Medieval in date; and
- Second World War defences along the Wash.

Prehistoric remains are likely to date from the Mesolithic period onward. These are likely to comprise scatters of stone tools or the detritus from tool manufacture and are most commonly recovered from higher drier parts of the landscape, beyond the fen-edge. Overall, Mesolithic remains are rare across the county and there is little known evidence of seasonal occupation sites; although these would have existed.

It is possible that the known Neolithic settlement sites of the county have Mesolithic origin or connections. Remains likely to be encountered from the Neolithic period include examples of tools (including weapons), and pottery - although fewer examples of this have been recovered north of the River Welland. Burial monuments for inhumed remains are also built during this period. Often, evidence for the Bronze Age transition is found near these monuments and at the same settlement sites.

The Bronze Age is notable not only the wider adoption of metal (resulting in the presence of metalworking sites and metal artefacts) but also changes in burial practice with community burial monuments falling out of use in favour of individual burial mounds. There are also observable changes in pottery typologies. These trends continue into and throughout the Iron Age, although burial in monuments disappears from practice.

The Iron Age also brings with it evidence for possible landscape division through the marking of territorial boundaries and salt production. Important archaeological remains, such as trackways or walkways, boats, and metal and wooden objects such as swords and shields and jewellery, survive well in waterlogged environments and, when founds, are often of national importance.

Roman influence in rural Lincolnshire is most observable through the presence of large-scale engineering works such as Carr Dyke, and other navigable canals and waterways, and the roads network. There are shifts in religious and burial practice during the Roman period with inhumation and cremation cemeteries replacing the Iron Age preference for excarnation. It is likely that the 'Romanisation' of the Iron Age settlements occurred steadily during the period with existing settlements and societal structures being absorbed into the more structured rural Roman economy and practices of land and people management. Industry expands during this period with remains of metal working sites, evidence of large-scale quarrying, and the production of pottery and presence of kilns becoming common. Salt production also continues.

4.7 Population and health

This section outlines the population and health baseline for the catchment. Table 24 outlines the key terminology used in this section.

Table 24: Glossary of population and health terminology

Terminology	Summary Definition
Indices of Multiple Deprivation (IMD) [83]	These datasets are small area measures of relative deprivation across each of the constituent nations of the United Kingdom and is part of a suite of outputs that form the Indices of Deprivation (IoD). The IoD2019 is based on 39 separate indicators, organised across seven distinct domains of deprivation which are combined and weighted to calculate the Index of Multiple Deprivation 2019. Areas are ranked from the most deprived area (rank 1) to the least deprived area. Some of these separate indicators include Employment Deprivation, Income Deprivation, Health Deprivation and Disability, Education Skills and Training Deprivation, Crime, Living Environment Deprivation and Barriers to Housing and Services.
Lower Layer Super Output Area (LSOAs) [84]	These are defined geographical areas which comprise between 400 and 1,200 households and have a usually resident population of between 1,000 and 3,000 persons. These LSOAs are a neat aggregation or split of wards, or may be exactly the same as wards in some areas. Unlike wards whose population sizes vary widely, the LSOAs provide a consistently sized statistical unit. There are 32,844 LSOAs in England.
Middle Layer Super Output Areas (MSOAs)	Middle layer Super Output Areas (MSOAs) are made up of groups of LSOAs, usually four or five. They comprise between 2,000 and 6,000 households and have a usually resident population between 5,000 and 15,000 persons. MSOAs fit within local authorities. There are 6,856 MSOAs in England.

Different classes of administrative unit each have their own datasets and are ordered from smallest to largest in terms of the geographical scale at which they operate. Data for the population and health baseline is collected at the level of Lower Layer Super Output Areas (LSOAs), and Middle Layer Super Output Areas (MSOAs). All of these administrative areas which intersect with the catchment have been included in the analysis and are listed in Table 25.

In most of England, including the Fens, there is a two-tier system of local government sitting at larger scales than the MSOAs: county and district. In two-tier areas, each county council area is subdivided into districts, for which there is an independent district council.

The catchment is entirely contained within the county of Lincolnshire (governed by the Lincolnshire County Council). Below this level, the catchment is sub-divided into two district areas: the northern part is within the East Lindsey District Council area, and the southern portion is within that of Boston Borough Council.

4.7.1 Overview

The catchment is located in the county of Lincolnshire. Figure 22 and Figure 23 show a map of the MSOA and LSOA areas within the catchment. Table 25 shows the overlap between the MSOA and LSOA areas that intersect the catchment, and have been used to analyse the demographic and health profile. Where summary values were not available for the catchment, data for East Lindsey District Council, Boston Borough Council and Lincolnshire have also been provided.

