OUSE WASHES

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ENVIRONMENT AGENCY

THE OUSE WASHES

ENVIRONMENT AGENCY

A CHANGED LANDSCAPE

The landscape of England has changed dramatically throughout the centuries. Few areas have undergone so complete a change as that part of the Cambridgeshire Fens known as the Ouse Washes. Running from Earith in the south to Denver in the north, it has been drastically altered by man. From being a wet and frequently flooded land unsuitable for farming, it is now one of the most fertile and productive areas of England. Additionally, the changes man has made to mould the land to his own use have created an area of great international ecological importance.

To understand the impact man has made on this environment, it is necessary to look at the lives that were lived on the Fens 400 years ago. It was a harsh and unhospitable area - with large parts flooded year round. Summer grazing was possible in some areas, but only when the tides allowed. The people who struggled to survive in this dank land were uncompromising and insular. These folk, the Breedlings, were a people apart who fought desperately to preserve their harsh way of life.

The Adventurers

In 1630, Francis, 4th Earl of Bedford, saw the potential of the land, if only the flooding could be controlled. He enlisted the aid of 13 other noblemen and landowners and formed a group known as "The Adventurers". A Dutchman, Sir Cornelius Vermuyden, was engaged to turn the watery landscape into one in which agriculture could thrive all year long. Vermuyden was already familiar with Dutch methods of keeping out the sea and had received a knighthood in recognition for repairing the Thames banks at Dagenham in 1626. He had also demonstrated his skill in drainage works at Hatfield Chase in Yorkshire.

Vermuyden began with a project intended to significantly improve the flow of flood water out to the Wash. He excavated a 30km straight channel between Earith and Salters Lode, replacing the existing meandering route of the river. This cut off the loop of the river through Ely and shortened the distance to the sea by 16 km. The excavation was completed in 1631 and, in honour of the project's patron, was named the Bedford River.

Although the new cut made some improvement, discharges of flood water to the sea were still held back by high tides. A further major modification to the drainage system was required. The Civil War which began in 1642, brought to a stop further work on the project. It was not until the war ended in 1649 that Cromwell set Vermuyden to work again.

Vermuyden

Cromwell

The Ouse Washes in flood

Welmore Lake Sluice re-built 1999

Earith Sluice built 1952

Creating a Washland

The second phase of the project would result in the creation of a washland, defined as an area of land periodically flooded by overflow water from a river, stream, or from the sea. The challenge facing Vermuyden was to counteract the effect of high tides which impeded the discharge of flood waters. A second 30 km channel was dug parallel to the first. Completed in 1656, this ran about 1 km east of the original Bedford River and created a washland between the two channels. The washland could be used to temporarily store flood water during periods of high tides. The second channel was called the New Bedford River, whilst the original became the Old Bedford River. A flood storage reservoir of around 1900 hectares was formed between the two new rivers, bounded on the west side by the Middle Level Barrier Bank and on the east by the South Level Barrier Bank. Thus the Ouse Washes were born.

