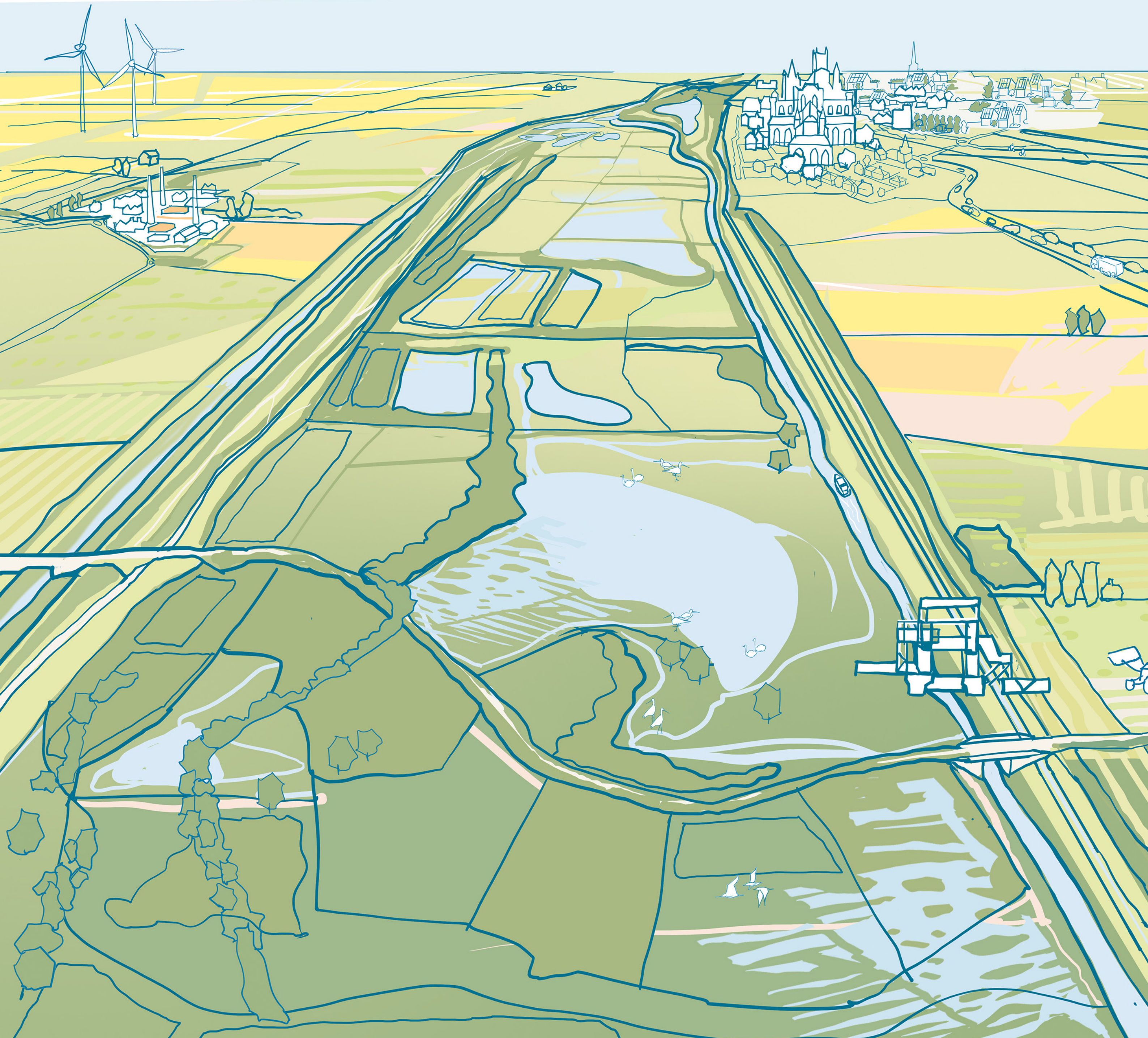
Fens 2100+

Lower Nene

Flood risk baseline

2025



Contents

Tables

Figures

Glossary of Terms

- **AIMS** – Asset Information System - An Environment Agency hosted database of information on Environment Agency assets, as well as some other key RMA assets.
- **AOD** – Above Ordnance Datum - Referring to an altitude above a localised mean sea level.
- **BRC** - Below Required Condition.
- **Cumecs –** is the SI unit of volumetric flow rate and are equivalent to cubic meters per second (m^3/s).
- **FCERM** – Flood and Coastal Erosion Risk Management.
- **The Fens** – In the context of Fens 2100+, the combined catchments of the Witham, Lower Welland, Lower Nene, Great Ouse and Steeping, including land with an elevation at or below 6m AOD.
- **Flood risk** - A combination of the probability and the potential consequences of flooding. This includes risks from various sources such as rivers, the sea, direct rainfall, rising groundwater, overwhelmed sewers, and reservoirs
- **IDB -** Internal Drainage Board - A public body that manages water levels in an area, known as an internal drainage district.
- **LLFA** – Lead Local Flood Authority, bodies with a statutory responsibility for taking the lead operational role in managing the risk of flooding.
- **MEICA** - Mechanical, Electrical, Instrumentation, Control and Automation assets, in the context of this report relating to flood and coastal risk management (FCRM) assets.
- **NFM** – Natural Flood Management, the practice of using natural processes to reduce the risk of flooding.
- **Resilience**: The capacity of people and places to plan for, protect, respond to, and recover from flooding and coastal change. Resilience has been considered in the context of Fens 2100+ as follows:
  - Anticipate and adapt: Taking action to prepare for and adjust to both the current effects of climate change and the predicted impacts in the future, while responding to local place-based needs and ambitions.
  - Protect: Reducing the risk of flooding and coastal erosion to enhance the safety of communities and places (through investment in physical grey and green infrastructure).
  - Maintain: Co-ordinated activity to realise the whole life value from flood risk infrastructure though inspection, operational management, repair, replacement, renewal and decommissioning.
  - Respond: The ability of places and people to prepare for and react to flooding and coastal erosion in a way that results in minimal impacts to property, the natural environment and health and wellbeing.

- Recover: The ability of places and people to rebound from flooding and coastal erosion with minimal impacts to property, the natural environment, and health and wellbeing.
- Transform: To change and improve the way FCERM infrastructure is planned, delivered and operated to be more efficient, sustainable and resilient.

- **RMA** - Risk Management Authority - an organisation responsible by statute for flood and coastal erosion risk management.
- **RNAG** – Reasons for Not Achieving Good.
- **SoP** – Standard of Protection - The severity of flooding that something is designed to withstand, represented by the percentage chance of a certain level of flooding occurring in that year.
- **Telemetry** – is technology that enables an asset to operate without manual interaction.
- **WFD** – Water Framework Directive.
- **WLCS** – Water Level Control Structures.

1. Introduction

1.1 Aim and purpose of this document

This document presents a catchment-scale assessment of current and future flood risk for the Lower Nene catchment. Using the best available data, it presents an overview of current and future flood risk and is intended to support future choices, investments and actions for the Fens 2100+ programme (hereafter referred to as 'Fens 2100+').

1.2 Usage statement

The purpose of the document is to support strategic decision making for the Fens 2100+. This document should be read alongside the Lower Nene baseline evidence report and is intended to provide a strategic current and future flood risk baseline which will inform the development of a future asset management strategy for the Fens 2100+. This document provides a proportionate level of detail required for a strategic catchment-scale baseline. It is anticipated that specific interventions will need to be supported by a more detailed study.

1.3 The Fens 2100+ programme

The Flood and Coastal Erosion Risk Management (FCERM) Strategy for England[1] sets out the need for a strategic, long-term and adaptive approach to organising flood and water management in the Fens. This will unlock investment and partnership working that will create a legacy for this unique system which balances the needs of people, the environment and agriculture.

The Fens is the only local area across England to have a specific measure included within the strategy. This marks a step-change in national commitment to rural places and the importance of the Flood Risk Management Authorities (RMAs) in managing flood risk and driving future investment in water management infrastructure. Additionally, the FCERM Strategy roadmap[2] states that the Environment Agency will work in partnership to develop long-term plans for adapting to flooding and drought and managing water differently in the Fens.

Fens 2100+ is being developed with, and on behalf of, RMAs. Fens 2100+ has a vision for '*a climate resilient and vibrant future for the Fens'* enabled by the following levers:

- **Inform** (resilient) choices and support future learning (and monitoring and evaluation).
- **Drive** (integrated) investment through agreed ways of working and decision making.
- **Deliver** (place-based*) impact by creating a tactical handshake between ambitions, investment and action (2027-2033).

** Place-based refers to strategies and initiatives that focus on addressing the specific contextual needs and leveraging the strengths of a particular geographic area.*

[1] Environment Agency (2022) National Food and Coastal Erosion Risk Management Strategy for England. Available at: National Flood and Coastal Erosion Risk Management Strategy for England - GOV.UK (www.gov.uk). Accessed: September 2024.

[2] Environment Agency (2022) Flood and Coastal Erosion Risk Management Strategy Roadmap to 2026. Available at: Flood and Coastal Erosion Risk Management Strategy Roadmap to 2026 - GOV.UK (www.gov.uk). Accessed: September 2024.

Fens 2100+ comprises the seven catchments of the Steeping, Lower Welland, South Forty Foot, East and West Fens, Lower Witham Fens, Lower Nene and Great Ouse (see Figure 1).

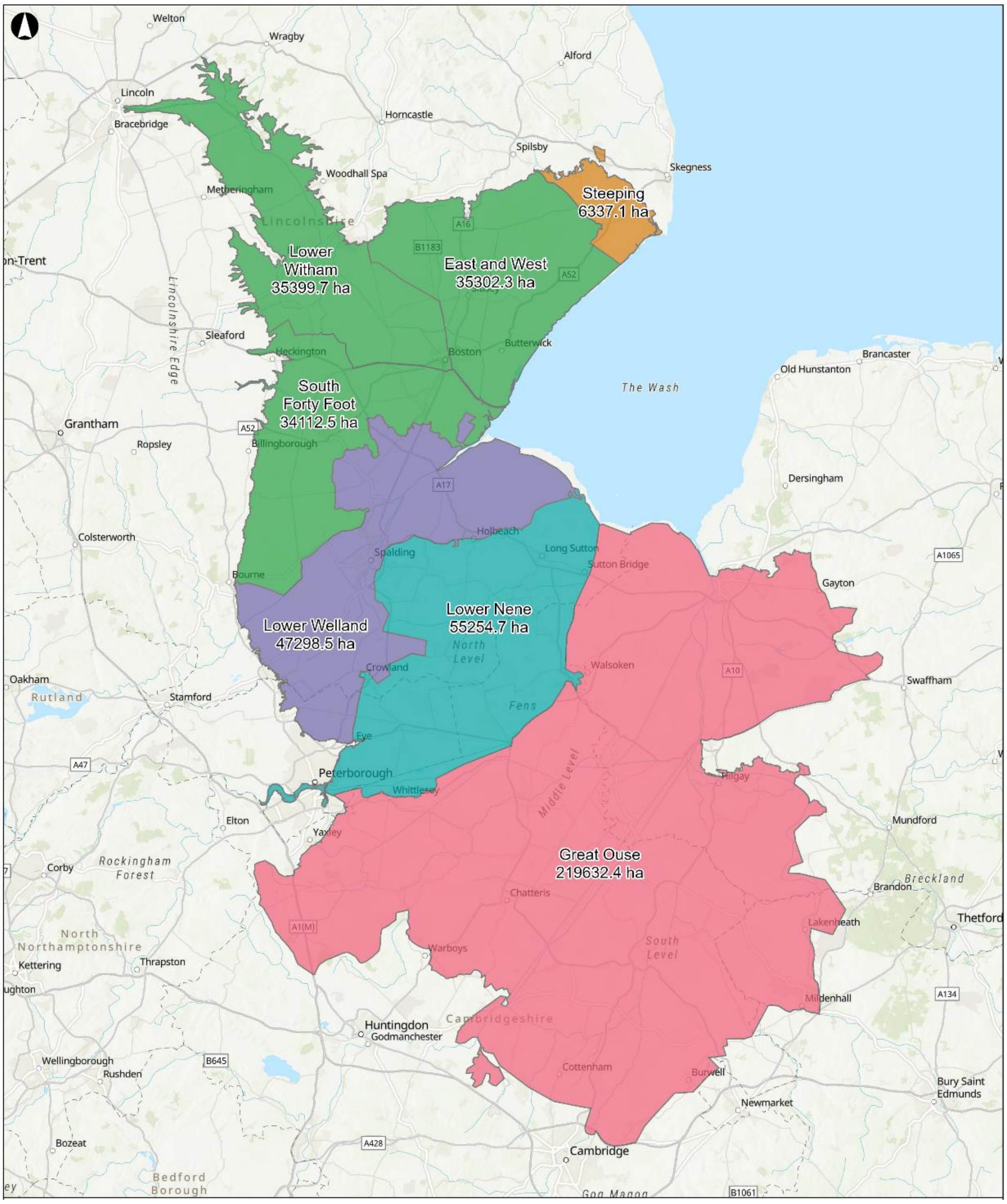


Figure 1: Fens 2100+ study area

1.4 Lower Nene catchment

The Lower Nene catchment (hereafter referred to as ‘the catchment’) covers an area of approximately 552.5km^2 (55250ha) located in eastern Lincolnshire at centre of the wider Fens 2100+ catchment bordering the Lower Welland and Great Ouse catchments.

The catchment stretches from 8km west of Peterborough in the south-west, to Lutton Leam Sluice where the River Nene discharges to the North Sea. The section of the River Nene within the catchment is approximately 55km long.

The lowest lying areas in the catchment sit at approximately 3m below sea level in the vicinity of the Lowland Drain south-west of Tydd Saint Giles and the A47 between Thorney and Guyhirn. Being below sea level puts these areas at significant risk of tidal and fluvial flooding. It is predominately artificially drained through a complex network of low-lying drains.

The land use within the catchment is primarily agricultural, predominantly focused on arable and higher value cropping with some livestock enterprises also present, including the only large commercial dairy unit in the Fens, and both grazing livestock and intensive poultry and pig operations. The south of the catchment includes the Whittlesey (Nene) Washes[3], a 1,522-hectare SSSI and nature reserve area which is used to store flood water flows to prevent flooding. The Whittlesey (Nene) Washes has a storage capacity of up to 35 million m^3.

The catchment is also home to many holiday parks which have been developed across the district. Some of these host fishing lakes, including those that have been constructed because of aggregate extraction, particularly near Eye, where a number of aggregate extraction facilities are still operational.

It is acknowledged that the 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.

1.5 Catchment context

The source of the River Nene lies outside the catchment boundary to the west, where its tributaries the Kislingbury Branch, the Brampton Branch and Wootton Brook, rise in the Northamptonshire Uplands. These headwaters meet in Northampton and from here the River Nene flows across gently undulating rural country to the flat plains around Peterborough, where it enters the Lower Nene catchment study area and its embanked tidal reach across the Fens.

The tidal limit of the river is controlled by the lock and sluice at Dog-in-a-Doublet. Downstream of this point, the River Nene is a heavily engineered channel which includes tidal embarkments along its 55km length.

The other Main Rivers within the catchment comprise the Morton's Leam, South Holland Main Drain and North Level Main Drain (see Figure 2).

The Lower Nene catchment relies heavily on its pumped drainage system to maintain its highly productive agricultural land. It is supported by a system of pumping stations, sluices and locks, most notably the Dog-in-a-Doublet Sluice, Tydd Pumping Station, Sutton Bridge Sluice and Lutton Leam Sluice. The loss of these pumped systems would render the land uninhabitable.

Internal Drainage Boards (IDBs) are responsible for all pumping activities within the catchment, moving water from the land into the River Nene. Each IDB maintains a

---

[3] Natural England (2024). Designates Sites Viewer, Nene Washes SSSI [online]. Available at https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=S1002071&SiteName=Nene%20Washes&countyCode=&responsiblePerson=&SeaArea=&IFCAArea= [Accessed 12th November 2024].

drainage network of channels, control sluices and pumping stations which control the discharge of water into the Main River or keep water on the land during drier periods.