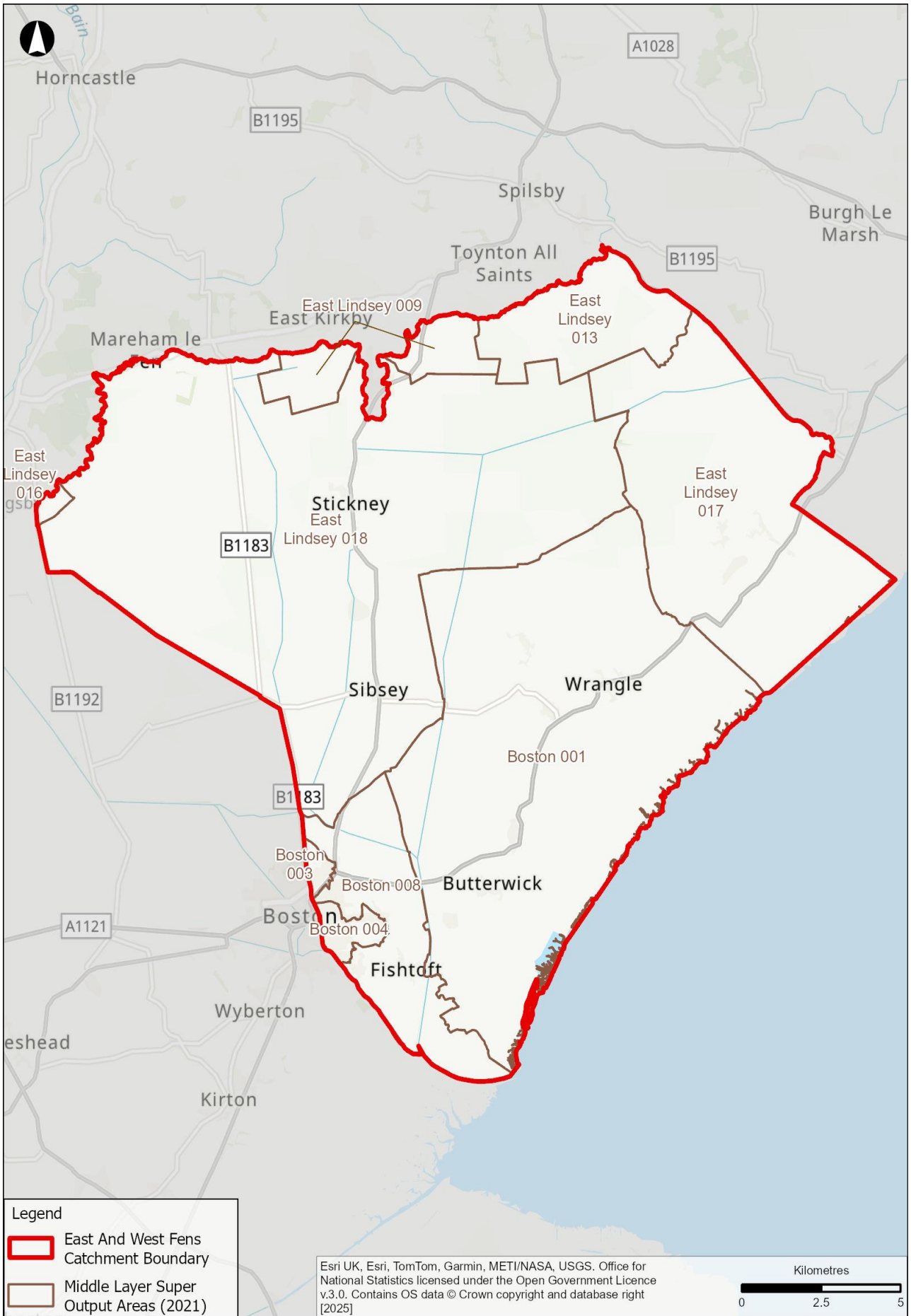


Figure 22: MSOAs which intersect with the catchment boundary

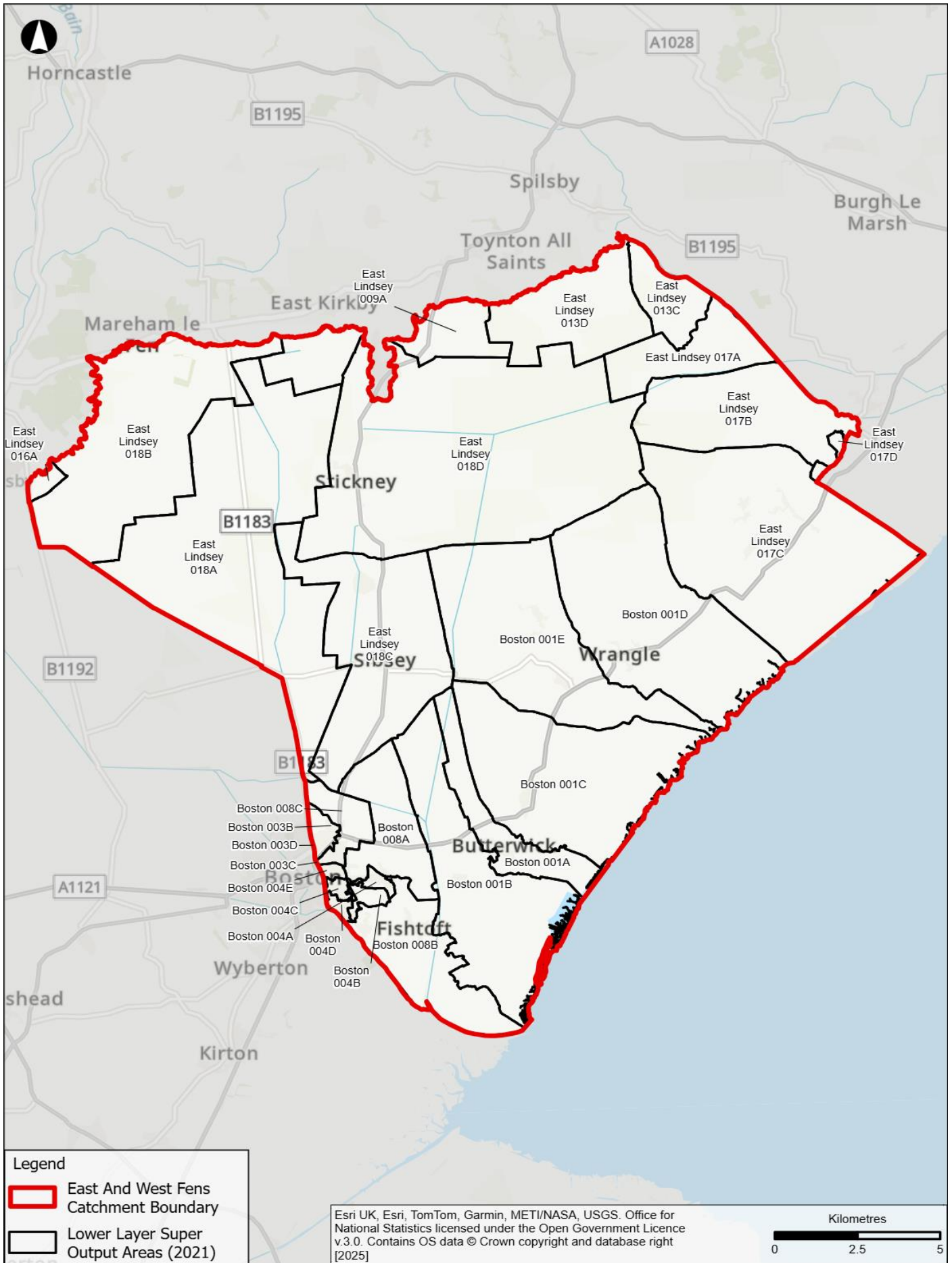


Figure 23: LSOAs which intersect with the catchment boundary

Table 25: LSOAs and MSOAs which intersect with the catchment boundary. In total there are 28 LSOAs and 9 MSOAs that intersect with the catchment.

LSOAs		MSOAs	
Boston 001A	E01026007	Boston 001	E02005417
Boston 001B	E01026008	Boston 003	E02005419
Boston 001C	E01026009	Boston 004	E02005420
Boston 004A	E01026012	East Lindsey 009	E02005432
Boston 008A	E01026013	East Lindsey 013	E02005436
Boston 008B	E01026014	East Lindsey 016	E02005439
Boston 004B	E01026015	East Lindsey 017	E02005440
Boston 003B	E01026021	East Lindsey 018	E02005441
Boston 008C	E01026022	Boston 008	E02006864
Boston 001D	E01026023		
Boston 001E	E01026024		
Boston 003C	E01026025		
Boston 004C	E01026026		
Boston 004D	E01026027		
Boston 004E	E01026028		
Boston 003D	E01026036		
East Lindsey 016A	E01026051		
East Lindsey 013C	E01026055		
East Lindsey 017A	E01026056		
East Lindsey 018A	E01026057		
East Lindsey 013D	E01026059		
East Lindsey 009A	E01026060		
East Lindsey 018B	E01026075		
East Lindsey 018C	E01026098		
East Lindsey 018D	E01026102		
East Lindsey 017B	E01026110		
East Lindsey 017C	E01026111		
East Lindsey 017D	E01026112		

4.7.2 Demographic Profile

Population

In 2022, the total population of the catchment was approximately 33,000⁷ compared to the population of Lincolnshire which totals 766,333 [85].

In the East Lindsey District Council area as a whole, the population size increased by 4.3% between 2011 and 2021, from around 136,400 to 142,300. Across the five MSOAs within East Lindsey which intersect with the catchment, the increase in population was similar, at 4.4%. This was lower than the overall increase for England (6.6%) in the same period.

In the Boston Borough Council area, the population increased by 9.1% over the same period, from

