



# The Great Ouse Tidal River Strategy

Draft for consultation September 2009

# managing flood risk

The background of the lower half of the cover is a photograph of tall grasses in the foreground, with a blurred body of water and a blue sky in the background.

We are the Environment Agency. It's our job to look after your environment and make it **a better place** – for you, and for future generations.

Your environment is the air you breathe, the water you drink and the ground you walk on. Working with business, Government and society as a whole, we are making your environment cleaner and healthier.

The Environment Agency. Out there, making your environment a better place.

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## Our role

At the Environment Agency we have overall responsibility for flood risk management in England and Wales. Our aim is to reduce the threat of flooding to people and property whilst achieving the greatest environmental, social and economic benefits in line with the Government's principles of sustainable development. Over recent years there have been a number of major floods, which have increased the demand for resources. In the face of such challenges we need to be sure we are getting the best value for money, and this means making difficult decisions. To help identify sustainable ways of managing defences in the future, we are preparing flood risk management strategies in many areas.

## Great Ouse Tidal River Strategy

In view of these challenges we have prepared a strategy for the Great Ouse Tidal River which flows through Norfolk and Cambridgeshire. The area considered within our strategy boundary extends from Earith to King's Lynn and covers 408km<sup>2</sup>.

The aim of this document is to:

- explain what our Flood Risk Management Strategy aims to achieve;
- publicise our proposals for the Great Ouse Tidal River;
- explain the current level of flood risk and the effects of climate change;
- allow you to comment on the proposals and to identify any locally sensitive issues;
- explain what will happen after the strategy is adopted.



Silt bars in the Tidal River (downstream of Denver)

## Our study area

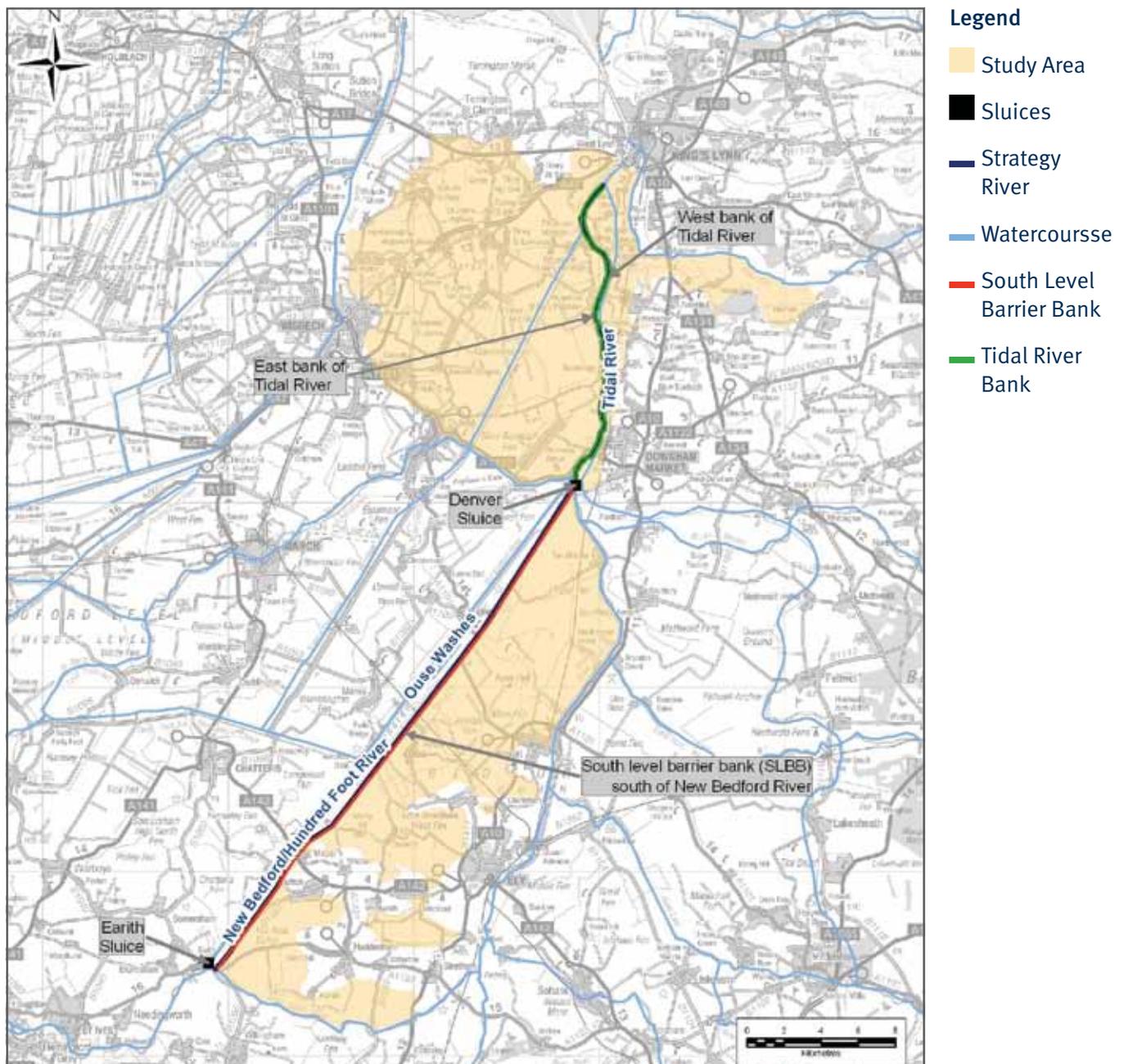
The strategy covers an area of the Cambridgeshire and Norfolk Fens shown in the plan below.