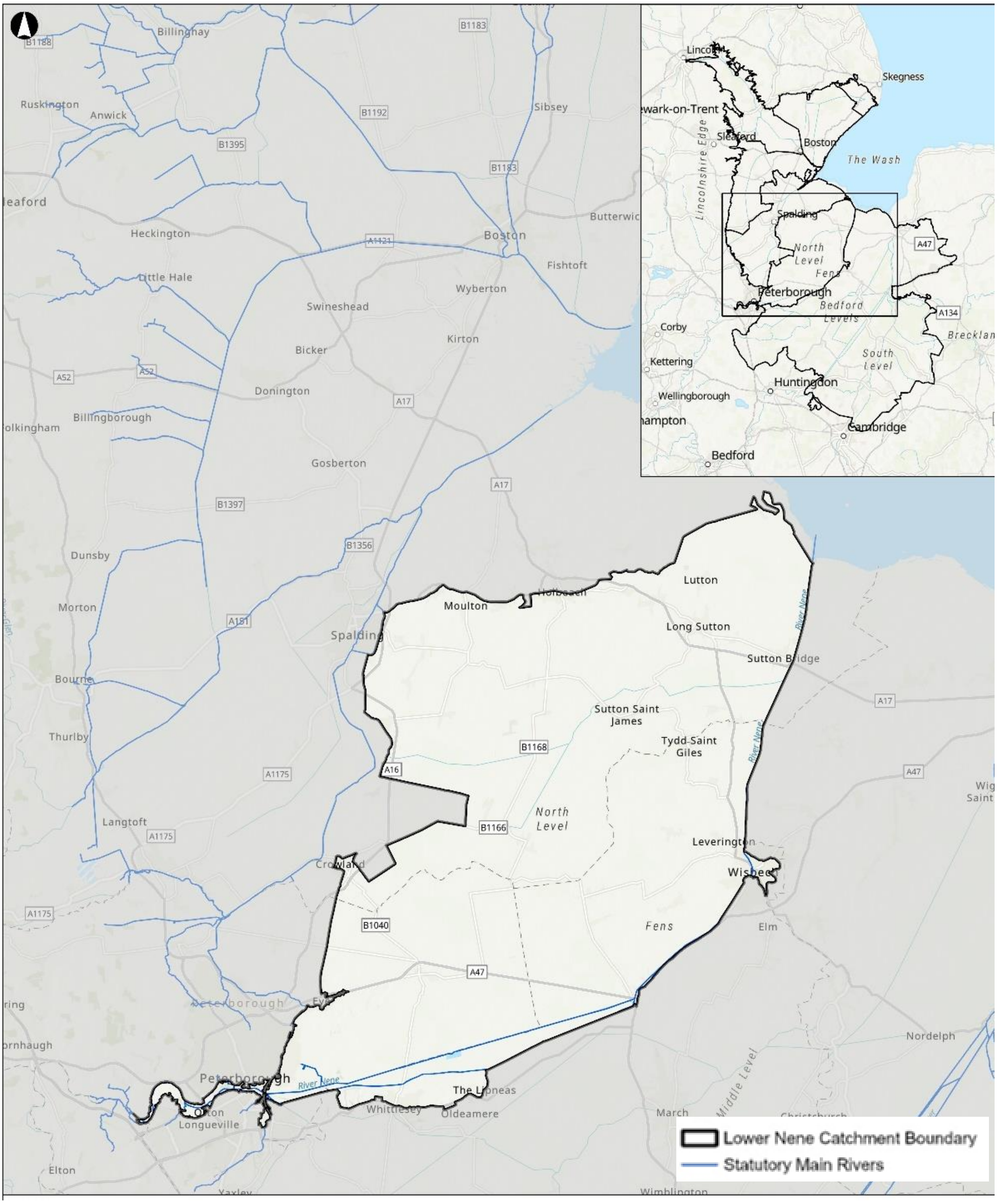


Figure 2: Main Rivers in the Lower Nene catchment

1.6 Key assets

The Lower Nene catchment contains a network of sluices, pumping stations, embankments and flood defences which work together to drain the catchment and prevent flooding.

gives an overview of the locations of some of the key assets. For clarity, not all assets have been included.

The proceeding sections give further details of some of these key assets. Refer to the Assets Technical Baseline Report for further information.

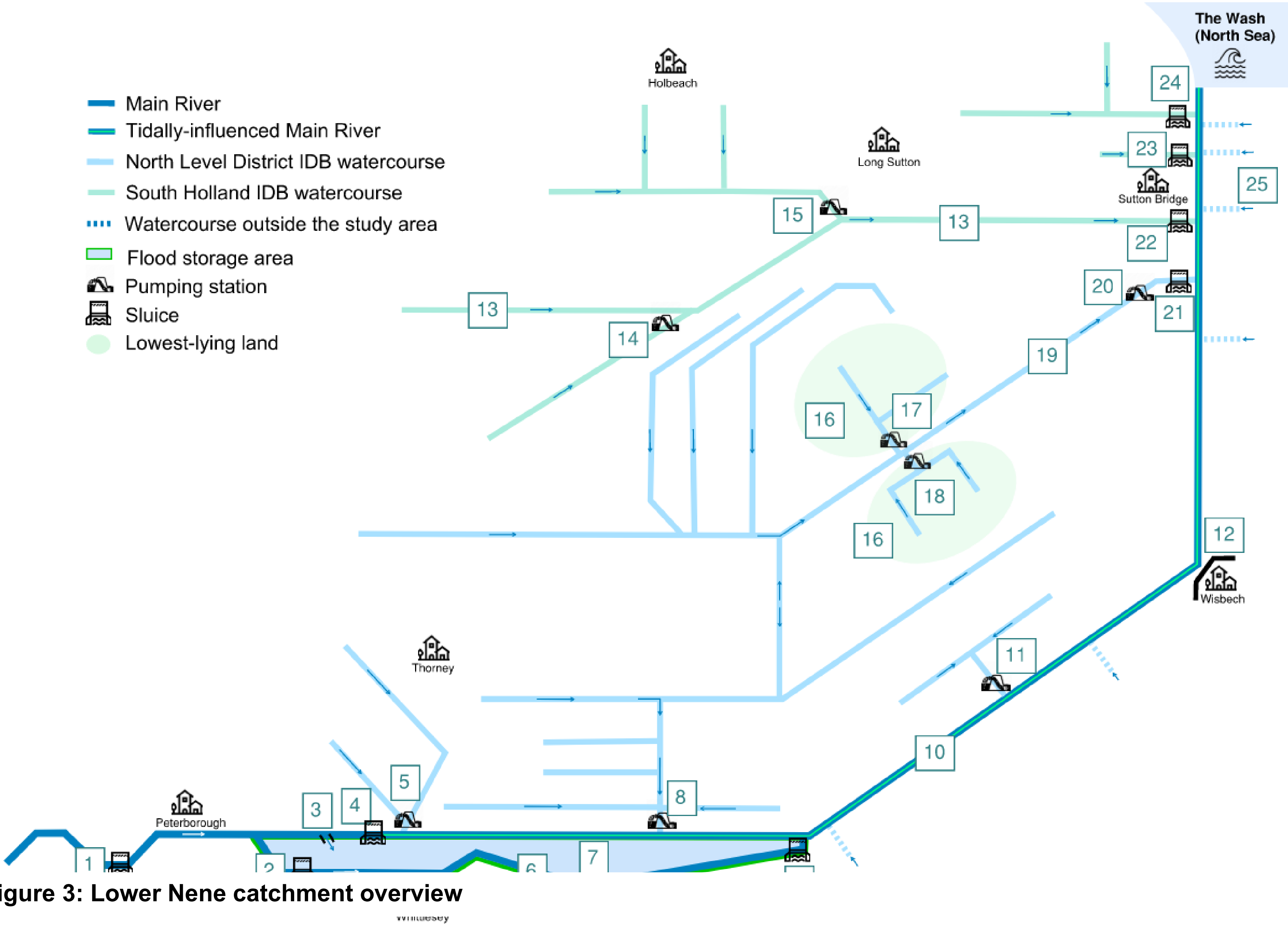


Figure 3: Lower Nene catchment overview

1
Orton Mere Sluice
Environment Agency
Helps to control water levels on the River Nene and includes a navigation lock.

2
Stanground Sluice
Environment Agency
In flood conditions, water is diverted out of the River Nene and into Morton's Leam through Stanground Sluice so that the Washes can start to fill. Water can also enter the washes by spilling over the Cradge Bank via Northey Gravel Weir on the southern bank of the River Nene.

3
Northey Gravel Weir
Environment Agency
The original inlet structure for the Whittlesey (Nene) Washes. Water flows over the weir during winter flood conditions.

4
Dog in a Doublet Sluice
North Level District IDB Environment Agency
Marks the tidal limit of the River Nene. It controls water levels from the fluvial to the tidal section and includes a navigation lock. In flood conditions it can become tide-locked, resulting in the operation of the Whittlesey (Nene) Washes.

5
Dog in a Doublet Pumping Station
North Level District IDB
Pumps water from the area of land between Peterborough and Thorney into the River Nene.

6
Morton's Leam
Main River
Flows through the Washes along its southern edge. During periods of high flow in the River Nene, Morton's Leam becomes a route for water onto the Washes, and then to Ring's End Sluice for discharge.

7
Whittlesey (Nene) Washes
Environment Agency & Partners
Registered under the Reservoirs Act 1975 and operated by the Environment Agency. The Washes function as a flood storage area for the equivalent of 14,000 olympic-sized swimming pools of water. The storage area is contained by the Cradge Bank and the South Barrier Bank.

8
Cross Guns Pumping Station
North Level District IDB
Pumps water into the Nene from land to the north. The network of drains across the North Level District are connected so that water can be pulled south towards Cross Guns to take pressure off Tydd Pumping Station.

9
Ring's End Sluice
Environment Agency
Water is released from the Washes back into the River Nene through Ring's End Sluice when river flows and tidal conditions allow.

10
River Nene
Main River
The study area encompasses around 60km of the Nene's lower course, which is tidal downstream of Dog-in-a-Doublet Sluice.

11
Mouth Lane Pumping Station
North Level District IDB
Pumps water from a small sub-catchment into the River Nene.

12
Wisbech flood defences
Environment Agency
Flood walls protect properties in Wisbech from high flows in the River Nene.

13
South Holland Main Drain
South Holland IDB
Carries water from smaller drains to the outfall at Sutton Bridge Sluice.

14
Fleet Fen Pumping Station
South Holland IDB
Pumps water out of the Fleet Drain into the South Holland Main Drain.

15
Little Holland Pumping Station
South Holland IDB
Pumps water out of the Little Holland Drain into the South Holland Main Drain.

16
Poplars and Willow Holt sub-catchments
North Level District IDB
These are especially low-lying.

17
Poplars Pumping Station
North Level District IDB
Pumps water out of a small low-lying sub-catchment into the North Level Main Drain. This water is pumped upwards again into the River Nene at Tydd Pumping Station.

18
Willow Holt Pumping Station
North Level District IDB
Pumps water out of a small low-lying sub-catchment into the North Level Main Drain.

19
North Level Main Drain
North Level District IDB
The main carrier of water from the southern portion of the Lower Nene catchment to Tydd Pumping Station.

20
Tydd Pumping Station
North Level District IDB
The largest pumping station in the Lower Nene catchment. It removes the majority of water from the North Level IDB system into the River Nene. Pumped water can be held in the water-storage pound upstream if Foul Anchor Sluice is tide-locked.

21
Foul Anchor Sluice
North Level District IDB
A Grade II listed structure which acts as a tidal defence.

22
Sutton Bridge Sluice
South Holland IDB
Controls discharge of the South Holland Main Drain into the Tidal River Nene. Although a network of pumps move water into the South Holland Main Drain upstream, there are no pumps here, so water can only be discharged through the sluice at low tide.

23
Westmere Sluice
South Holland IDB
Outfall for Westmere Creek into the Tidal Nene.

24
Lutton Leam Sluice
South Holland IDB
Outfall of Lutton Leam into the Tidal Nene.

25
Other inflows to the Nene
King's Lynn IDB
King's Lynn IDB discharge water from the west of their district into the River Nene. Further south, Waldersey IDB and Hundred of Wisbech IDB also discharge to the Nene, but are part of the Middle Level system of the Great Ouse catchment.

1.6.1 Whittlesey (Nene) Washes

East of Peterborough and bordering the southern bank of the Nene for 20km is the Whittlesey (Nene) Washes flood storage reservoir. This provides flood storage capacity of 35 million m^3 (equivalent to 14,000 Olympic swimming pools) which provides tidal flood protection to Peterborough, as well as fluvial flood protection to agricultural land to the south. In flood conditions water is diverted through Stanground Sluice so the Washes can fill, Ring's End Sluice is located at the end of the Washes and releases water back into the River Nene. If flows in the Nene are exceptionally high and the river becomes tide locked, Cradge Bank is designed to be overtopped and water will spill into the Washes, which are contained on the outer edge by the South Barrier Bank.

1.6.2 Sluices

The Dog-in-a-Doublet Sluice and Lock (shown in Figure 3), inaugurated in 1937 and managed by the Environment Agency, serves to prevent tidal waters from entering Peterborough while maintaining levels in the navigable River Nene upstream through Peterborough. The sluice closes when the tidal level exceeds the fluvial river level, causing the downstream water level to fluctuate with the tide, while the upstream area remains protected from tidal inflows, but fluvial flows are unable to discharge, creating 'tide-lock' conditions upstream of the sluice. When the tidal levels drop below the fluvial river level, the sluice opens, allowing the river to discharge freely.

During periods of 'tide lock', river flows are diverted into Morton's Leam via Stanground Sluice, eventually overflowing and flooding the Whittlesey (Nene) Washes. The water remains in the Washes until tidal levels permit its discharge at Ring's End Sluice at the downstream end of Morton's Leam.

Further downstream on the River Nene, several sluices control discharge of water from the South Holland IDB district into the River Nene. For example, Sutton Bridge Sluice controls the discharge of the South Holland Main Drain, although gravity only allows this discharge to occur at low tides.

Figure 4: Dog-in-a-Doublet Sluice © Arup 2024

1.6.3 Pumping Stations

Diesel pumping stations were initially installed in the Lower Nene catchment in 1936 as part of the Third North Level Major Improvement Scheme. The stations at Tydd Gote, Dog-in-a-Doublet, and Cross Guns facilitated the drainage of an additional 180km^2 to support food production during World War II. In the latter part of the 20th Century, ten new electric and diesel pumping stations were constructed under the Fourth North Level Major Improvement Scheme. Some key pumping stations in the catchment are summarised below:

Dog-in-a-Doublet Pumping Station is managed by the North Level District Internal Drainage Board and was updated in 1983. It pumps water from the area of land between Peterborough and Thorney into the River Nene. It consists of 4 pumps and 3.6 cumecs capacity.

Tydd Pumping Station is the largest pumping station in the catchment. It removes the majority of water from the North Level District IDB system into the River Nene. Pumped water can be held in the water-storage pound upstream if Foul Anchor Sluice is tide-locked. It consists of 6 pumps and has 20.17 cumecs capacity. It was first commissioned in the 1930s and has been refurbished several times The pumping station is shown in Figure 5.

Poplars Pumping Station managed by the North Level District Internal Drainage Board, pumps the water out of an especially low lying area into the North Level Main Drain. This water is then further pumped upwards into the River Nene at Tydd Pumping Station downstream. This asset consists of 2 pumps and a total of 1.6 cumecs capacity.

Willow Holt Pumping Station is also managed by North Level District IDB and lies on the opposite bank of the North Level Main Drain from Poplars Pumping Station, carrying out an equivalent role of pumping water from an especially low-lying area located just to the south of the Main Drain.

Cross Guns Pumping Station constructed in 1977 as part of the North Level Major Improvement Scheme, pumps water into the River Nene from the Cross Guns sub-catchment. It consists of 6 pumps with a total of 9.54 cumecs capacity. The network of drains across the catchment are connected so that water can be pulled south towards Cross Guns to take pressure off Tydd pumping station.

Figure 5: Tydd Pumping Station (© Copyright Arup 2024)

1.6.4 Embankments

Embankments are a critical asset in the Lower Nene catchment, and there are many. The majority of embankments in the catchment are concentrated along the tidal section of the River Nene, with IDB drains being dug into the land surface.

The embankments that are owned, operated or maintained by the Environment Agency in the Lower Nene catchment are shown in Figure 6. An overview of the Lower Nene catchment including key assets is presented in Figure 3. .