⁷ This population figure has been calculated using the total population of every LSOA that fully or partially overlaps with the East and West Fens catchment area. It considers the proportion of the LSOA which intersects with the catchment, such that the same

64,600 in 2011, to 70,500 in 2021. Of the four MSOAs in this district which intersect with the catchment, the average rate of growth was lower, at 7.0%. However, the rate in Boston 008 MSOA (covering the northern and eastern fringes of the city, down to the mouth of the Haven) was exceptionally high, increasing 11.3% in the decade. Across all MSOAs intersecting with the catchment, the average growth over the decade was 5.9%.

Future population growth is only projected for local authority areas or larger national units. The population within both the East Lindsey District Council area and the Boston Borough Council area are anticipated to continue to grow between 2025 and 2041, at 8% and 9.5% respectively. This is higher than the rate of 6% predicted for England as a whole.

Population density

The population density within LSOAs intersecting with the catchment are displayed in Table 26. The highest density area is the Boston 004C LSOA, and the LSOAs located around the outskirts of Boston, which contrast sharply with the more rural areas of the northern and eastern catchment.

Table 26: Population Density by LSOA Area (2021)

LSOA	Area (km ²)	Mid-2022 population	Population Density (residents per km ²)
Boston 001A	7.14	1,135	159
Boston 001B	21.47	1,483	69
Boston 001C	25.59	1,265	49
Boston 004A	0.52	1,159	2,248
Boston 008A	7.74	1,509	195
Boston 008B	11.89	1,951	164
Boston 004B	0.72	1,661	2,298
Boston 003B	1.02	1,778	1,748
Boston 008C	5.21	2,338	449
Boston 001D	27.97	1,525	55
Boston 001E	24.08	2,265	94
Boston 003C	0.92	2,395	2,590
Boston 004C	0.41	2,293	5,547
Boston 004D	0.44	1,856	4,225

percentage of the population of an LSOA will be counted as the percentage area which overlaps with the catchment. It is assumed that the population density across each LSOA is uniform.