There are around 2400 properties and 26,000 hectares of agricultural land at risk of flooding in this area. These are currently protected by the South Level Barrier Bank and Tidal River defences.

## Aims of the strategy

The strategy aims to provide a 100-year management plan for the Great Ouse Tidal River. It will take into account:

- flood risk management – the best way to manage flood risk to people and property over the next 100 years;
- navigation – maintaining navigation access where possible;
- environment – finding ways of improving the environment and ensuring our strategy does not have a negative impact on the environment.



Map showing the Tidal River Flood Plain study area

## Existing flood risk

Floods are characterised by their size and how often they occur. The larger a flood, the less often it is likely to occur.

For example a flood with a 1% annual probability of occurring is also expressed as a flood that has a 1 in 100 chance of occurring in any given year. If a flood of this magnitude occurs in one year the chance of it occurring the following year is still the same, 1 in 100.

A flood with 0.5% annual probability of occurring is expressed as a flood that has a 1 in 200 chance of occurring in any given year. A flood of this size occurs less frequently than a flood with a 1% annual probability, but it is a larger flood and so causes more flooding of land and property.

Currently there are approximately 2400 properties in the Great Ouse Tidal River flood plain which would be at risk of flooding should the defences fail. Over the next 100 years this could rise to around 5000 properties due to the effects of climate change and sea level rise.

At present the South Level Barrier Bank flood defence provides a minimum standard of protection of 1 in 120 to over 750 properties in this area. The Tidal River Banks, which are north of Denver, are estimated to provide a standard of 1 in 500 or more to around 1600 properties.

## Climate change

Government guidance sets out how we should predict the effects that climate change may have on flood levels in the future. Using computer flood modelling we can identify how many properties may be affected by these changes. It is expected, for many areas, the standards of protection against flooding will decrease over time due to climate change.



Aerial view of the Denver Complex



Properties protected by the Tidal River Banks

## The Ouse Washes

In 1630, the Dutch engineer Cornelius Vermuyden created the two Bedford Rivers. The purpose of this was to improve the drainage of the Great Ouse between Earith and Downham Market. The area between the rivers (now called the River Delph and the New Bedford River) is 20 miles long and almost a mile wide, and it acts as a flood storage reservoir in the winter (and increasingly in summer). This area is called the Ouse Washes and is drained by the Great Ouse Tidal River.

The Ouse Washes are the largest area of frequently flooded grazing marsh in the UK. This makes them attractive to certain bird species (including breeding waders and overwintering birds). It is therefore now an area of international conservation importance and is a designated Special Protection Area.