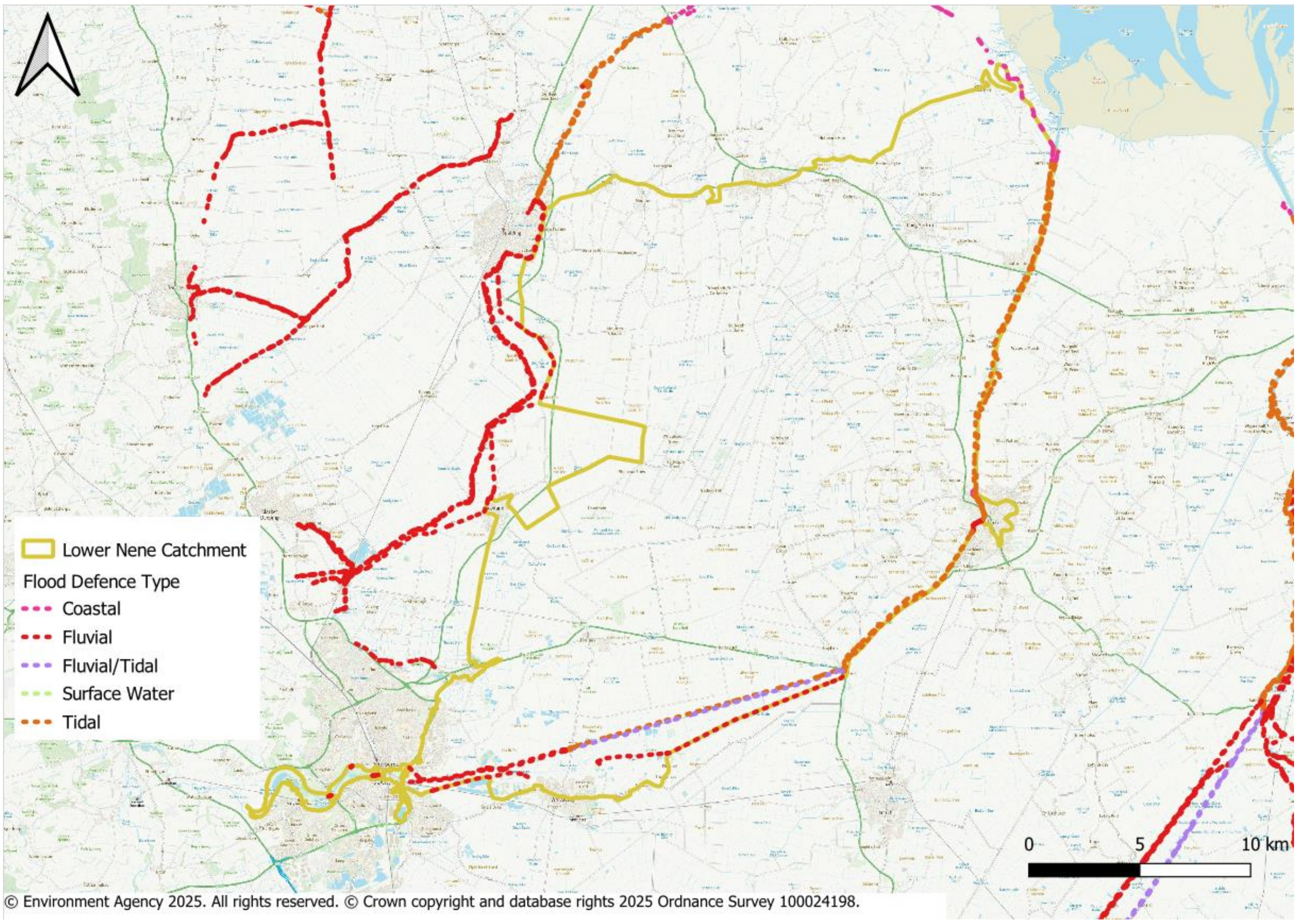


Figure 6: Embankments in the Lower Nene catchment owned, operated or maintained by the Environment Agency

2. Notable flood history

A number of flood events have impacted the Lower Nene catchment. These events have been summarised in the proceeding sections.

Information on flood history has largely come from a variety of sources, in the form of:

- Recorded flood outlines (GIS files);
- Peterborough Strategic Flood Risk Assessment; and
- Fenland Level 1 Strategic Flood Risk Assessment.

Other sources of information have come from Section 19 reports as well as news articles from reputable news organisations, such as the BBC.

2.1 1868

On 11th July 1868, 4.15 inches of rain fell in 12 hours causing much damage to crops in the North Level District. Approximately 30.14 inches of rain fell in that year, leading to the Clark Scheme of major improvement.

2.2 1876

In 1876 illustrations document the Nene in flood downstream from the city of Peterborough. No further information is known on this event. Flood events occurred in the city prior to the construction of the Dog-in-a-Doublet Sluice.

2.3 November 1903

This flood event occurred prior to the construction of the Dog-in-a-Doublet sluice gates. It is not known whether this event was tidal or fluvial. A photograph of the flood waters during this event is shown in Figure 7.

Figure 7: November 1903 flood event (location unknown but possibly at Orton Mere)

2.4 1912

In 1912 flooding was recorded at the Whittlesey (Nene) Washes, as shown in Figure 8. Heavy rainfall fell between the 20th and 26th August, bringing 4 inches (101.6mm) of rainwater. Most of the North Level District was flooded, and the potato crop failed as a result. This flood event occurred prior to the construction of the Dog-in-a-Doublet sluice gates.

Figure 8: 1912 Flooding at Whittlesey (Nene) Washes[4]

2.5 Winter 1946/1947

The winter of 1946/1947 saw extremely low temperatures and heavy snowfall. A rapid thaw led to significant flooding across the United Kingdom. Failure of the southern barrier of the Crowland High Wash leaded to severe flooding of the North Level IDB district, causing widespread damage, the flood extent is shown in Figure 9.

There was also flooding from the Nene during this event around Peterborough – as shown in Figure 10.

[4] Floods (1876) | PETERBOROUGH IMAGES ARCHIVE (Accessed 19th December 2024).

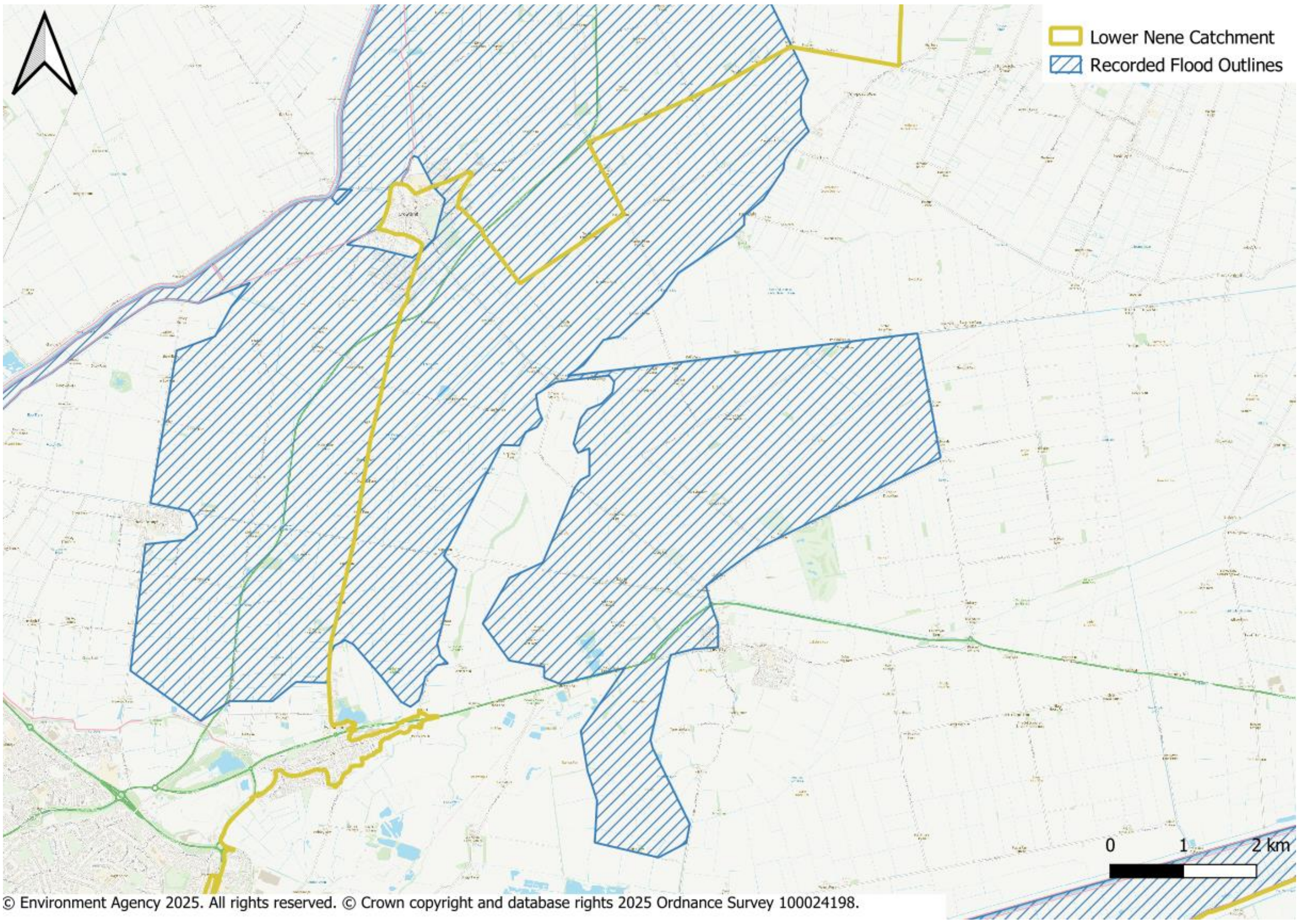


Figure 9: 1947 Environment Agency recorded flood from Crowland High Wash breach

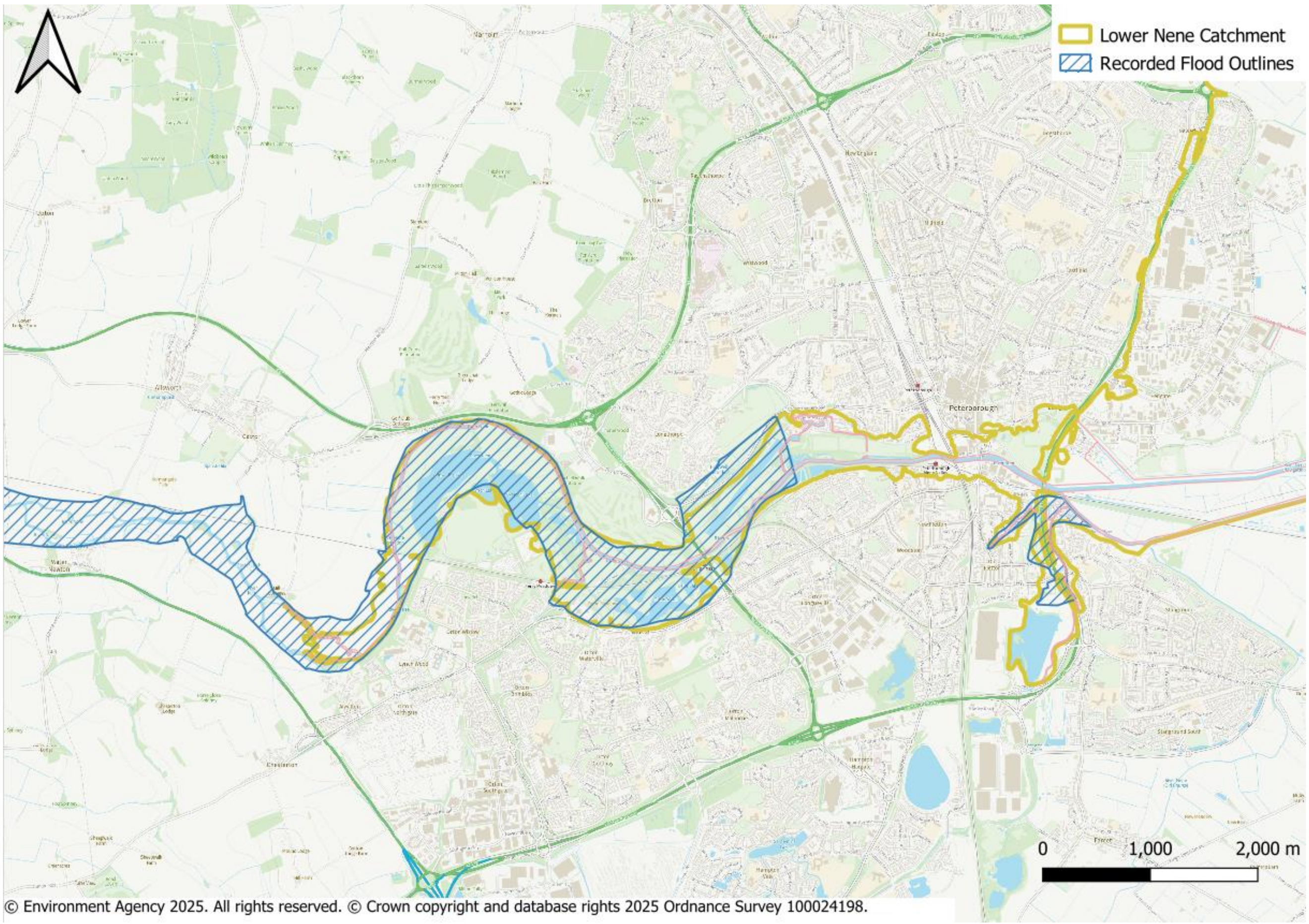


Figure 10: 1947 Environment Agency recorded flood extent at Peterborough

2.6 1950

Seven fluvial flood peaks with sustained high discharge caused flooding. Flooding locations are not known.

2.7 1960

Localised flooding caused by fluvial and high tide. Locations of flooding are not known.

2.8 January 1953

On the 31st January 1953, the greatest storm surge within records held for the North Sea caused extensive tidal flooding along the coast, including breaching the defences in Wisbech.

2.1 1974

Shallow floodplain flooding. No major flooding reported. Source of flooding was tidal. It is not known where overtopping occurred.

2.2 January 1978

On the 11th January 1978, an intense storm caused multiple tidal flood events in Sutton Bridge and Wisbech, causing extensive damage and the evacuation of about 1,000 people at Wisbech when the Nene overflowed its banks, with one person losing their life[5].

In the Lower Nene catchment both banks in Wisbech were overtopped, and the high tides impeded discharge of pumped water into the river, leading to further surface water flooding in Wisbech and Sutton Bridge, as shown in Figure 11, Figure 12 and Figure 13. Damages exceeded £10million. In response, significant flood defences were built in Wisbech which were subsequently improved in 2010.