Boston 004E	0.36	1,829	5,118
Boston 003D	0.55	1,604	2,902
East Lindsey 016A	5.76	1,415	246
East Lindsey 013C	26.45	1,147	43
East Lindsey 017A	37.35	1,309	35
East Lindsey 018A	73.93	1,976	27
East Lindsey 013D	20.65	1,212	59
East Lindsey 009A	34.85	1,338	38
East Lindsey 018B	79.47	2,225	28
East Lindsey 018C	22.16	2,064	93
East Lindsey 018D	53.94	2,341	43
East Lindsey 017B	17.57	1,498	85
East Lindsey 017C	36.94	1,571	43
East Lindsey 017D	24.57	1,245	51

Age distribution

The catchment has a distinctively elderly population relative to Lincolnshire as a whole, which itself has 5.3% more residents aged 65 or older than the rest of England.

Generally, MSOAs in the north of the catchment have a much higher proportions of elderly residents than the more urbanised areas around Boston in the south-west of the catchment. For example, in East Lindsey 009 (north of Stickney), 32.2% of residents are aged 65 or over, compared to an equivalent figure of 11.8% in Boston 003 MSOA which covers the central and northern parts of the town.

The proportion of elderly residents in the catchment is set to increase further in the future. In East Lindsey as a whole, the percentage of the population aged 65 or over was 29.8% in 2018 and this is projected to increase to 37.8% in 2043 [86]. In the Boston Borough Council area, the percentage of residents aged 65 or over is also set to increase from 20.8% to 24.7%.

All MSOAs intersecting with the catchment, except Boston 004 and Boston 008, have a lower proportion of children than the average for England. Only 12.8% of residents in East Lindsey 009 to the north of the catchment are aged 15 or younger, lower than the national average of 19.2%.

Table 27: Age structure by MSOA area

Age Band	East Lindsey 013	East Lindsey 017	East Lindsey 008	Lincolnshire	England
0-15	17.0%	16.0%	14.7%	17.2%	19.2%
16-64	52.2%	54.5%	53.1%	59.0%	62.3%
65+	30.8%	29.5%	32.2%	23.8%	18.5%

Ethnicity

The catchment has a slightly higher proportion of ethnically white residents than England as a whole. Across the 28 LSOA areas which wholly or partially overlap with the catchment, an average of 95.1% of the residents are white, compared to a national average of approximately 82% [87]. Of those white residents, the vast majority (88.2%) identified as English, Welsh, Scottish, Northern Irish or British, with 11.2% identified as ‘other white’ and 0.3% as Gypsy, Irish Traveller or Roma.

The second largest ethnic group in the catchment is Asian (including Bangladeshi, Chinese, Indian, Pakistani, or other) making up 2.2% of the population.

4.7.3 Employment Status

Employment

An average of 54.4% of the adults in the MSOA areas which intersect with the catchment are economically active (above 16 years old and not in full time education). This is lower than the figure for England of 58.6% but is largely accounted for by the relatively high proportion of population aged 65 and older in these MSOA areas [88].

Across the catchment, an average of 6.8% of economically active residents work in the agricultural, forestry and fishing sector [88]. In the more rural areas of the catchment, including East Lindsey 009 and East Lindsey 018 MSOAs, this figure is 11.6% and 9.7% respectively, which is significantly higher than the figure for England at 0.8%. The largest employment sector in both areas is ‘wholesale and retail trade; repair of motor vehicles and motor cycles’, which constitutes an average of 17.5% across the nine MSOAs. Another large sector is ‘human health and social work activities’, employing 15.6% of working adults in the catchment.

Travel

Across the catchment, there is a high reliance on private vehicles for getting to and from places of work. The most common commute mode is in a car or van (either as a driver or passenger) with an average of approximately 68.9% travelling to work in this way across the nine MSOAs. This is higher than the East Lindsey Local Authority figure of 59.5%, and significantly higher than the England figure of 44.5%, although it is lower than the Boston local authority average of 73.3%.

In terms of active travel modes, an average of 2.9% of commuters in the catchment travel to work by bicycle, but in Boston 004 (south-east Boston) cycling is much more popular at 6.3% (which is much higher than the England average of 2.1%). Across the catchment, 8.3% of workers commute on foot, but again there are pockets where walking is a much more popular mode. For example, 16.6% of workers walk to work in Boston 003 MSOA.

Unemployment

There is significant variation in unemployment across the catchment. In much of the catchment, unemployment rates are lower than the averages for England, but in Boston and the north-eastern portion of the catchment near Wainfleet All Saints, levels of unemployment are higher. Within the catchment, unemployment rates for 2021-2022, measured as a percentage of the working age population claiming out of work benefit, are highest in Boston 003 MSOA, which correspond to the town centre and inner suburbs. Here, 9.6% of working age adults claim unemployment benefit, almost twice the England average of 5.0%.

In the East Lindsey 017 MSOA, 6.3% of residents are unemployed, as measured by the percentage of the working age population claiming out of work benefits, and 2.3 out of every 1,000 people are long term un-employed. These levels are lower in the East Lindsey 013 MSOA, at 4.8% and 1.7% respectively [89].