Over the past 75 years river bed levels in the Great Ouse Tidal River have risen. Bed levels rise during droughts as silt is drawn in from the sea, on the tide, and settles in the Great Ouse Tidal River – primarily downstream of Denver Sluice. High river flows, following periods of drought, scour the majority of this silt back out to sea, but sometimes not all of it is removed. In addition, as a result of the construction of the Great Ouse Flood Protection Scheme 50 years ago, high freshwater flows in the Ely Ouse are now routed down the Flood Relief Channel instead of through

Denver Sluice. This has brought major flood risk benefits for the South Level but it has been achieved at the expense of reduced ‘flushing’ flows in the Great Ouse Tidal River and this in turn has led to higher silt levels in the Tidal River. These high bed levels have a negative impact on the drainage of the Ouse Washes as bed levels are often too high to allow water to drain by gravity into the river. As a result there has been increased flooding on the Ouse Washes for longer periods and to greater depths.

High river bed levels and increased flooding on the Ouse Washes create a number of issues:

- high bed levels can impede navigation;
- increased flooding harms habitat suitable for many of the rare birds which visit the site;
- it affects landowners who use the Ouse Washes as grazing marsh;
- users of Welney Road, which crosses the Ouse Washes, must take a 30-mile detour;
- as bed levels continue to rise in the future, the standard of protection provided by the South Level Barrier Bank may reduce;
- anticipated future sea level rise will make the problem of managing silt levels in the Great Ouse Tidal River increasingly difficult in future decades.



The Ouse Washes in flood

## How we have developed our strategy

We apply a clearly defined approach to assessing flood risk management options which is set by the Department for Environment, Food and Rural Affairs (Defra).

The key aim of the strategy is to identify how we can manage flood risk. We have developed the strategy to follow four key aims of: sustainability; maximising environmental benefit; ensuring health and safety; and securing value for money.

To develop our strategy we identified all the possible options to manage flood risk at a high level. We identified the following options:

- **do nothing** – this would mean that all of the work we currently do now, such as flood warning, channel and defence maintenance, would stop. This is a standard option against which the benefits and costs of the other options are compared.
- **do minimum** – this would mean that we would continue to maintain the existing structures, walls and embankments. However, at the end of their design-life these assets would not be replaced.
- **do something** – under this approach we would change how we currently manage flood risk. A number of different types of options were considered for this. These are summarised on the next page.



Blacktailed Godwit – one of the rare birds which visits the Ouse Washes



Erosion protection on the Tidal River flood defences

## ‘Do something’ options

### Hold the line of defence at an agreed standard of protection (various standards considered)

Over time, it is predicted that Tidal River siltation and the risk of increasing flood flows as a result of climate change will lead to a reduction in the standard of protection of the South Level Barrier Banks.

Under this option, we would undertake works to raise embankments as and when necessary. The need for bank raising would be determined by assessing the cost of raising the banks against the value of the properties and agricultural land protected by those banks. Therefore for some of the banks we may still have to accept a lower standard of protection than is currently provided.

This option would also involve proactive maintenance and replacement of the low walls along embankment crests when necessary. In some locations crest walls would have to be rebuilt after bank raising or the walls would have to be increased in height instead of bank raising.

### Bank Reinforcement on the South Level Barrier Bank

This option would include 2.5km length of erosion protection works at the southern end of the South Level Barrier Bank and a further short length of erosion protection at the northern end.

### Tidal Barrier at King’s Lynn

This could be north or south of the port of King’s Lynn and would provide a surge barrier that could be shut when extreme surge tides occur.

### Replacement of crest walls

Many of the embankments on the Tidal River have low crest walls which vary between 0.2m and 1.5m in height. The walls have been repaired recently but replacement is predicted to be necessary after 25 years to maintain their flood defence capability.

### Flood storage

This would involve creating flood storage areas which could be used to hold water during floods. One of the areas investigated for this is the land directly adjacent to the South Level Barrier Bank at the southern end of the bank.

### Managed realignment of the Tidal River East Bank

This option would involve allowing flood waters to overtop the Tidal River Bank which is located between the Tidal River and the Flood Relief Channel.

### River narrowing

Narrowing the river channel would increase the speed of the flow of water in the river. This could help with flushing silt and lowering bed levels.

### Improving or changing the operation of existing structures – Denver Sluice

The Denver Sluice allows water from the Ely Ouse to discharge into the Tidal River. By increasing flow through Denver Sluice there would be an increase in the flushing flows in the Tidal River which could help lowering bed levels by flushing silt out of the river.

### Improving or changing the operation of existing structures – Earith Sluice

The Earith Sluice allows water from the Tidal River to enter the River Delph and flood the Ouse Washes. The level of the sluice gate (the ‘drawmark’) is currently set in byelaw. There is an opportunity to reduce the flooding of the Ouse Washes by changing this level to allow less water into the River Delph, particularly during the winter months. This would also mean more water flows down the Tidal River which would aid the flushing of silt.