[5] Tidal Nene Economic Baseline (2021) Environment Agency

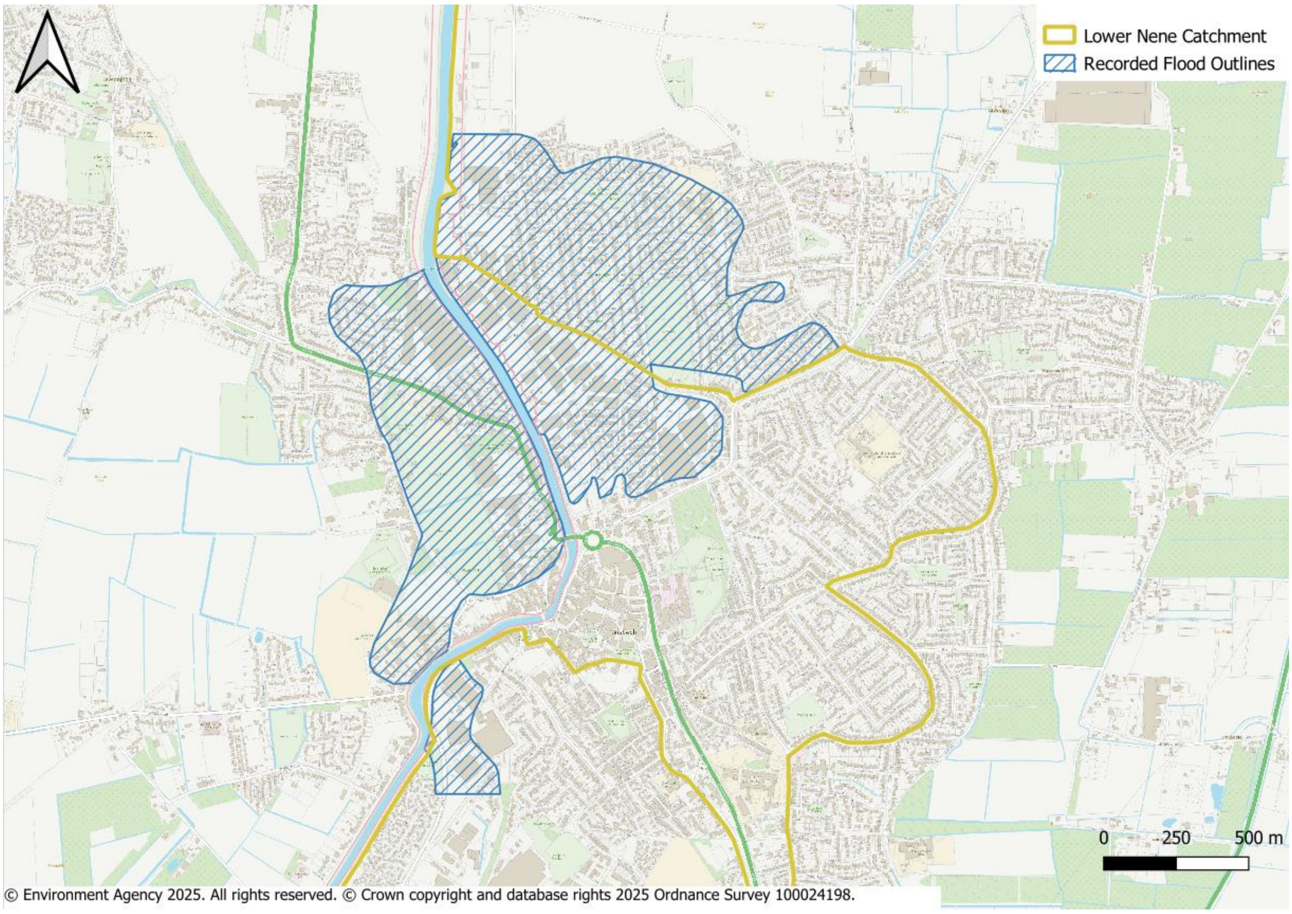


Figure 11: 1978 Environment Agency recorded flood extent Wisbech

Figure 12: Flooding at Edinburgh Drive in Wisbech

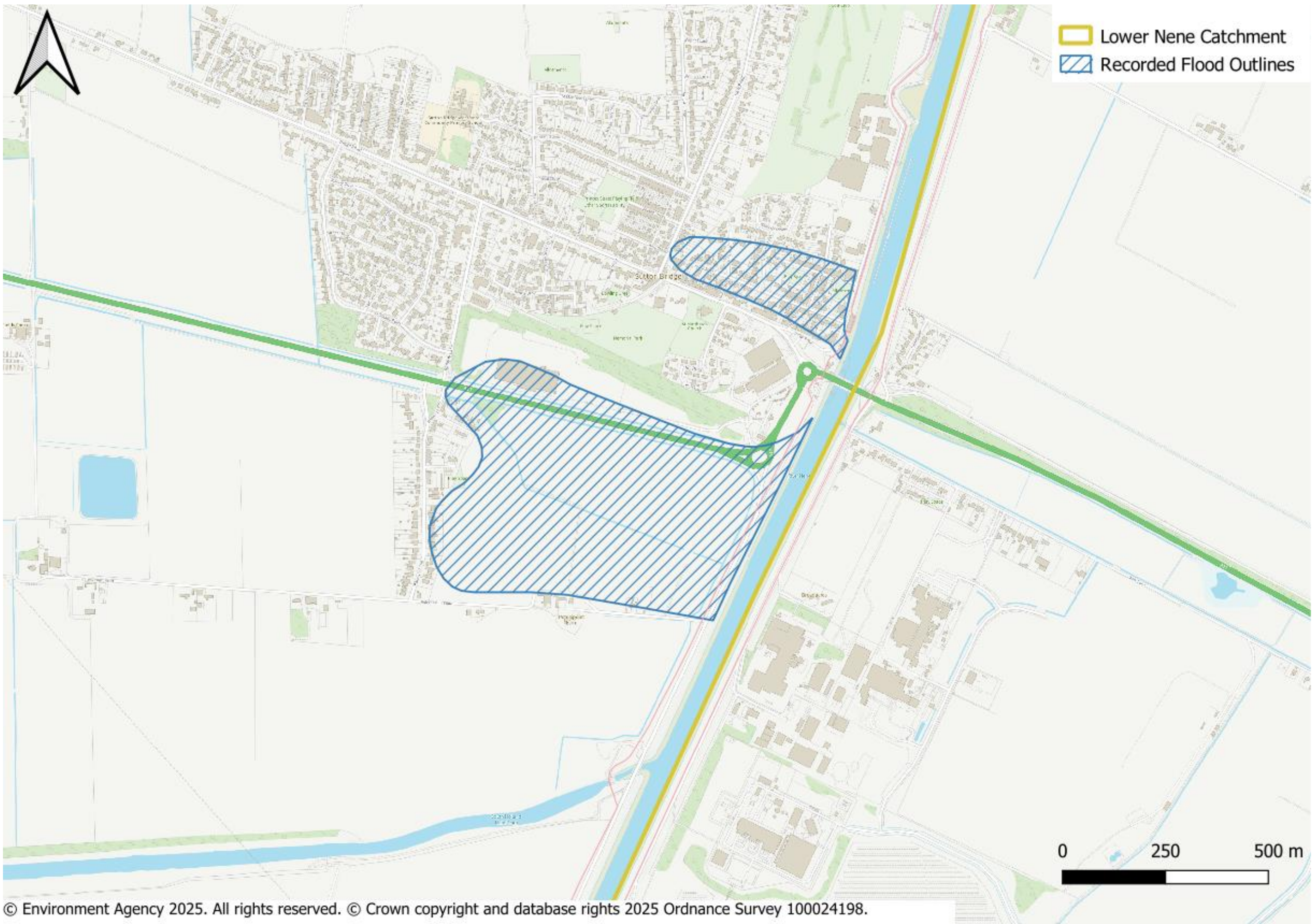


Figure 13: 1978 Environment Agency recorded flood extent at Sutton Bridge

2.3 Winter 1981- 1982

Agricultural land flooded, but no properties flooded. Source of flooding unknown.

2.4 April 1998

Early on the 10th April 1998, the River Nene caused flooding after Northamptonshire received a month's worth of rain in just 24 hours.

Wisbech and Sutton Bridge were impacted, but the worst affected areas were upstream of the Tidal River Nene extent[6] in Peterborough. Within Peterborough, there was flooding of properties at Riverside Gardens and Thorpe Meadow, as shown in Figure 14 and Figure 15 – it is estimated that nine residential properties and nine commercial properties were inundated in Peterborough.

[6] Arup and Environment Agency (2021) Tidal River Nene Baseline Report.

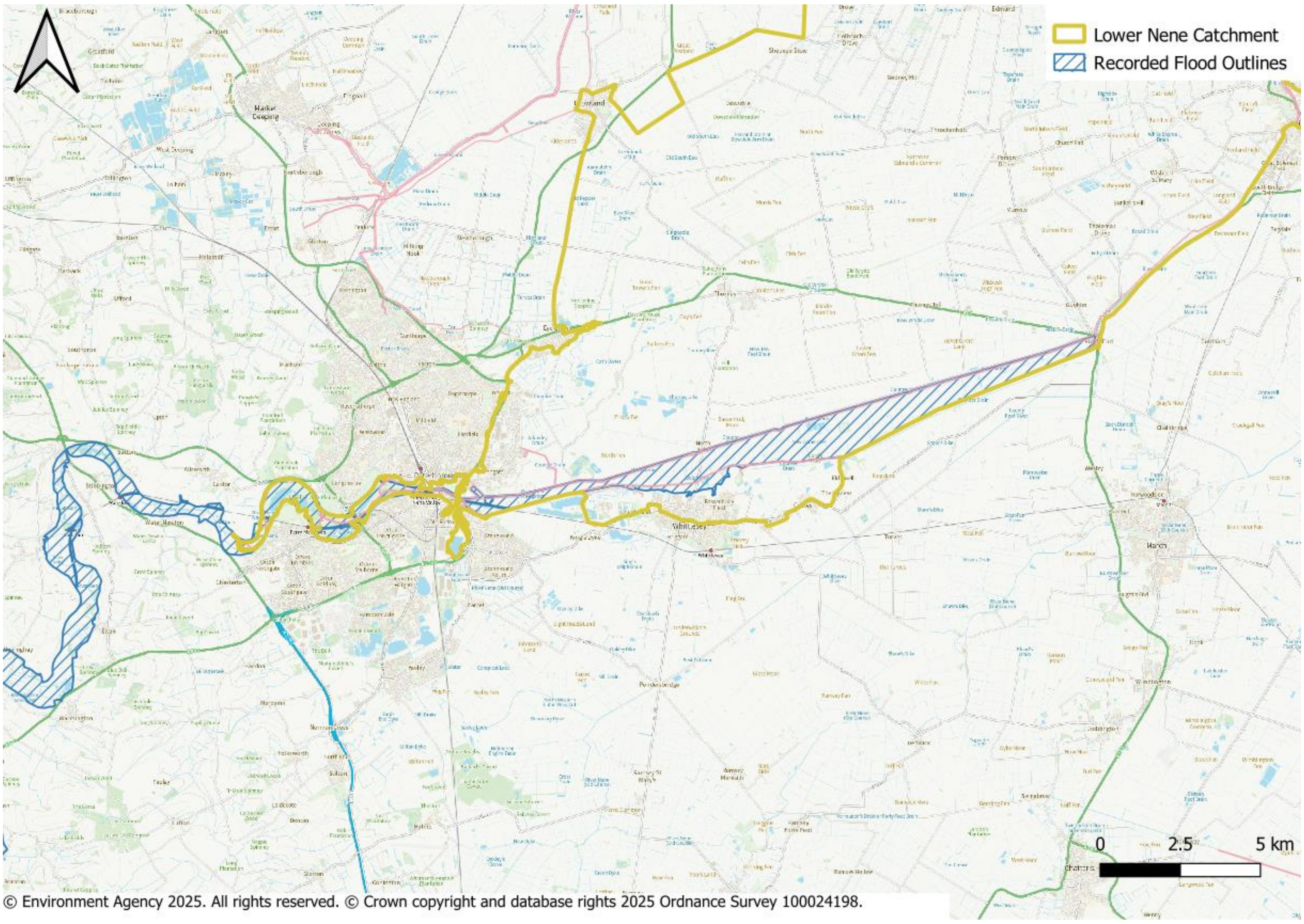


Figure 14: 1998 Environment Agency recorded flood extent

Figure 15: 1998 flooding at Orton Mere

2.5 2012

On 27th November 2012 heavy rain caused flooding from the River Nene at a number of locations, as shown in Figure 17.

Figure 16: River Nene flooding at Orton Mere[7]

2.6 2023

Heavy rainfall in Storm Babet leads to flooding along the River Nene in the vicinity of Peterborough and throughout the catchment.

2.7 February 2024

Heavy rainfall led to flooding of the Whittlesey (Nene) Washes and other areas of the catchment.

2.8 Other events

The flood events detailed in the preceding sections detail the flood history of the catchment where records have been found. Recorded flood history is likely to be biased towards flooding that impacts properties.

It is expected that there will be more instances of flooding of agricultural land that have not been recorded.

---

[7] https://www.peterboroughimages.co.uk/peterborough-in-flood-november-2012/>

2.9 Discussion

There is a long history of flooding the Lower Nene catchment, with records dating back to 1876. The flood history can be separated into two locations; upstream and downstream of the Dog-in-a-Doublet Sluice. The flood mechanisms at these locations are different and are discussed in more detail in the following sections.

2.9.1 Upstream of Dog-in-a-Doublet Sluice

Peterborough is upstream of the Dog-in-a-Doublet Sluice, which provides protection to the city from tidal flooding. The flood history at this location is largely due to fluvial flooding from 1937 onwards.

Many of the flood events recorded upstream of the Dog-in-a-Doublet Sluice involve out-of-bank flooding around Orton Mere, but with no recorded commercial or residential flooding. This description can be applied to the events of 2023 and 2012. Both events were fluvial in nature.

The two events that caused the most damage within Peterborough were those of 1947 and 1998, which were both fluvial in nature.

2.9.2 Downstream of Dog-in-a-Doublet Sluice

Wisbech and East Sutton both experienced flooding during the 1978 tidal event, though it is notable the defences in this location were improved following this event (and again in 2010). Since these improvements were made, no other flood events impacting property have been recorded.

A number of other recorded flood events have been recorded downstream of Dog-in-a-Doublet sluice gates, within the Whittlesey (Nene) Washes – whilst there is significant flooding of agricultural land, the Whittlesey (Nene) Washes acts as a flood storage reservoir, flooding during high flow events to protect downstream agricultural land, as such these events are not strictly flood events.

3. Methodology and data review

3.1 Methodology

The methodology used in this assessment is to use best available information (i.e. no new modelling work has been undertaken for this study) to document both current and future flood risk and has been agreed with the Environment Agency. This assessment has been informed by a review of the existing hydraulic modelling and engagement with the relevant Environment Agency teams.

The following sections detail the existing datasets used to determine the baseline flood risk in the Lower Nene catchment.

3.2 Detailed hydraulic modelling

As part of the modelling methodology report a review of all detailed models in the Fens 2100+ was undertaken. The review found that in the Lower Nene catchment, there were two models that could be used to describe flood risk and which a number of metrics could be extracted from:

- 2021 Tidal Nene Strategy Model.
- 2010 Northern Area Tidal Modelling.

Both these models are described in more detail in the proceeding sections.

The 2013 Lower Nene fluvial model was reviewed to determine its suitability for use, however there is no mapping downstream of Peterborough, as such its outputs would be of limited use within this study.

The 2013 Padholme drainage model was also considered for use in this study, however it was discounted as it was 1D only and there would be uncertainties in the flood extents produced as part of this study.

The Middle Nene model only covers a small area of the catchment upstream of Peterborough, as such it is considered it is of limited use in this study.

3.2.1 2021 Tidal Nene Strategy Model

A 1D-2D model of the River Nene from Stanground Lode to the confluence with the North Sea was developed to provide an evidence base to support scoping of the Tidal River Nene Strategy.

The modelling has assessed a range of tidal AEP events; however, no fluvial scenarios have been undertaken. All tidal scenarios have been run with a 50% AEP fluvial event as the inflow boundary to the model. The following scenarios have been undertaken:

- 50% fluvial with 0.5% AEP tidal;
- 50% fluvial with 0.33% AEP tidal;
- 50% fluvial with 0.1% AEP tidal.

The model extent is shown in Figure 17. Only tidal flooding from the River Nene channel has been represented in this model. Flooding arising from overtopping or failure of the tidal defences along the coast has not been represented.

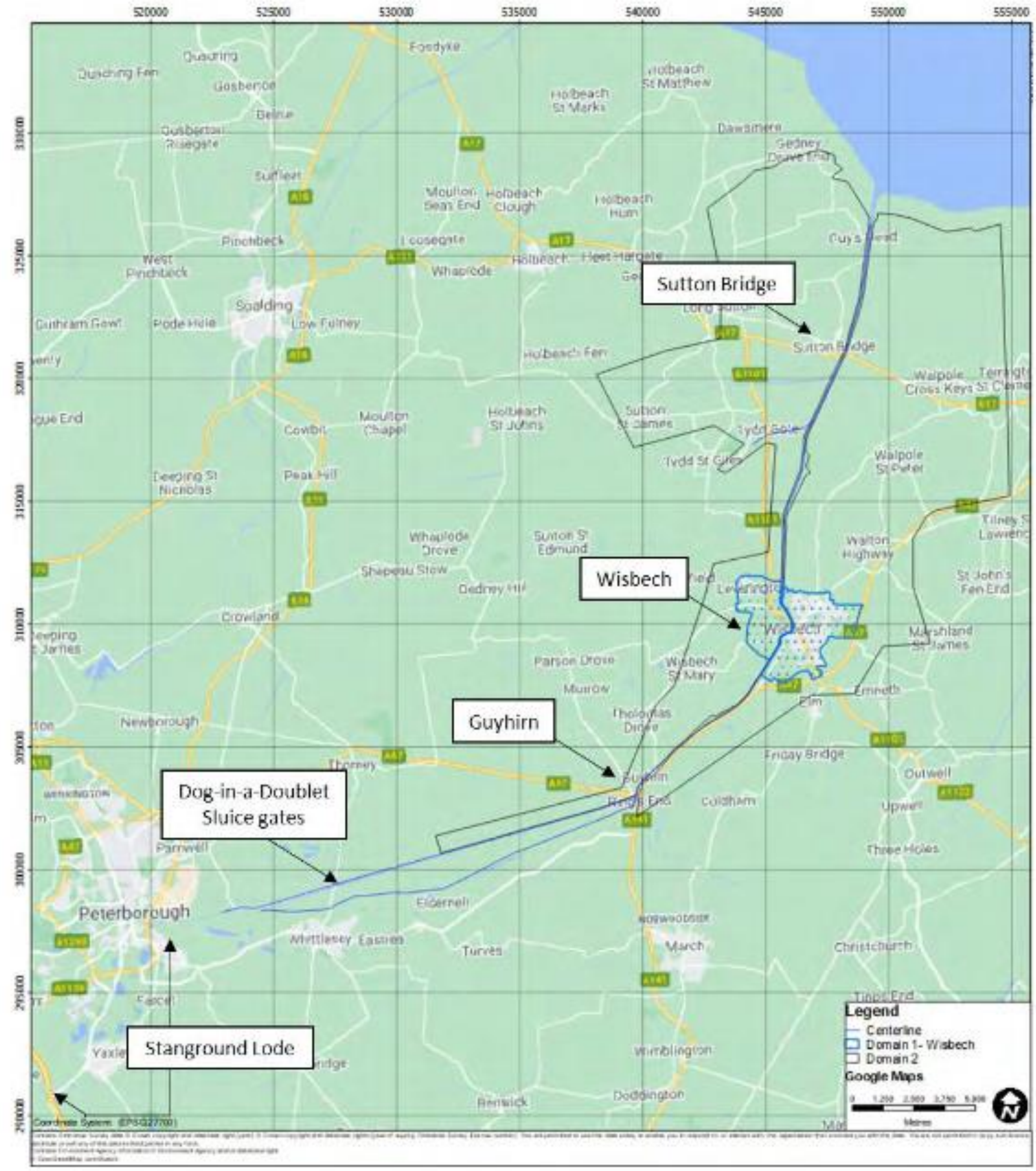


Figure 17: 2021 Tidal Nene Strategy Model extent © Environment Agency

3.2.2 Northern Area Tidal Modelling

In 2010, Mott MacDonald, on behalf of the Environment Agency undertook tide, surge and wave analysis of the coastline from the Humber to The Wash. The results from this analysis were then input into a 2D TUFLOW model of the same area to understand the flood risk. The study area for the modelling is shown in Figure 18.