4.7.4 Health profiles

Life expectancy

Average life expectancy at birth for both males and females within Boston and East Lindsey is slightly below the England average. For females in the catchment, life expectancy ranges from 80.0 years in central and north Boston to 84.4 years in East Lindsey 016 (which intersects with the far north of the catchment near Coningsby). For males, life expectancy is also lowest in central Boston, where life expectancy is 74.7.

Mortality and cause of death

Health indicators relating to mortality are assessed using the Standardised Mortality Ratio (SMR) which is calculated by dividing the number of observed deaths by the number of expected deaths. This ratio illustrates whether a study population is more or less likely to die than a reference population (in this case the reference population is England, which has a SMR of 100). Wherever the SMR is greater than 100, there are a higher number of deaths than expected.

Deaths from all causes are particularly pronounced in central and northern Boston (Boston 003 MSOA), and the SMR for stroke in this area is the highest of any measured across the catchment, at 174.3. Of any of these measured causes of death, coronary heart disease has the highest mean SMR across the nine MSOAs intersecting with the catchment. For all MSOAs except East Lindsey 009 and Boston 008, mortality from coronary heart disease is greater than expected.

Long-term illness or disability

In the wider Boston Borough District, 5.8% of the population are classed as being in either bad or very bad health, and in the East Lindsey District this figure is even higher, at a combined 8.2% [90]. Of all MSOAs intersecting with the catchment, every one except Boston 003 had a higher percentage of residents with a limiting long-term illness or disability than the England average. The East Lindsey 013 MSOA in the far north of the catchment has the highest proportion of residents who reported having a limiting long-term illness or disability, at 26.8% [91].

Obesity

East Lindsey 017 MSOA in the far north-east of the catchment has the second highest prevalence of obesity (including severe obesity) amongst reception age children of all MSOA areas in Lincolnshire [92]. 17.4% of reception age children in this area are obese, placing the MSOA in the top 5% across England for this indicator. In the neighbouring East Lindsey 013 MSOA, this figure is lower at 11.1%, but this is still within the top 20% of areas in England. By year 6, prevalence of obesity (including severe obesity) is 27.6% and 23.1% in MSOA areas East Lindsey 017 and 013 respectively. In central and northern Boston, 32.3% of children in year six are obese or severely obese (compared to an average of 21.6% in England as a whole).

Mental wellbeing

The estimated prevalence of common mental disorders (aged 16 and over) is 15.8% for Lincolnshire, which is marginally lower than the prevalence of 16.9% reported for England [93].

Self-reported wellbeing

Self-reported wellbeing status of people within the UK is now measured by the Office for National Statistics. This data was not available at ward level, and as such Lincolnshire has been used as a comparator to England. Reports for Lincolnshire reflected fewer people with a low satisfaction score than the England average, at 4.5% compared to 6.1%. Comparatively, the proportion of people with a low happiness score was significantly lower in Lincolnshire than the England average. The percentage of people with a high anxiety score was only marginally higher than the England average of 24.2%, with the Lincolnshire score being 25.5% [94].

4.7.5 Deprivation

Overall deprivation

Generally, the more deprived areas within the catchment are to the north-east, with East Lindsey 17A, 017B and 17C all within the top 20% of most deprived neighbourhoods in England, based on 2019 data (see Figure 24) [83].

East Lindsey 017D which overlaps with the edge of the catchment is categorised as being in the top 10% most deprived neighbourhoods nationally. Apart from the Boston 004C, which is also in the top 20% of deprivation, generally the level of deprivation is lower towards the south of the catchment.