### Build a new pumping station to drain the Ouse Washes

A pumping station located at the Welmore Lake Sluice (at the north end of the Ouse Washes) could be used to drain the Ouse Washes when natural discharge is not possible. This would reduce flooding of the Ouse Washes.

### Dredging of the Tidal River

By dredging the Tidal River the bed levels could be reduced. This would reduce the flooding of the Ouse Washes and reduce flood risk on the South Level Barrier Bank.

### Build a new pumping station at Denver

A pumping station at Denver Sluice could be used to pump water from the Ely Ouse into the Tidal River even when gravity discharge at the sluice is not possible. (note – without a pumping station water can only be discharged through the Denver Sluice when the water levels in the Tidal River are lower than the water levels in the Ely Ouse.)

## How we selected the most appropriate option

We engaged with external stakeholders to share ideas and expertise and we then assessed all options against the following criteria:

1. The cost of each option compared with the benefits gained, including the number of properties affected.
2. Whether the option would effectively manage flood risk.
3. The environmental impact of each option.

Our thorough assessment of the options led us to dismiss the following:

Option	Justification for dismissal
Tidal Barrier at King's Lynn Flood storage	The existing banks on the Tidal River are of a high standard (1 in 500+). Therefore, there is not enough additional benefit to be gained within the study area by constructing a Tidal Barrier at King's Lynn or a new flood storage area in order to further protect properties in the Tidal River flood plain.
Managed realignment of the Tidal River East Bank	This would result in saline water from the Tidal River entering the Flood Relief Channel (which is a freshwater channel). Not only would this have an adverse environmental impact, but it could also cause the Flood Relief Channel to start accumulating silt creating greater flood risk for the Ely Ouse catchment upstream of Denver.
River narrowing	This option was found to have less impact on bed levels than improving gravity discharge through Denver Sluice, which is a very low cost option.
Build a new pumping station to drain the Ouse Washes	This is an environmentally unsustainable option. As sea levels rise the drainage of the Ouse Washes will continue to deteriorate and the amount of pumping required will increase, escalating future costs and increasing carbon emissions.
Dredging of the Tidal River	This would involve dredging a huge amount of silt – equivalent to the volume of ten football pitches to a depth of the goal posts. The costs of this are prohibitive. In addition, there is a chance that silt levels could return to the previous state within four to six months.
Build a new pumping station at Denver	This option was found to have less impact on bed levels than improving gravity discharge through Denver Sluice, which is a very low cost option in comparison to the building of a new pumping station.