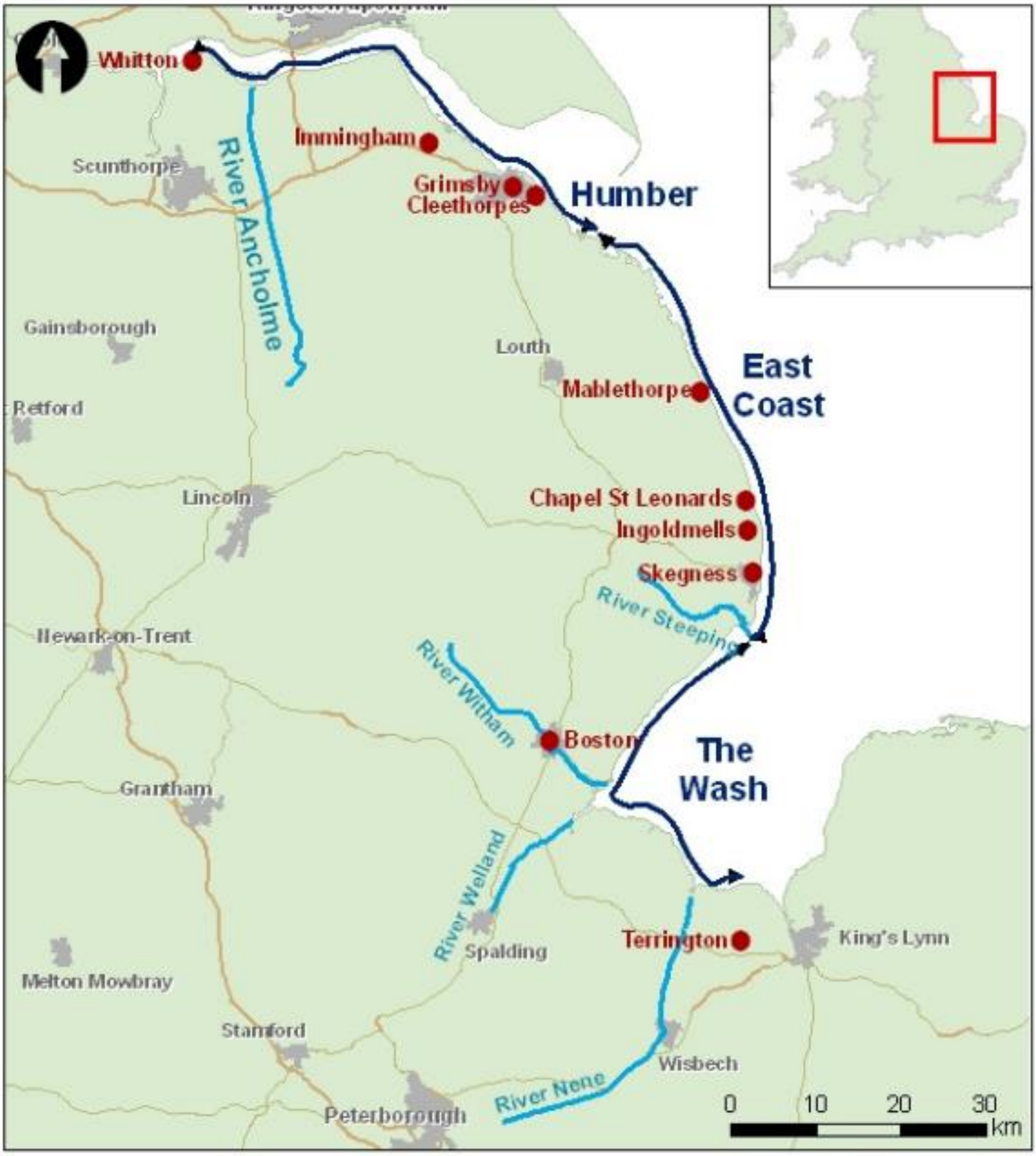


Figure 18: Northern Area Tidal Modelling study area, extracted from the Northern Area Tidal Modelling report © Environment Agency

As part of the inundation modelling, defended and undefended scenarios were considered.

The modelling only assessed tidal flood risk - no representation of fluvial flooding was undertaken as part of this modelling study.

As part of the same study, a detailed analysis of the wind and wave conditions in the study area was undertaken. This established the 1 in 1 year wave conditions and was used in the TUFLOW inundation modelling. For the climate change scenarios, a 10% uplift has been applied to wave inflows.

Figure 19 details the events undertaken as part of the Northern Area Tidal Modelling study.

Water Level - Event Scenario	Water Level - Annual Exceedance Probability	Wave Condition	Present Day (2006)	Climate Change (2115)
1 in 10	10%	1 in 1 annual chance	Humber and East Coast models and for internal use only.	x
1 in 75	1.3%	1 in 1 annual chance	√	x
1 in 100	1%	1 in 1 annual chance	√	x
1 in 150	0.7%	1 in 1 annual chance	√	x
1 in 200	0.5%	1 in 1 annual chance	√	√
1 in 1000	0.1%	1 in 1 annual chance	√	√

Figure 19: Events modelled as part of the 2010 Northern Area Tidal Modelling © Environment Agency

An update of the coastal modelling is currently in progress and is due to be delivered in March 2026.

3.2.3 Limitations

The following limitations are associated with the data:

- Both models are Environment Agency – therefore are primarily interested in flooding from tidal and Main Rivers, as such the representation of flooding from drainage ditches is likely to be simplistic of not represented at all.
- The 2010 model did not include any fluvial elements;
- The 2010 model used tidal boundary data that is now 15 years old – these levels will certainly have changed; and
- The 2010 model uses LIDAR data has been superseded by finer resolution data.
- The 2021 Lower Nene did not include an assessment of joint probability, and the tidal events are modelled with a 50% fluvial AEP event. There may be a risk that there is a significant fluvial element to flooding, however this has not been assessed within the modelling.
- At time of writing, the 2021 Tidal Nene Strategy Model has not been fully approved by the Environment Agency for use.

3.3 Other Data Sources

3.3.1 National Flood Risk Assessment

The National Flood Risk Assessment (NaFRA) consists of several different products, including:

Risk of Flooding from Rivers and Sea – A geospatial dataset which divides the floodplain into 50m x 50m cells and each allocated one of four flood risk likelihood categories.

Reduction in Risk of Flooding from Rivers and Sea Due to Defences – Produced using the defended scenario of flood risk in the Risk of Flooding from Rivers and Sea dataset and an undefended scenario of flood risk from rivers and sea.

Risk of Flooding from Surface Water (RoFSW) - A geospatial dataset the floodplain split into 2m x 2m cells and each allocated one of four flood risk likelihood categories.

Risk of Flooding from Multiple Sources (RoFMS) - A geospatial dataset combining data from RoFRS & RoFSW. The RoFMS inherits the appearance of the input datasets. When both RoFRS and RoFSW indicate a risk in the same area, the RoFSW (surface water flood risk) will be the more prominent feature, indicating the potential for flooding from surface water in that specific location (see Figure 20).

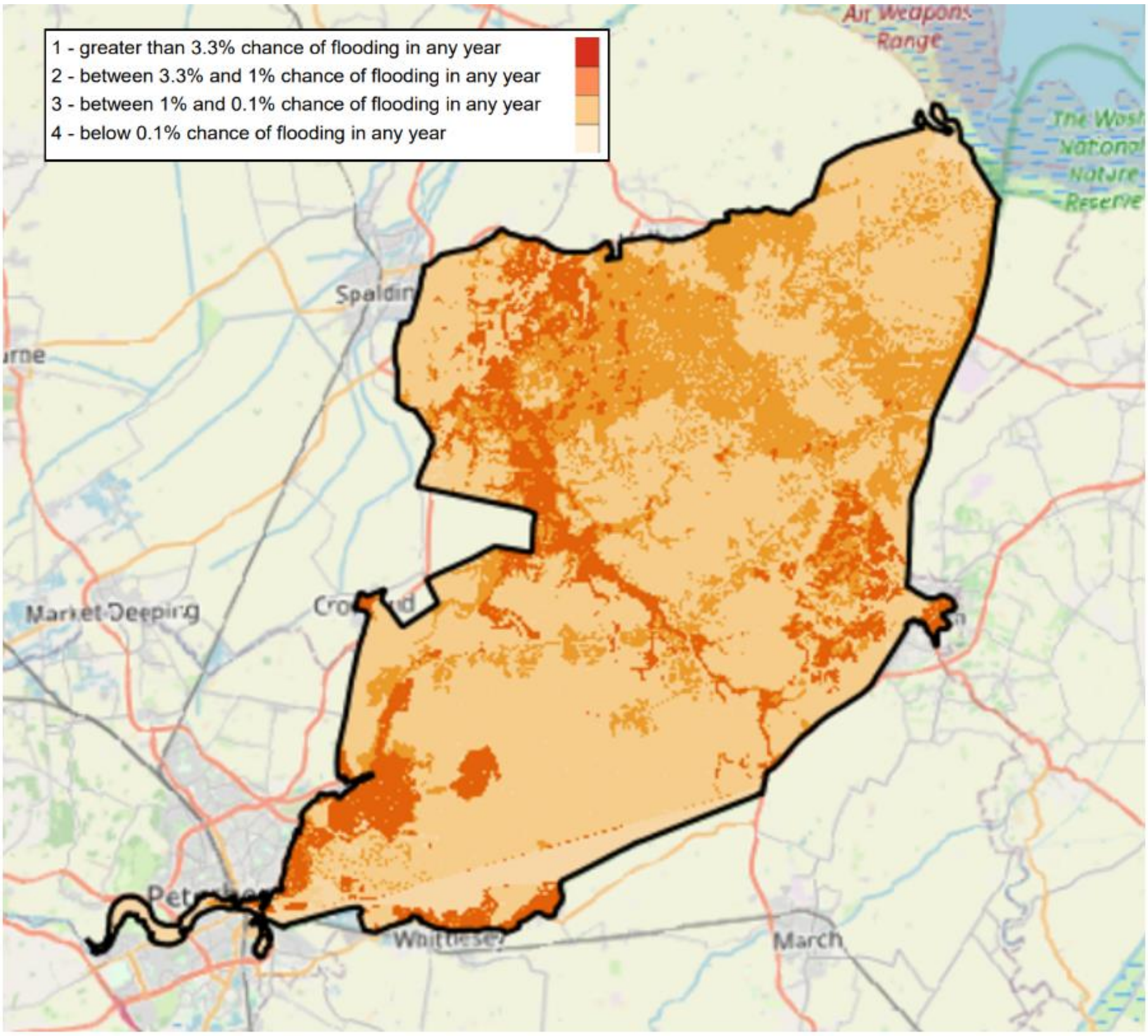


Figure 20: Risk of flooding from multiple sources (Environment Agency, 2025)

Reduction in Risk of Flooding from Rivers and Sea Due to Defences - Produced using the defended scenario of flood risk in the Risk of Flooding from Rivers and Sea dataset and an undefended scenario of flood risk from rivers and sea.

Reduction in Risk of Flooding from Rivers and Sea Due to Defences - Produced using the defended scenario of flood risk in the Risk of Flooding from Rivers and Sea dataset and an undefended scenario of flood risk from rivers and sea.

Flood Zone 2 - It is the best estimate of the areas of land at risk of flooding, when the presence of flood defences is ignored and covers land between Zone 3 and the extent of the flooding from rivers or the sea with a 0.1% AEP of flooding each year.

Flood Zone 3 - It is the best estimate of the areas of land at risk of flooding, when the presence of flood defences is ignored and covers land with a 1% AEP or greater chance of flooding each year from Rivers; or with a 0.5% AEP or greater chance of flooding each year from the Sea.

The datasets listed above, have been developed using an 'undefended' approach – i.e. the tidal and fluvial flood defences have been removed. Given the low lying nature of the majority of the catchment and the reliance on flood defence assets, this will inevitably result in an over-prediction of current flood risk. The dataset does not include any allowance for climate change. It would also not represent flood risk accurately in a heavily pumped catchment such as the Lower Nene catchment.

As this catchment has detailed models for both fluvial and tidal flood risk, NaFRA has not been used in this assessment.

3.3.2 National Flood Risk Assessment 2

National Flood Risk Assessment 2 (NaFRA2) includes:

- NaFRA2 software system: a web-based IT solution for Environment Agency staff; and
- New National Modelling (NNM): provides hazard outputs for rivers, sea, and surface water for various scenarios.
- For NaFRA2, the focus is on local modelling, though limited detailed local models are available within the catchment. The NNM will be used throughout most of the catchment and features:
- Models using JFlow GPU software;
- A 2m model grid based on the Environment Agency's Integrated Height Model 2019 and Defra Marine DEM;
- Outputs including maximum depth, level, etc.; and
- Present day and climate change scenarios.

However, the specific Fens model developed for NaFRA2 is not available for this project, as it is not currently approved for use locally.

3.3.3 Internal drainage board models

We have not been made aware of any models produced by the Internal Drainage Boards for this catchment. Although there are Environment Agency models for both fluvial and tidal flood risk as detailed in Section 3.2, these models would be of limited use when trying to understand the wider drainage network.

3.4 Discussion

As shown above, there are two suitable models to represent tidal flood risk for the Nene catchment. Whist they both represent tidal flooding, the represent different aspects of tidal flooding.

The recent 2021 Tidal Nene model represents tidal flooding from the River Nene channel *only*. The 2010 Northern Area Tidal modelling represents wave overtopping and tidal flooding to coast – it does not represent flooding from the River Nene channel directly. There is also no fluvial element in this model.

As detailed in Section 3.2 there are no suitable fluvial models available for the whole Nene catchment. This study has investigated using the NaFRA modelling outputs to describe current and future flood risk, however a review of the data shows that NaFRA is unsuitable for this in the Nene catchment – this is because:

- NaFRA combines both fluvial and tidal flood risk – as such it is impossible to separate the two – particularly towards the coast.
- NaFRA is modelled as undefended – it does not include the embankments and sluices that provide a high degree of protection from fluvial flood events.

The above limitations mean that the current and future flood risk sections of this report will be narrative, only using available historic flood data.

3.5 Other sources of information

3.5.1 Peterborough City Council Strategic Flood Risk Assessment (2018)

Peterborough City Council SFRA was completed in January 2018 and provides an assessment of flood risk to inform the Council's strategy for delivering sustainable development. No further modelling was undertaken as part of the SFRA.

3.5.2 Fenland District Council Level 1 Strategic Flood Risk Assessment (2022)

Fenland District Council SFRA was completed in June 2022 and provides an assessment of flood risk to inform the Council's strategy for delivering sustainable development. No additional modelling was undertaken as part of the SFRA.

3.5.3 South East Lincolnshire Strategic Flood Risk Assessment (2017)

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

3.6 Key receptors

3.6.1 Settlements

The Lower Nene catchment encompasses a range of urban areas and settlements, most notably the centre of Wisbech; Long Sutton; Sutton Bridge and parts of Holbeach; Whittlesey; Crowland; Thorney; and Peterborough; as well as a range of other smaller village settlements.[8] It can be noted that that almost 9.6km^2 (960ha) of the catchment (1.7%) is classified as of urban use. Connectivity within the catchment is supported by key transport routes, such as the A17, A16 and A47.

[8] Arup (2024) Technical Note: Fens 2100+ The Lower Nene Catchment-scale desk study: Agricultural Baseline

3.6.2 Agriculture

The Fens is an area of significant agricultural value due to its loamy and clayey soils of coastal flats with naturally high groundwater[9]. Farms across the catchment are mainly focused on the production of arable and grassland crops.