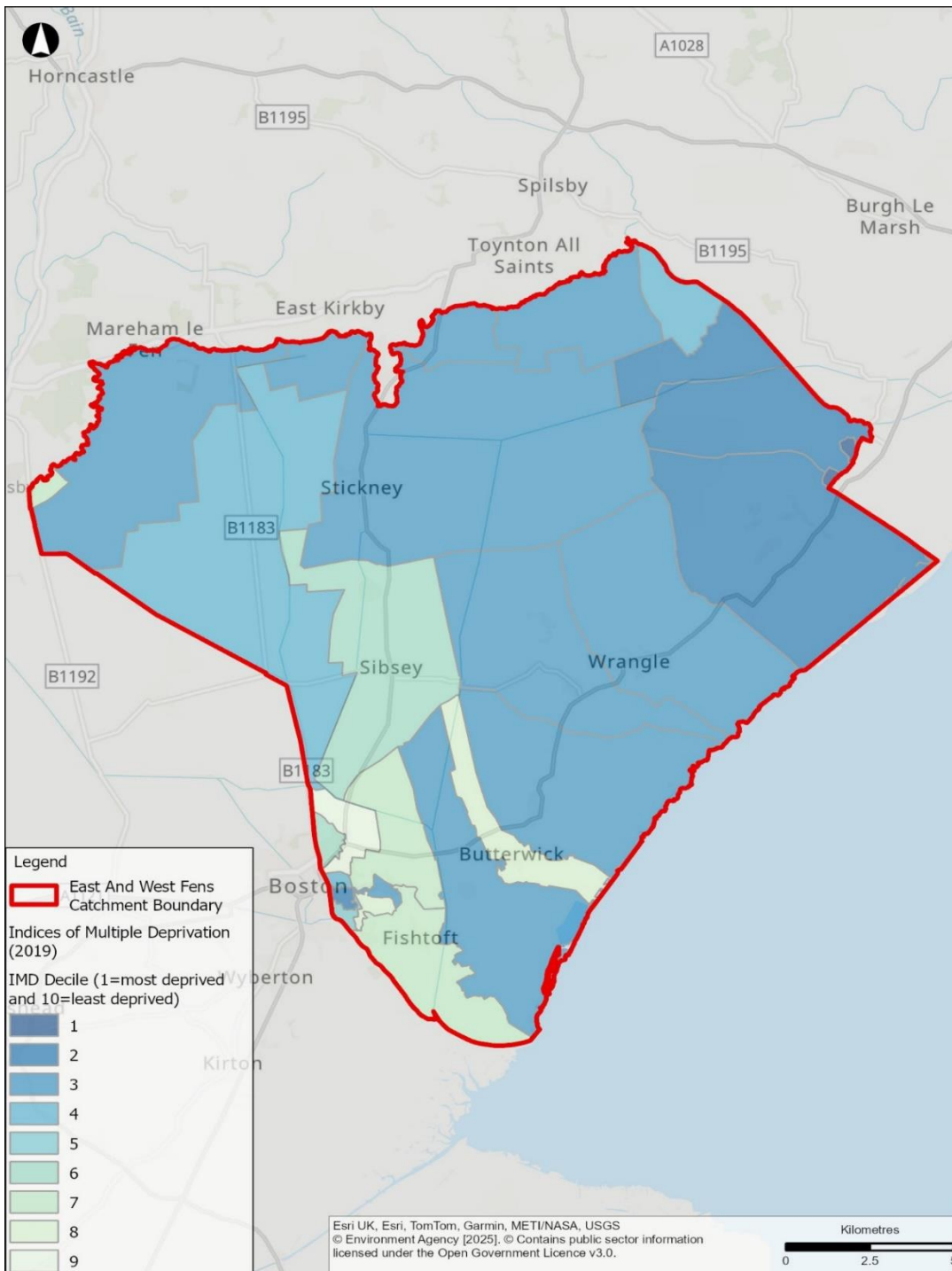


Figure 24: Map of deprivation across the catchment

Education, skills and training deprivation

In terms of education, skills and training, the majority of LSOAs intersecting with catchment are within the top 50% most deprived. Of the nine areas ranked in the most deprived 20% in the country, Boston 004C is the most deprived in terms of access to education, skills and training.

Across the East Lindsey local authority area as a whole, the proportion of the catchment in the most deprived decile of the education, skills and training domain increased from 14% to 22% between 2015 and 2019. Out of all adults in the wider East Lindsey local authority, 25.2% have no qualifications.

The local authority district of Boston is currently ranked as the worst out of the 317 local authority districts in England both in terms of the average rank for education skills and training as well as for the average score achieved across all LSOAs in the district [83].

Income deprivation

The income deprivation domain measures the proportion of the population experiencing deprivation relating to low income. This included those people who are out of work as well as those who are in work but who have low earnings. The IMD 2019 identified that East Lindsey 017D LSOA to the far north-east of the catchment is in the most deprived decile for income deprivation, ranked 220 out of 32,844 LSOAs in England; where 1 is the most deprived LSOA [83]. The majority of the other LSOAs in the catchment are ranked between the 4th and 7th decile, showing comparatively similar levels of income deprivation to the rest of England.

4.7.6 Housing and private property

In determining the number of properties within the catchment now and in the future, household projections are utilised as a key dataset, as well as considering existing housing and land allocated for housing. The 2018-based household projections for the East Lindsey local authority area predict an increase of 22.8% between 2018 - 2043 [95]. The District is currently one of the most sparsely populated parts of the country. Only 5% of the area, is identified as “urban” [96].

Housing allocations for settlements within the Local Plan area (and that intersect the catchment) are as follows:

- Friskney has a housing allocation of 59;
- Mareham le Fen has a housing allocation of 113;
- Sibsey has a housing allocation of 239;
- Wainfleet All Saints has a housing allocation of 96; and
- Stickney has a housing allocation of 18.

The 2018-based household projections for the Boston Borough Council local authority area predict an increase of 24.6% between 2018 – 2043 [97]. Housing allocations for settlements within the Local Plan area (and that intersect the catchment) are as follows:

- Boston (including parts of Fishtoft and Wyberton Parishes) has a housing allocation of 6111;
- Butterwick has a housing allocation of 70;
- Old Leake has a housing allocation of 100;
- Wrangle has a housing allocation of 100; and
- Fishtoft has a housing allocation of 50.

4.7.7 Social infrastructure

There are a range of community resources located within the catchment:

- There are 24 educational establishments within the catchment, with most of the schools concentrated near the major centres of population towards the south of the catchment.
- The Pilgrim Hospital in Boston provides all major specialties and has a 24-hour major accident and emergency service. The Boston West Hospital is located outside of the catchment but provides many day-case services.
- Of the eight residential care/nursing homes in the catchment, six are located in Boston. The rest of the catchment is served by two other nursing homes located in Stickney and Wrangle.
- Boston Library is the only public library in the catchment area. Spilsby Library is located just north of the catchment boundary and Wainfleet Library is located just to the east of the catchment boundary.
- Within the catchment boundary, there are nine sports facilities [98]. With the exception of Pymoor Lane Recreation Ground in Sibsey, all of these facilities are located in Boston, or in the villages which follow the A52 parallel to the coast (Figure 25). There is a recreation ground in New Leake but there still remains a large proportion of the northern catchment without provision of more formalised sports facilities in their communities.