## The importance of Denver Sluice

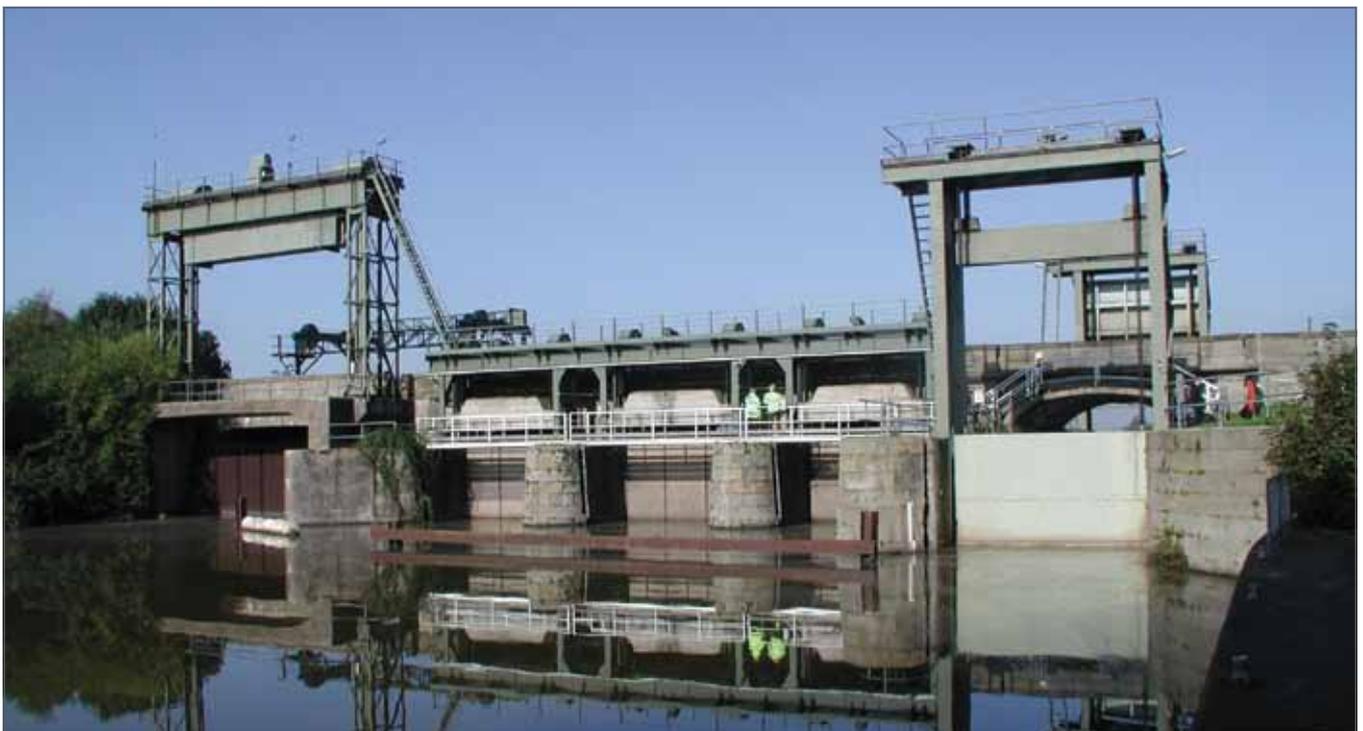
First built in 1651, Denver Sluice was constructed to protect the South Level fens from flooding by providing a secure point for discharge of flood water and by preventing tidal flooding of the fens. Fifty years ago, this original function of Denver Sluice was taken over by the Flood Relief Channel and the Tail Sluice near King's Lynn. The main purpose of Denver Sluice now is to prevent the build up of silt in the Tidal River Great Ouse.

The adjacent Denver lock provides an essential navigation link between the Great Ouse navigation and the remainder of the inland waterway system. This may be accessed through Salter's Lode lock on the west bank of the Tidal River 500m downstream of Denver Lock.

Flows discharged through Denver Sluice from the Ely Ouse to the Tidal River help flush out silt and keep bed levels down. Modelling of the river has shown that, apart from natural flood flows in the Bedford Ouse, gravity flows through the sluice are the single most important factor for siltation management in the river.

We aim to discharge as much water out of the Denver Sluice as possible. During the last year the dedicated Denver Sluice operators have managed to get 85% of flows through the sluice compared to the theoretical maximum. This is higher than in previous years, and is crucial to getting the river bed down to lower levels and then keeping them at a lower range.

It is possible that future sea level rise may make gravity flows through the sluice more difficult, and this will need to be monitored. However, as long as gravity flows are achievable it is important that the sluice is used to its maximum capacity.



Denver Sluice

## Our preferred strategy

Our preferred strategy for this area is to:

- maximise flows through Denver Sluice to flush out silt in the Tidal River;
- new erosion protection as well as repair and replacement of existing erosion protection;
- changing how we operate Earith Sluice;
- replacement of crest walls on top of embankments expected in 2035;
- the standard of protection of the South Level Barrier Bank is predicted to fall to 1 in 20 years in around 2080. When this happens we will carry out bank-raising work to ensure that the standard does not fall below 1 in 20;
- raise the West Bank defences of the Tidal River between Old Bedford Sluice and St Germans pumping station when the standard of protection falls to 1 in 100 years in around 2080;
- raise the East Bank defences of the Tidal River between Wiggshall St Peter and Saddlebow when the standard of protection falls to 1 in 75 years in around 2100;
- we will also continue with a programme of monitoring the river flows and bed levels in the Tidal River to gauge the effectiveness of the strategy in lowering bed levels and improving the drainage of the Ouse Washes.