Across the catchment, around 505km^2 (91.4%) of land is classified as ALC Grade 1 and 2 land, with the largest majority being classified as Grade 2 land. Table 1 presents an overview of ALC classification in the catchment.

Throughout the catchment, though particularly in South Holland, where higher value cropping is most concentrated, there is also an increasing use of cover crops on winter fallows as the agricultural transition is leading to more regenerative farming practices. Many of these cover crop areas are being grazed by store livestock over the autumn and winter to incorporate organic matter into the soil.

Table 1: Overview of ALC classification within the catchment

	Grade 1	Grade 2	Grade 3	Grade 4	Non-agricultural
Area (km^2)	230km^2 (23,000ha)	275km^2 (27,500 ha)	29km^2 (2,900ha)	6.4km^2 (640ha)	2.4km^2 (240ha)
Percentage of catchment (%)	41.4	50	5.3	1.2	0.4

9 Land IS (2024). Land Information Service, Soilscapes, Cranfield Environment Centre, Cranfield University. [online]. Available at https://www.landis.org.uk/soilscapes/ [Accessed 5th October 2024]

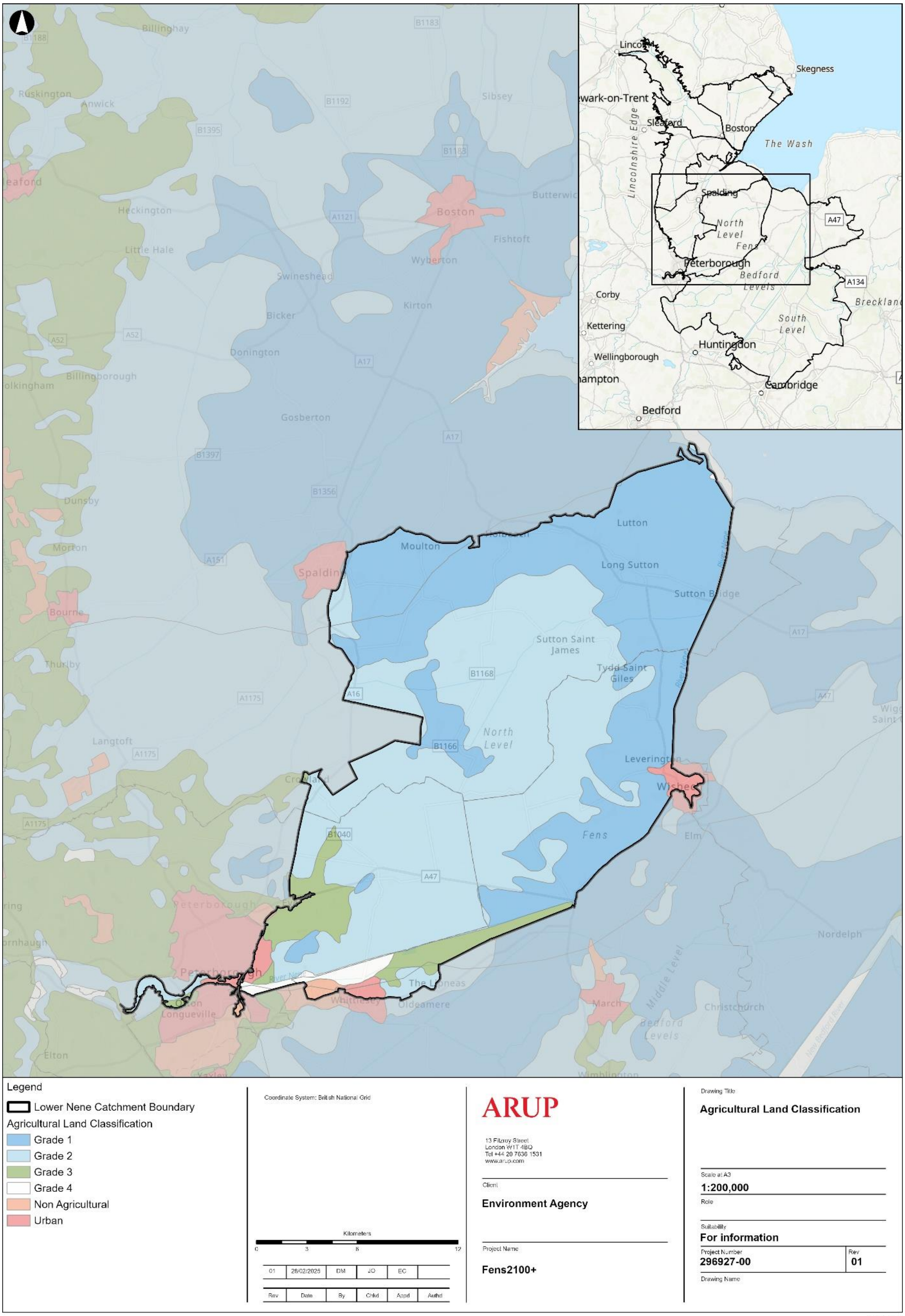


Figure 21: Land classifications across the catchment

Approximately 432km^2 (78%) of land across the Lower Nene catchment is currently farmed.

It is estimated that the agricultural value of the crops grown on this land (based on data) is as follows:

- Cereal production – c.£31.5 million;
- Other arable – c.£27.7 million; and
- Fruit and vegetables – c.£63.6 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 crops and livestock is in the region of £187.4 million, highlighting the importance of the agricultural sector.

4. Climate change

The impact of climate change has been represented in the models used in this assessment to define tidal and fluvial flood risk. Climate change allowances for tidal and fluvial flood risk have changed since they have first been applied to flood studies.

4.1 Tidal climate change

4.1.1 2021 Tidal Nene Strategy

Climate change has been assessed as part of the 2021 Tidal Nene Strategy model. Climate change has been applied up to 2120 using the Higher Central allowance for the Anglian region as per 2016 Environment Agency guidance. This is the same as the current guidance. The values used are shown in Table 2.

Table 2: Current Environment Agency Sea Level Rise

Area of England	Allowance	2000 to 2035 (mm)	2030 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
Anglian	Higher central	5.8	8.7	11.6	13	1.20
Anglian	Upper end	7	11.3	15.8	18.1	1.6

The peak levels used in this study were:

- 0.5% AEP event – **5.84mAOD**.
- 0.1% AEP event – **6.16mAOD**.

4.1.2 2010 Northern Area Modelling

Climate change has been assessed as part of the Northern Area Tidal Modelling up to 2115, calculated rates of sea level rise used in this study are shown in Figure 22.

Years	Net Sea Level Rise (mm/yr)	Calculated Sea Level Rise (m)
2006 - 2025	4	0.08
2025 - 2055	8.5	0.26
2055 - 2085	12	0.36
2085 - 2115	15	0.45
Calculated Total Sea Level Rise (2006 – 2115)		**1.14**

Figure 22: Sea level rise used in 2010 Northern Area Tidal Modelling

The sea level rise applied to the design peak water levels generates a level of **7.15mAOD** at West Lighthouse.

Since the study was completed in 2010, sea level rise estimates have been revised. Current Environment Agency recommends assessing against two scenarios: Higher Central and Upper End as shown in Table 3.

Table 3: Sea level allowances for each epoch

Area of England	Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	Cumulative rise 2000 to 2125 (metres)
2025 Anglian	Higher central	5.8	8.7	11.6	13	1.20
	Upper end	7	11.3	15.8	18.1	1.60

For flood risk assessments and strategic flood risk assessments both the higher central and upper end allowances will need to be assessed.

Flood and Coastal Erosion Risk Management (FCERM) schemes are typically assessed against the higher central. Given the long-term nature of the Fens 2100+ project, the 2080s epoch with the higher central allowance is most applicable to this study as this is what FCERM scenarios should be tested against. This is to understand the impacts of higher scenarios of climate change and any extra mitigation.

These estimates have been compared to those applied in the 2010 modelling, shown in Figure 23. This shows that the estimates used in the 2010 study lie between the Higher Central and Upper End. Given that FCERM schemes typically assessed against the higher central it is considered that the climate change estimates used in the 2010 modelling are appropriate for use in this study.

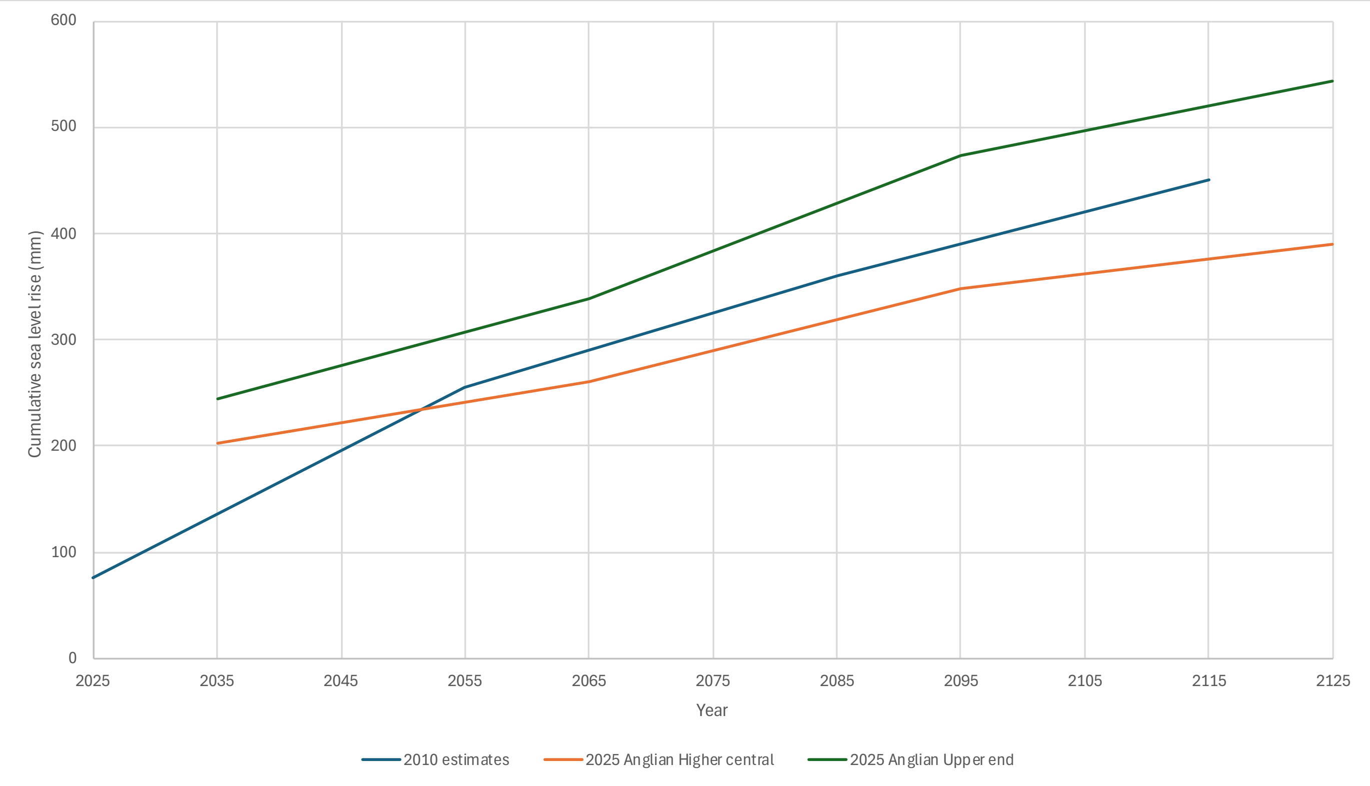


Figure 23: Comparison of sea level rise estimates

4.1 H++ scenario

The Fens 2100+ project is a long term adaptive plan for the landscape as such the H++ is a useful sensitivity test. Current Environment Agency guidance states that a value of 1.9m up to 2100 should be used (There is no H++ value for sea level rise beyond 2100).

None of the available modelling for the Lower Nene catchment includes an assessment of the H++ scenario. The most extreme value for climate change used within the 2010 modelling (as detailed in Figure 22) is 1.14m – this is considerably smaller than the value if 1.9m. We can therefore infer that the H++ scenario would show significantly more flooding (depth and extent) than the results presented in the proceeding sections.

4.2 Fluvial climate change

Latest climate change guidance for the Nene Management Catchment (where the River Nene catchment is located), is provided in Table 4.

Table 4: Nene Management Catchment peak river flow allowances

	Central	Higher	Upper
2020s	-2%	4%	18%
2050s	-7%	0%	17%
2080s	4%	13%	36%

For Flood Risk Assessments and Strategic Flood Risk Assessments the following are used:

- Flood zones 2 or 3a:

  - essential infrastructure – higher central allowance;
  - highly vulnerable – central allowance (development should not be permitted in flood zone 3a);
  - more vulnerable – the central allowance;
  - less vulnerable – the central allowance;
  - water compatible – the central allowance;
- Flood zone 3b:
  - essential infrastructure – use the higher central allowance;
  - highly vulnerable – development should not be permitted;
  - more vulnerable – development should not be permitted;
  - less vulnerable – development should not be permitted;
  - water compatible – use the central allowance.
- For FCERM schemes, the following are used:
  - Central allowance as the design allowance;
  - Higher central allowance to test the impacts of higher scenarios of climate change and any extra mitigation;
  - Extreme allowance to test the option under more extreme climate change and exceedance events; and
  - 2080s epoch allowances for changes beyond the 2080s epoch and up to 2115.

5. Tidal flood risk

5.1 Current tidal flood risk

Model results show that in the 0.5% AEP event there is very limited tidal flooding in the Lower Nene catchment owing to the presence of defences, limited to small parcel of agricultural land near the coast, as shown in Figure 24.

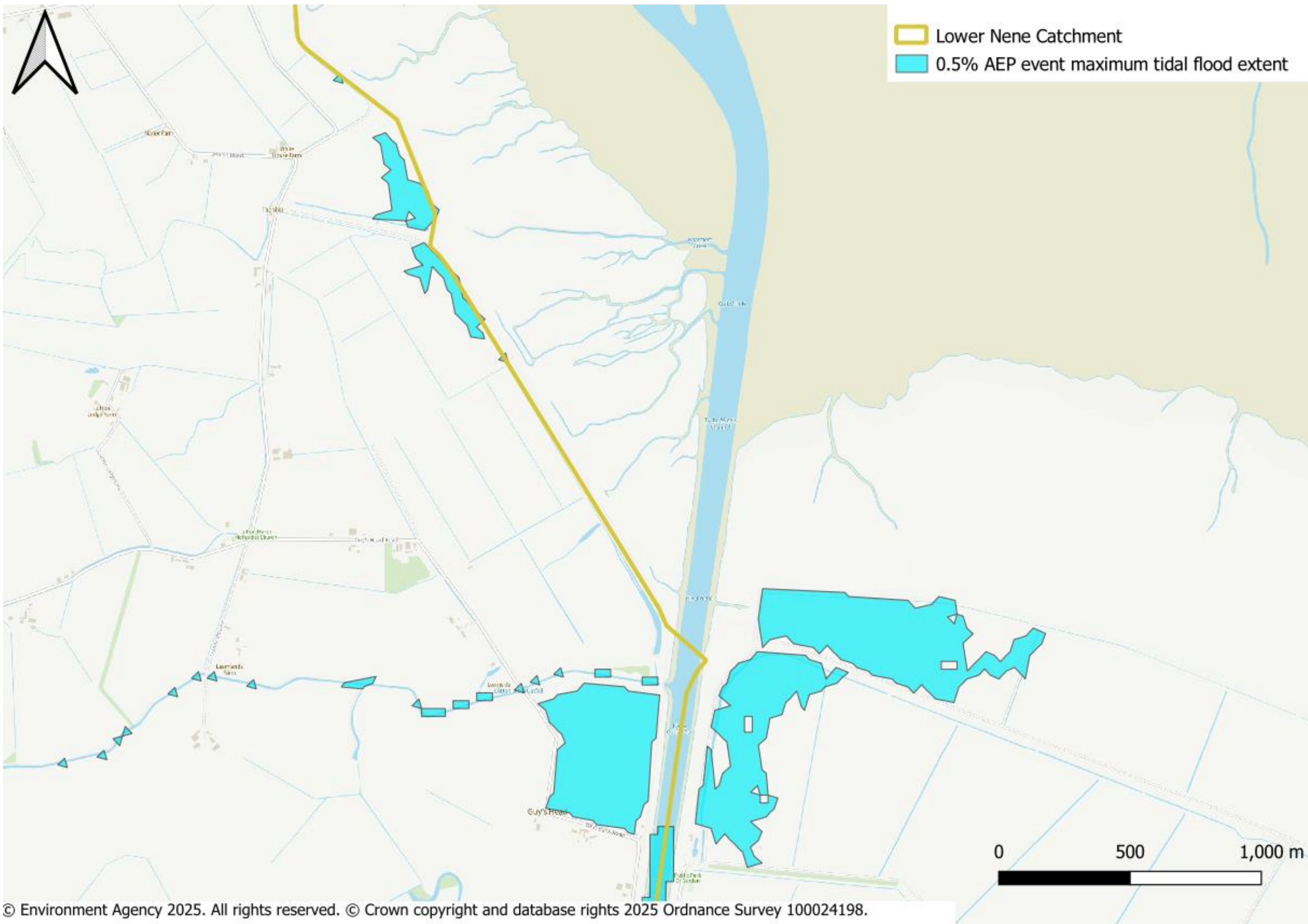


Figure 24: 0.5% AEP event tidal flood extent

There is not a significant increase flood extent of the present day 0.1% AEP event, though there is some additional flooding at Curlew Cottage and Sutton Bridge, as shown in Figure 25 and Figure 26. At Sutton Bridge, there is flooding to commercial properties on the left bank of the River Nene.