The key challenges identified in the East Lindsey Local Plan which have prevented better provision of leisure facilities are the ageing population, low population density and small settlement sizes across much of the catchment, exacerbated by heavy reliance on private transport, and significant levels of deprivation and poor health.

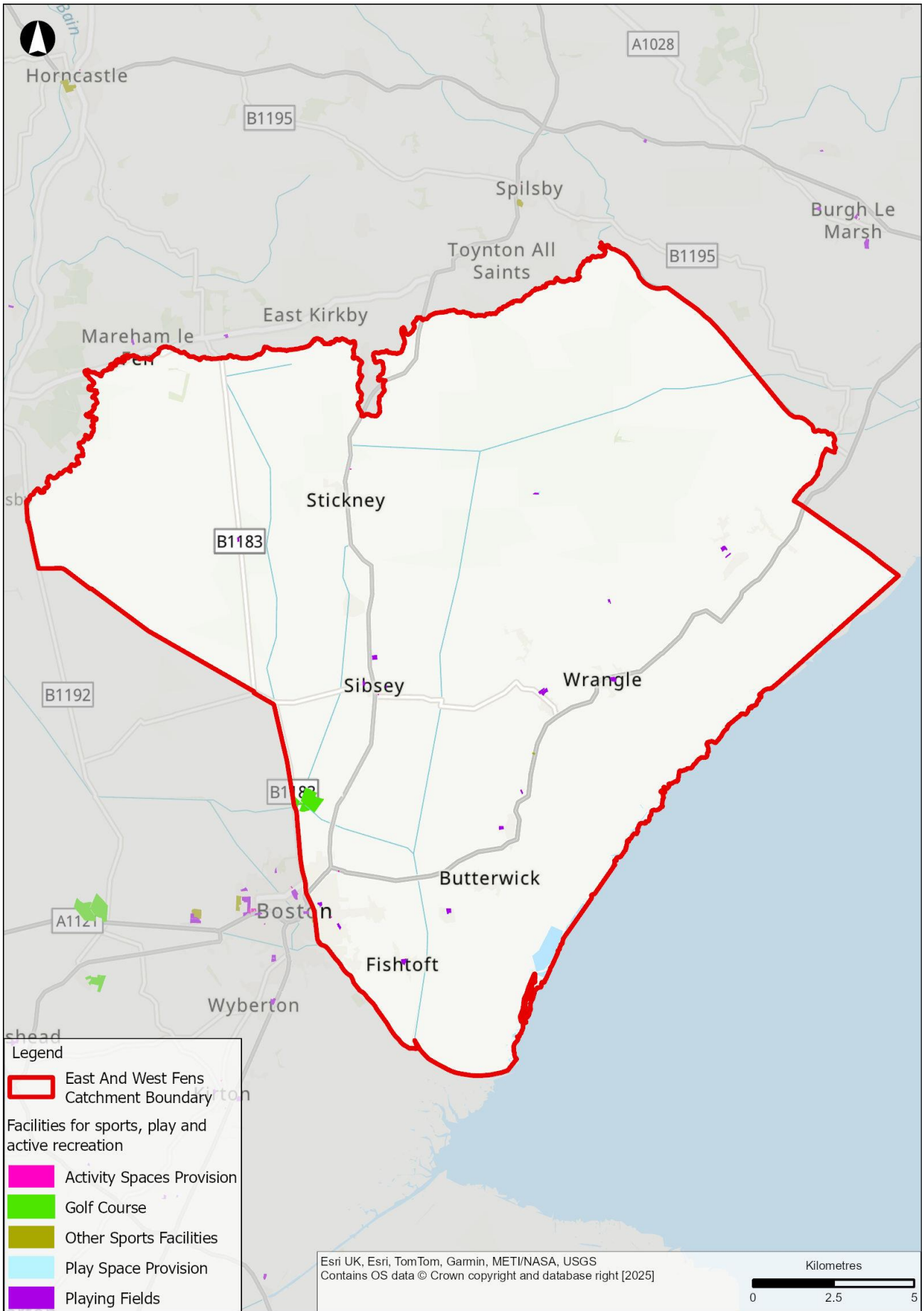


Figure 25: Facilities for sports, play and active recreation within the catchment

4.7.8 Transport Infrastructure

The catchment is poorly served for active travel routes (refer to Figure 4):

- There are approximately 10.8km of Bridleways and 136.8km of footpaths within the catchment boundary, largely concentrated near the coast and along the banks of the Witham. With the exception of a limited network of footpaths and bridleways around Stickney, many of the rural communities within the catchment have no access to any joined-up network of routes for walking, wheeling or horse-riding [99].
- The Sustrans National Cycle Network Route 1 runs through Boston parallel to the river Witham [100].
- The King Charles III England Coast Path National Trail follows the coastline of the catchment, including the tidal banks of Haven into the town centre of Boston [101].

4.8 Air quality

This section outlines the air quality baseline in the catchment. Table 28 outlines the key terminology used in this section.