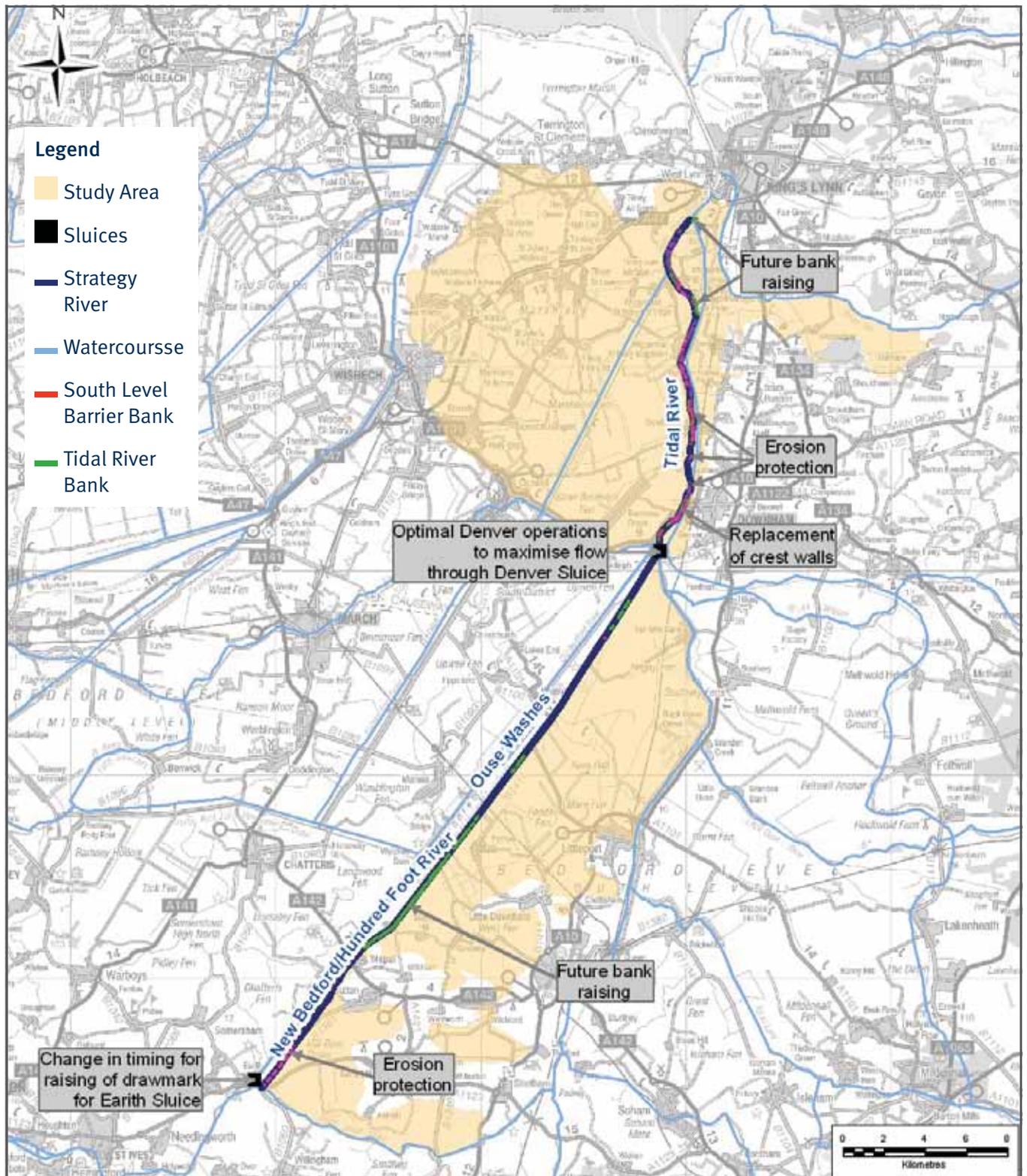
We estimate that, over the 100-year strategy period, the standard of protection provided by the Tidal River Banks will be lowest for the East Bank between Wiggshall St Peters and Downham Market, but even here the standard will only reduce to 1 in 90 until around 2085. However, as stated above, the standard of protection provided by the South Level Barrier Bank may drop to as low as 1 in 20 by 2080.

### Management activities:

We currently undertake a range of flood risk management activities and we are proposing to continue with these:

- improving the flood warning service and promoting its wider use;
- channel maintenance, where necessary;
- maintaining existing flood defences;
- continuing to influence planning and development proposals;
- continuing to provide advice on protecting individual properties to increase their resistance to flooding.

# Our preferred strategy



## **Contact details**

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