Figure 25: 0.1% AEP tidal flood extent at Curlew Cottage

Figure 26: 0.1% AEP event flood extent at Sutton Bridge

5.2 Future tidal flood risk

For the 0.5% AEP event with allowance for climate change, flood risk increases significantly in comparison to present day. This event shows significant overtopping of the River Nene embankments, resulting in flooding of large swathes of agricultural land, as well as large extents of Wisbech and Sutton Bridge, as shown in Figure 27.

The 0.5% AEP shows significant overtopping, causing significant flooding across the Lower Nene catchment.

At the 0.5% AEP, a number of settlements are at flood risk, these include:

- Wisbech
- Sutton Bridge

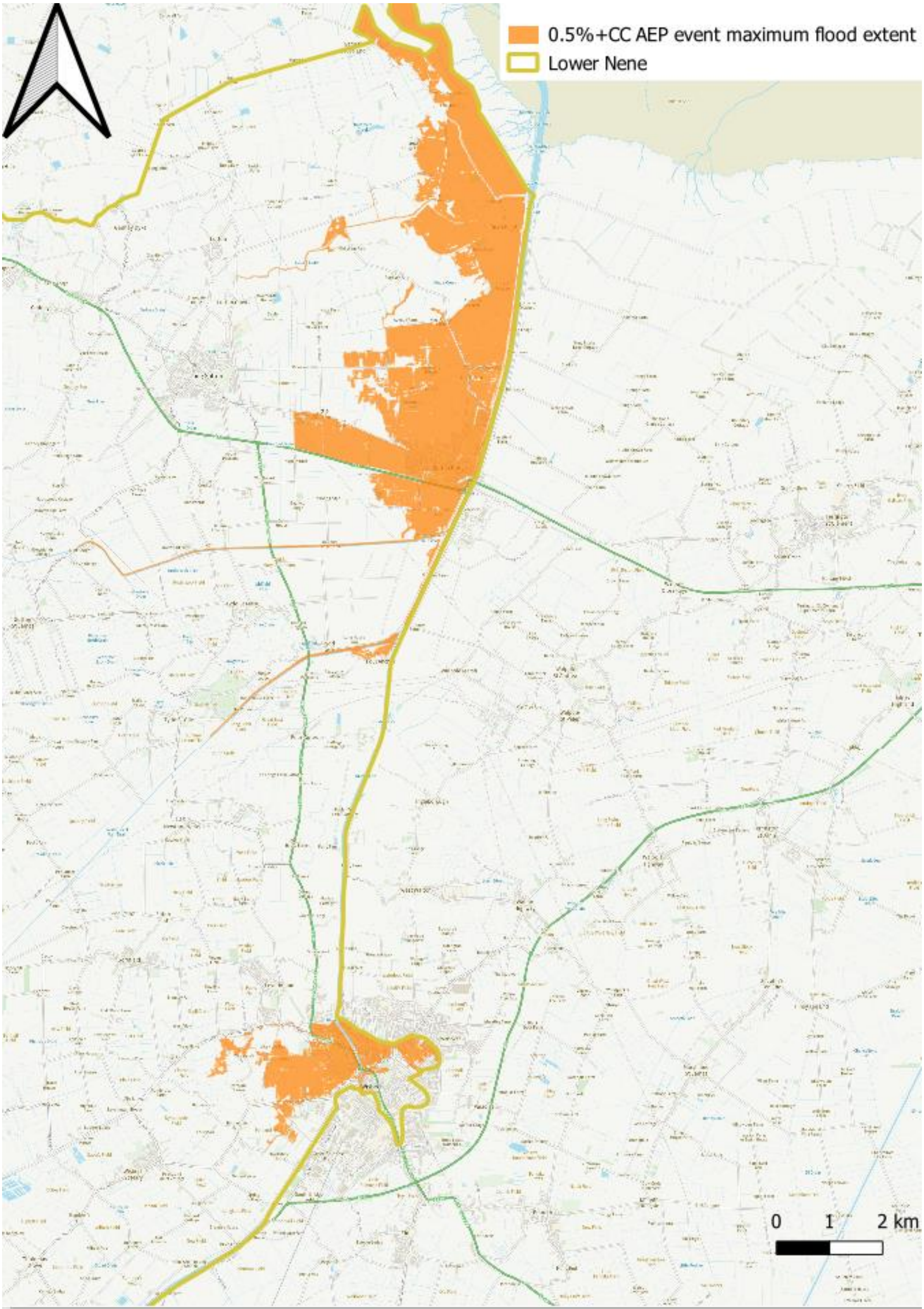


Figure 27: Tidal 0.5% with an allowance for climate change flood extent

5.3 Key metrics

5.3.1 Total area

The total area modelled to be at risk of tidal flood risk within the Lower Nene catchment is as follows:

- 0.5% AEP event – 0.58km^2 (58ha) – **0.10%** of total catchment area.
- 0.5% AEP with sea level rise to 2115 – 20.91km^2 (2,091ha) – **3.78%** of the total catchment area.
- 0.1% AEP event – 0.80km^2 (80ha) – **0.14%** of total catchment.

5.3.2 Grades of agricultural land

The agricultural land within the Lower Nene catchment area is assessed for flood risk based on different grades, this has been summarised in Table 5.

Table 5: Agricultural land grading at risk of flooding

Agricultural Grade	0.5% AEP (km^2)	0.5% AEP with allowance for climate change AEP (km^2)	0.1% AEP (km^2)
Grade 1	0.35km^2 (35ha)	18.91km^2 (1,891ha)	0.51km^2 (51ha)
Grade 2	0	0.23km^2 (23ha)	0
Grade 3	0	0	0
Grade 4	0.03km^2 (3ha)	0.1km^2 (10ha)	0.07km^2 (7ha)
Grade 5	0	0	0
Total	**0.38km^2 (38ha)**	**19.24km^2 (1,924ha)**	**0.58km^2 (58ha)**

5.3.3 Percentage area over 30cm flood depth

The area that floods over 30cm for each event is:

- 0.1% AEP event – **0.31km^2 (31ha)**
- 0.5% AEP with sea level rise up to 2115 event – **10.88km^2 (1,088ha)**
- 0.1% AEP event – **0.37km^2 (37ha)**

5.4 Discussion

The substantial increase in flood risk for the 0.5% AEP event, when accounting for climate change, highlights the vulnerability of the Lower Nene catchment to rising sea levels. This scenario demonstrates significant overtopping of the River Nene embankments, leading to extensive flooding of agricultural land and large areas of Wisbech and Sutton Bridge. In contrast, a present-day 0.5% AEP event results in minimal flooding, which does not affect settlements, property, or agricultural land. However, when climate change is factored into the same event, the flood extent is considerably greater, with several settlements predicted to be at risk.

6. Fluvial flood risk

6.1 Current fluvial flood risk

The Lower Nene catchment is defended, with flood defences along the entire stretch of the tidal River Nene consisting of raised earth embankments, with the exception of Wisbech, where defences consist of raised concrete walls on both the north and south banks.

The land between the Nene and South Barrier Bank is known as the Whittlesey (Nene) Washes Flood Storage Reservoir (FSR). Registered under the Reservoirs Act 1975 and operated by the Environment Agency. The Washes function as a flood storage area for the equivalent of 14,000 Olympic sized swimming pools of water. The storage area is contained by the Cradge Bank and the South Barrier Bank. Both the Whittlesey (Nene) Washes and the flood defences therefore provide a high degree of protection against extreme flood events – as evidenced by the low current tidal flood risk in the catchment (see Section 5).

Current fluvial flood risk in the Lower Nene catchment is limited to the area upstream of Dog-in-a-Doublet Sluice – at this location there have been a number of flood events, with flooding of both residential and commercial properties occurring. A review of the Environment Agency Flood Map for Planning at this location, shows that a large number of properties are at risk in the 1% AEP event and 0.1% AEP event – though the flood defences at this location are not represented – as such this outline is likely to be conservative (see Figure 28).

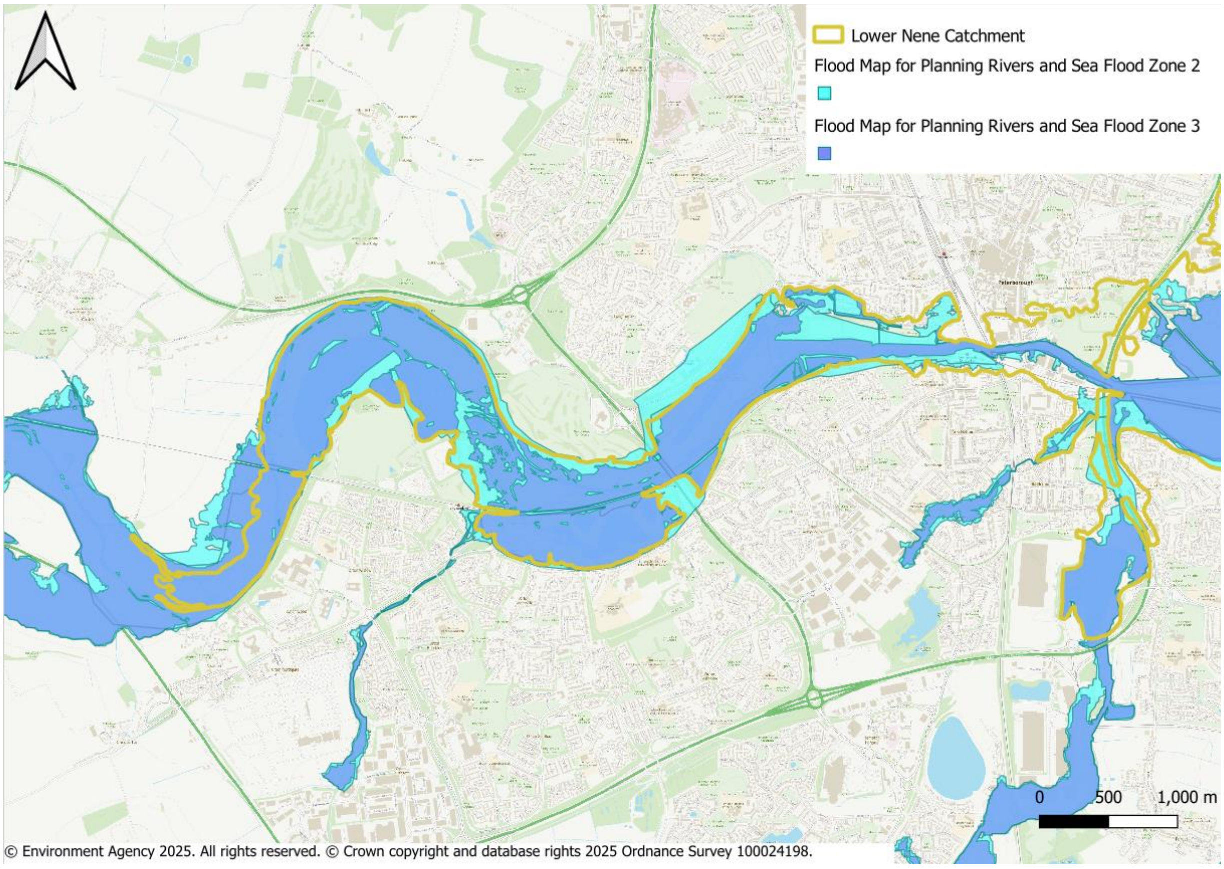


Figure 28: Environment Agency Flood Zones upstream of Dog-in-a-Doublet Sluice

6.2 Future fluvial flood risk

No suitable fluvial climate change modelling has been undertaken in the Lower Nene catchment, as such it is difficult to infer what the future fluvial flood risk will look like in the catchment.

Downstream of Dog-in-a-Doublet Sluice, the flood embankments and Whittlesey (Nene) Washes still provide a degree of protection in the future to increased fluvial flows, however it is likely that in extreme fluvial events such as the 1% AEP event there will be fluvial flooding of properties and agricultural land at and around Sutton Bridge and Wisbech, as these are areas that flood during the tidal climate change scenarios.

Upstream of Dog-in-a-Doublet sluice, where the current fluvial flood risk is greater, flood extents and depths will be larger than those shown in Figure 28.

6.3 Key metrics

As detailed in Section 3.4, there is no detailed fluvial flood modelling in the Lower Nene catchment, as such it has not been possible to generate fluvial flood metrics.

6.4 Discussion

The Lower Nene catchment area is well-defended against flooding, with raised earth embankments along the River Nene, except in Wisbech, where concrete walls provide protection. The Whittlesey (Nene) Washes Flood Storage Reservoir plays a crucial role in managing fluvial floodwaters, diverting excess water from the River Nene through the Stanground Sluice.

Historically, the Lower Nene catchment has experienced significant fluvial flooding, with notable events in 1946, 1950, and 1998. These floods have caused damage to both residential and commercial properties in various areas, including Wisbech and parts of Peterborough close to the River Nene, such as Thorpe Meadows.

Currently, the highest fluvial flood risk is upstream of the Dog-in-a-Doublet Sluice in Peterborough. However, predicting future fluvial flood risk is challenging due to the lack of suitable fluvial flood model for the Lower Nene catchment. While the NaFRA2 model provides some insights, it has limitations, such as assuming no defences are present and combining the different flood risks.

7. Other sources of flooding

Aside from fluvial and tidal, other sources of flooding include surface water, groundwater, and reservoirs. These sources can be the sole cause of flood events or compound the effects of flooding from fluvial or tidal sources. This section sets out these other sources of flood risk, and potential impacts from these sources. It will also consider historical events in the catchment which highlight these issues. This information is intended to provide a high-level summary of the risk of flooding from these wider sources.

7.1 Surface water

Surface water flooding occurs when intense rainfall results in an excess of overland flow before it can reach a watercourse or drainage network. This type of flooding can also happen when rainwater is unable to drain away through the usual drainage systems or soak into the ground. Contributing factors may include insufficient system capacity, saturated ground, or failures in the drainage network due to blockages or culvert collapses.

While surface water flooding is typically caused by high-intensity rainfall, it can also occur during lower-intensity rainfall if the land has low permeability. Permeability can be reduced by factors such as development, frozen ground, or already saturated soil. Additionally, flooding can occur if the drainage network is already at capacity, preventing water from draining efficiently to the intended watercourse or sewer.

The Environment Agency's long term flood risk service[10] provides mapping of surface water flood risk. It shows that flood risk from surface water is generally highly localised, with dense but small and isolated patches where surface water flooding is likely. However, there are larger areas of surface water flood risk across parts of central Wisbech, and in the area around Thorney. The Whittlesey (Nene) Washes also has a high risk of surface water flooding, with much of the central Whittlesey (Nene) Washes having more than a 3.3% chance of flooding each year. Peterborough's SFRA[11] also identifies the city as an area susceptible to surface water flooding.

7.1.1 Wisbech surface water flood event 9th May 2023

A recent occurrence of surface water flooding affected Wisbech in the location shown in Figure 29. This shows the approximately location of the reported flooding on Osborne Road, Wisbech.

A high-intensity storm resulted in surface water flooding affecting five properties on Osborne Road, Wisbech[12]. The intense rainfall quickly overwhelmed the local surface water drainage system, causing it to reach full capacity. Consequently, excess surface water flowed down the road to the lowest point, accumulating to a depth of approximately 300mm above the drain cover.