Table 28: Glossary of air quality terminology

Terminology	Summary Definition
Air quality management area (AQMA)	A geographically defined area designated by a local authority where national air quality objectives are not likely to be met. This may cover an area from one street or much larger where the Local Authority is required to develop an Air Quality Action Plan to improve air quality in the that area.
Air Quality Action Plan	The action plan developed by a local authority setting out measures to address achieving air quality objectives in a designated AQMA.
Background concentrations	The levels of air pollutants for a reference year including nitrogen, nitrogen dioxide and particulate matter, published by Defra for support the review and assessment of local air quality under the Environment Act (2021) [2]
Sensitive receptors	A receptor that is potentially sensitive to changes in air quality such as residential property, schools, hospitals, and statutory designated ecological sites.
NO _x , NO ₂	Nitrogen oxides (NO _x) refers to nitric oxide (NO) and nitrogen dioxide (NO ₂), both of which are mainly formed during the combustion of fossil fuels.
PM ₁₀ and PM _{2.5}	Particulate matter (PM) is everything in the air that is not a gas. It consists of a huge variety of chemical compounds and materials, some of which can be toxic. Particulates are classified according to size. The UK is currently focused on measuring the fractions of PM where particles are less than 10 micrometres in diameter (PM ₁₀) and less than 2.5 micrometres in diameter (PM _{2.5}).
Units - µg/m ³	The units are in microgrammes of pollutant per cubic metre of air

4.8.1 AQMAs

There are no AQMAs within the catchment. The closest AQMA is Haven Bridge AQMA, located approximately 200m south-west of the catchment. It was declared in 2001 by Boston Borough Council due to exceedances of annual mean nitrogen dioxide (NO₂).

4.8.2 Air quality monitoring

A review of the existing air quality conditions in the catchment area has been undertaken using the Boston Borough Council 2023 Air Quality Status Report [102] and East Lindsey District Council 2024 Air Quality Status Report [103]. Within the catchment area, there are no monitoring sites from East Lindsey District Council, whilst Boston Borough Council has two monitoring sites. The monitoring sites within the catchment are roadside diffusion tubes DT 14 and DT9 that measured

NO₂ concentrations below than the annual mean objective (40µg/m³) from 2018 to 2022*⁸. However, due to the area being largely rural these roadside locations are not considered to be representative of the catchment area.

4.8.3 Background concentrations

Background concentrations refer to the existing levels of pollution in the atmosphere, produced by a variety of stationary and non-stationary sources, such as roads and industrial processes. Defra publishes background pollutant mapping [104] for every 1km x 1km OS grid square across the UK for NO_x, NO₂ and PM₁₀ and PM_{2.5}, as well as national air quality objectives for each pollutant. As there are no background monitoring sites within the catchment, Defra background data have been used as the representative for the area.

The 2024 annual mean background concentrations of NO₂ are found to be low (a mean of 5.7µg/m³) in the vicinity of the catchment, well below the annual mean limit value of 40µg/m³.

The 2024 annual mean background concentrations of NO_x (relevant to ecological receptors) are also found to be low (a mean of 7.2µg/m³) in the vicinity of the catchment, well below the critical level value of 30µg/m³.

The annual mean background concentrations of PM₁₀ are also well below the national air quality objective of 40µg/m³. The annual mean concentration in the vicinity of the catchment was 12.9µg/m³ in 2024. Background concentrations of PM_{2.5} are also below the national air quality objective of 12.0µg/m³, with a mean of 5.8µg/m³ in 2024 in the vicinity of the catchment.

4.8.4 Sources of Air Pollution

Industrial air pollution sources are regulated through a system of operating permits or authorisations, requiring stringent emission limits to be met, and ensuring that any releases to the environment are minimised or rendered harmless. Regulated (or prescribed) industrial processes are classified as Part A(1), A(2), Part B of Medium Combustion Plant processes and are regulated through the Pollution Prevention and Control (PPC) system [105] [106]. The larger more polluting processes are regulated by the Environment Agency (EA), and the smaller, less polluting ones by the local authorities. Local authorities focus on regulation for emissions to air, whereas the EA regulates emissions to air, water, and land.

There are no regulated industrial installations listed on the EA website [107] within the catchment.

Traffic is a significant contributor to air pollution. Pollution from traffic includes vehicle exhaust emissions, secondary pollutants formed in the atmosphere, evaporative emissions from vehicles and non-combustion emissions such as tyre wear and road dust. There are very few A-roads within the catchment: the A52 spanning approximately 15km and A16 spanning approximately 14.5km.

4.8.5 Sensitive Receptors

Sensitive human receptors are defined as those residential properties, schools and hospitals that are likely to experience a change in pollutant concentrations with potential exposure relevant to the averaging periods set out in the air quality standards.

- Individual properties and residential areas within the catchment e.g. Wainfleet All Saints; Friskney, and Old Leake;
- Highgate Day Nursery And Pre-School;
- Butterwick Pre-school;

⁸ The latest available monitoring data from East Lindsey District Council is from 2022, as stated in the Air Quality Annual Status Report

- Kenway Nurseries;
- Halton Holegate Nursery;
- Tower Road Academy (Primary School);
- Pilgrim Hospital Day Nursery;
- Shining Stars Nursery;
- Pilgrim Hospital; and
- Support Services - Cardiology & Nuclear Medicine (Outpatients).

Sensitive ecological receptors are defined as those sites whose qualifying features have been designated as sensitive to air pollutants. There are sensitive nationally and internationally designated ecological receptors, such as the Wash Site of Special Scientific Interest (SSSI), Special Protection Area (SPA), Special Areas of Conservation (SAC) and Ramsar located within the catchment. Please see Section 4.5 for further information.

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