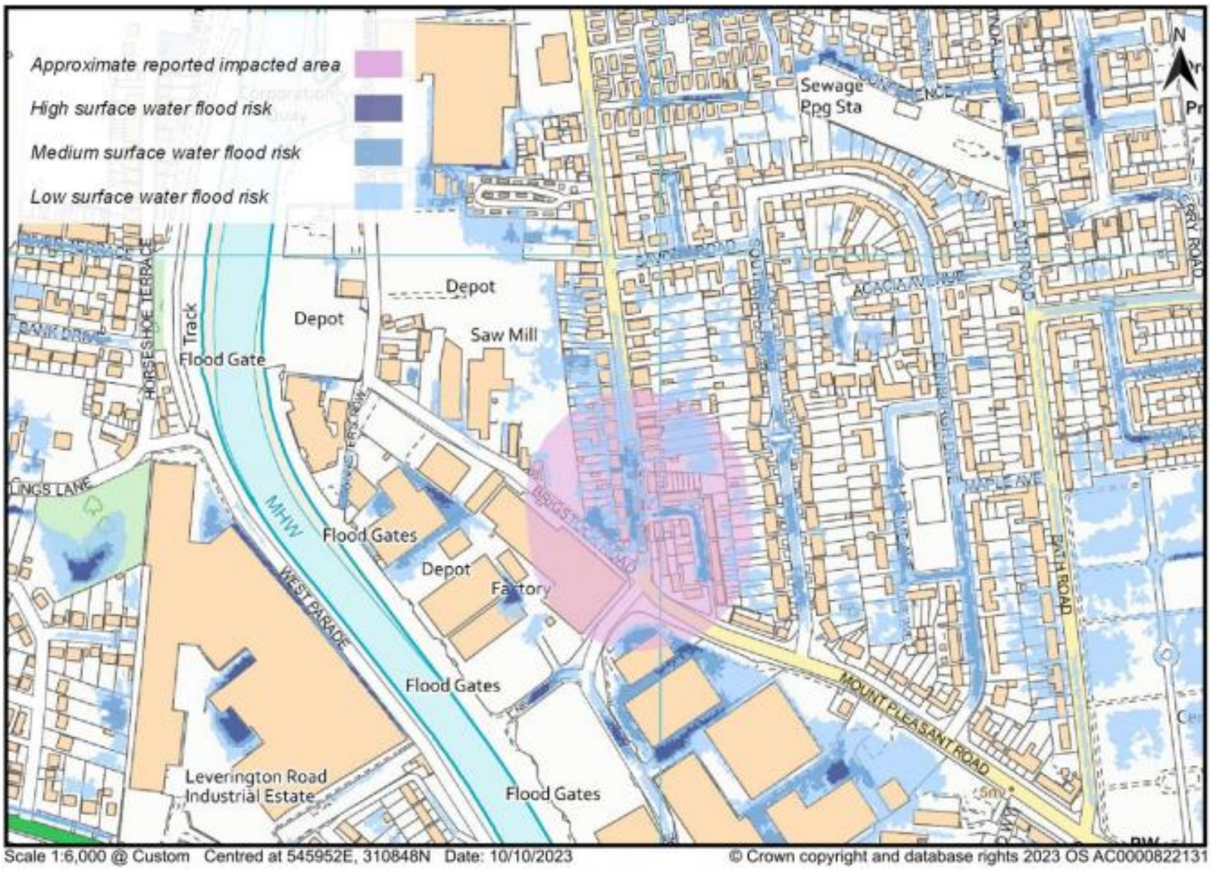
It was also reported that the sewer system in the area was overwhelmed by the excess surface water. The fire service attended the scene and pumped the water away. By 20:00, the water had subsided.

---

[10] Environment Agency (2024) Check the long term flood risk for an area in England. Available at: Information for planning - Check your long term flood risk - GOV.UK. Accessed 04/04/2025.

[11] Peterborough City Council (2018) Peterborough Level 1 Strategic Flood Risk Assessment & Outline Water Cycle Study. Available at: Local flood and water documents | Peterborough City Council. Accessed 08/04/2025.

[12] https://www.cambridgeshire.gov.uk/asset-library/wisbech-may-2023-flood-investigation.pdf



Scale 1:6,000 @ Custom Centred at 545952E, 310848N Date: 10/10/2023 © Crown copyright and database rights 2023 OS AC0000822131

Figure 29: Location of Wisbech surface water floods on 9th May 2023 © Cambridgeshire County Council

7.2 Groundwater

Groundwater flooding occurs when the water table, the level of the water within the land, rises above the ground surface. This type of flooding typically follows extended periods of sustained rainfall. Groundwater flooding can persist for a prolonged duration, often lasting longer than other types of flooding. Throughout the year, the water table naturally fluctuates in response to seasonal rainfall. Groundwater flooding is most common in spring, following prolonged rainfall during the preceding autumn. The presence of sandy or gravel soils can mean increased susceptibility to movement of groundwater and flooding from this source.

Across the Lower Nene catchment, the land is low-lying, which can contribute to a higher risk of groundwater flooding through the water table being at a shallow depth[13]. There is also a risk that any flooding will not recede for long periods of time due to the flat nature of the catchment and the reliance on pumping for drainage. Whilst no specific groundwater flood incidents are noted in the historic flooding events in the area, it is possible that high groundwater levels contributed to flooding in a number of historic flood events caused by other sources. The Peterborough Level 1 SFRA[14] records no previous flood events related to groundwater, although it acknowledges that to the west of the city at the furthest

[13] Peterborough City Council (2018) Peterborough Level 1 Strategic Flood Risk Assessment & Outline Water Cycle Study. Available at: Local flood and water documents | Peterborough City Council. Accessed 08/04/2025.

[14] Peterborough City Council (2018) Peterborough Level 1 Strategic Flood Risk Assessment & Outline Water Cycle Study. Available at: Local flood and water documents | Peterborough City Council. Accessed 08/04/2025.

western extent of the catchment, the exposure of solid geology could lead to water seepage through faults.

7.3 Reservoir

Reservoir flooding is very rare but occurs when there is a failure of reservoir impounding structures such as raised embankments. By far the largest reservoir in the study area is the Whittlesey (Nene) Washes. The Whittlesey (Nene) Washes is approximately 20km long and up to 1.4km wide in places and covers an area of 14.5km^2 (1,450ha)[15]. The reservoir can temporarily store the equivalent of 14,000 Olympic-sized swimming pools of flood water and reduces the risk of flooding to properties as well as roads, railways and more than 80km^2 (8,000ha) of farmland in the fenland area to the south-east of Peterborough. The Crowland and Cowbit Washes are a similar flood storage reservoir and are located just outside the south-western catchment boundary within the Lower Welland catchment.

The likelihood of Peterborough flooding from the failure of large, raised reservoirs is very low[16]. This is due to the high level of protection offered by the Reservoir Act. Nevertheless, the consequence of a failure of the retaining structures could be quick and catastrophic flooding of surrounding land and property. The Whittlesey (Nene) Washes is surrounded by low lying agricultural land with pumped drainage. As shown in Figure 30, any failure of the embankments would lead to large areas of land being flooded, as far north as Thorney and Murrow and as far east as Guyhirn. Similarly, the Crowland and Cowbit Washes are shown to breach eastwards in the event of a reservoir failure, affecting the eastern extent of the Nene catchment adjacent to Spalding, as well as rural areas further south (Figure 31). It is likely that flood waters would not recede for a long period of time due to the constrained capacity of pumping stations in the area.

---

[15] https://www.whittleseytowncouncil.gov.uk/wp-content/uploads/2022/07/Whittlesey-Washes-Factsheet-Spring-2022.pdf

[16] Peterborough City Council (2018) Peterborough Level 1 Strategic Flood Risk Assessment & Outline Water Cycle Study. Available at: Local flood and water documents | Peterborough City Council. Accessed 08/04/2025.

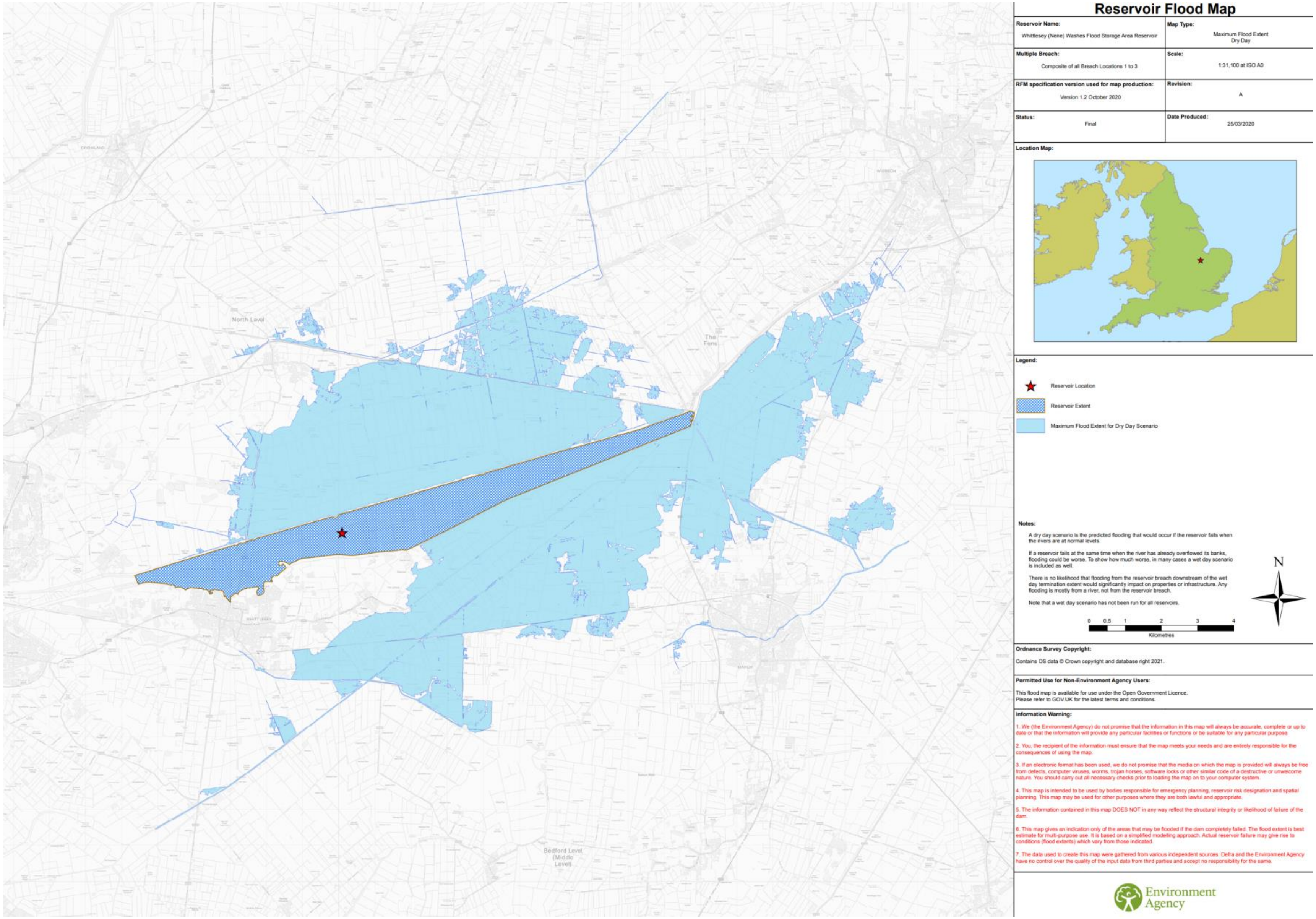


Figure 30: Reservoir Flood Map for the Whittlesey (Nene) Washes © Environment Agency

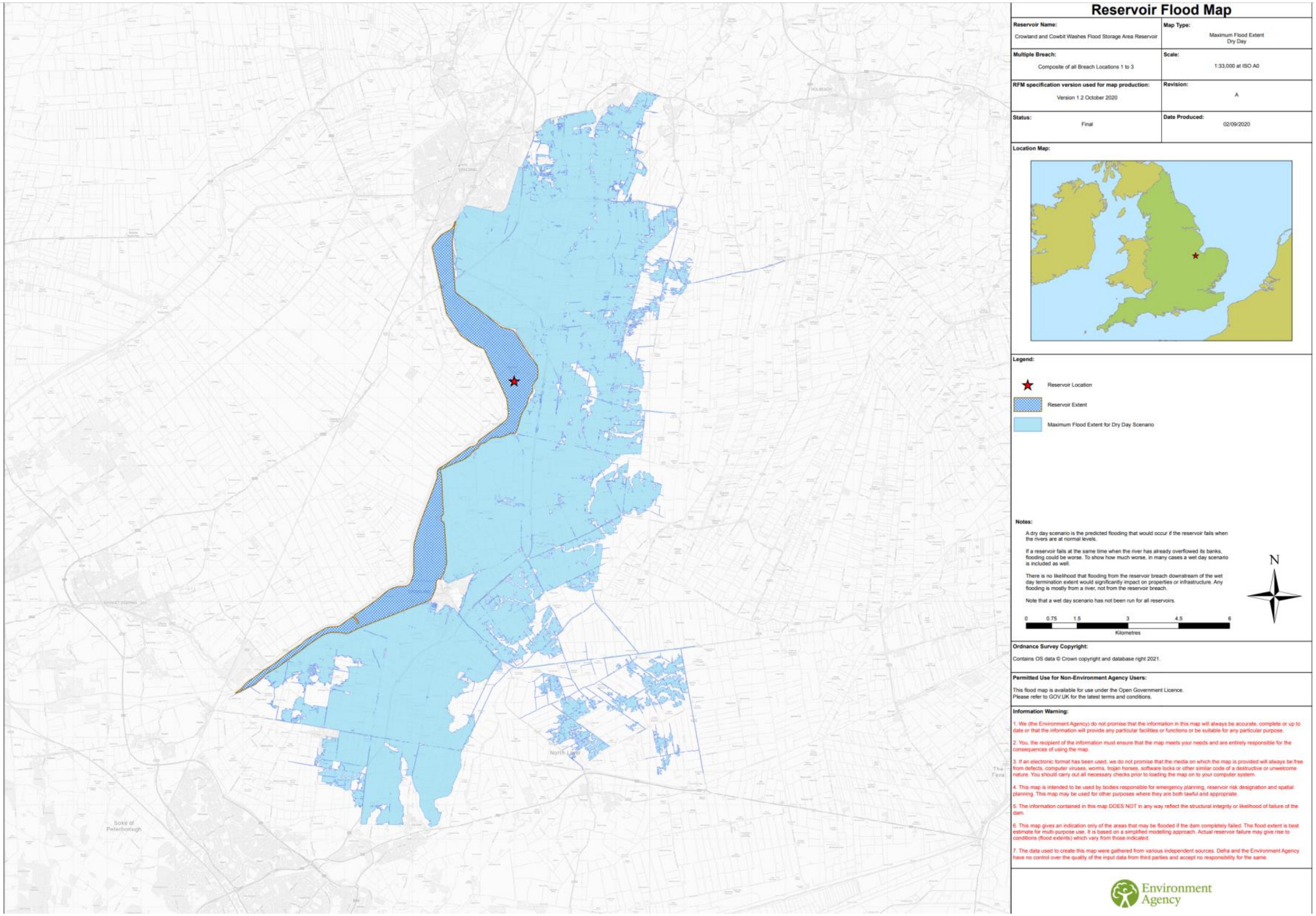


Figure 31: Reservoir Flood Map for the Crowland and Cowbit Washes © Environment Agency

8. Summary

8.1 Tidal flood risk

There are limited records of tidal flooding in the Lower Nene catchment following the construction of the Dog-in-a-Doublet sluice and the defence improvements at Wisbech following the flooding occurred in 1978. The defence improvements at this locations, as well as the presence other significant tidal flood embankments means that the current tidal flood risk in the Lower Nene catchment is low.

Tidal flood risk extents increase significantly when climate change is applied, however the extents are still small in relation to the size of the Lower Nene catchment – though the settlements of Wisbech and Sutton Bridge are at risk. What is notable though, is that the highest grade agricultural land makes up the vast majority of agricultural land at risk from tidal flooding in the future.

8.2 Fluvial flood risk

There is no detailed fluvial modelling of the Lower Nene catchment, as such current and future flood risk has been assessed based on historic flood records as well as where possible NaFRA (though for most the catchment, the data is of very limited use).

Current fluvial flood risk to the Lower Nene catchment is concentrated upstream of Dog-in-a-Doublet sluice, within Peterborough. At this location, commercial and residential properties appear to be most at risk during flood events.

Future fluvial flood risk is likely to mean that that flooding will increase in frequency and severity upstream of Dog-in-a-Doublet sluice, with Peterborough.

8.3 Conclusion

Present day tidal and fluvial flood risk is low downstream of Dog-in-a-Doublet sluice, with the flood embankments and defences, as well as the Whittlesey (Nene) Washes providing a degree of protection against both sources of flooding. Upstream of the sluice, there is evidence of risk to properties from fluvial flooding.

In the future, both tidal and fluvial flood risk will become greater in the catchment due to climate change, in particular around Wisbech and Sutton Bridge.