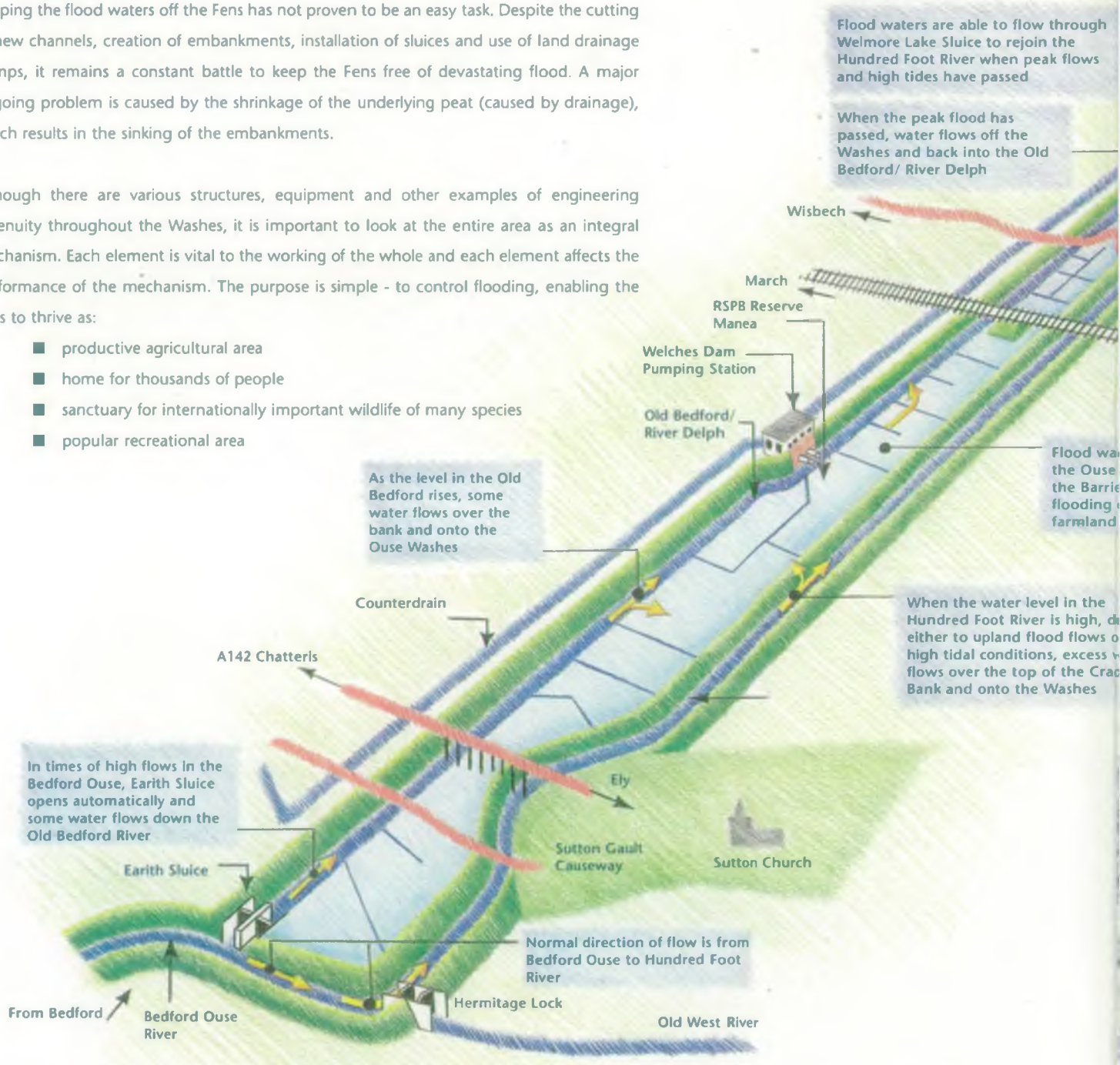
Welches Dam Pumping Station built 1948

The Ongoing Battle

Keeping the flood waters off the Fens has not proven to be an easy task. Despite the cutting of new channels, creation of embankments, installation of sluices and use of land drainage pumps, it remains a constant battle to keep the Fens free of devastating flood. A major ongoing problem is caused by the shrinkage of the underlying peat (caused by drainage), which results in the sinking of the embankments.

Although there are various structures, equipment and other examples of engineering ingenuity throughout the Washes, it is important to look at the entire area as an integral mechanism. Each element is vital to the working of the whole and each element affects the performance of the mechanism. The purpose is simple - to control flooding, enabling the Fens to thrive as:

- productive agricultural area
- home for thousands of people
- sanctuary for internationally important wildlife of many species
- popular recreational area



MANAGEMENT AND CONTACTS:

The Environment Agency delivers a service to its customers, with the emphasis on authority and accountability at the most local level possible. It aims to be cost-effective and efficient and to offer the best service and value for money.

Head Office is responsible for overall policy and relationships with national bodies including Government.

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ENVIRONMENT AGENCY GENERAL ENQUIRY LINE
0645 333 111

The 24-hour emergency hotline number for reporting all environmental incidents relating to air, land and water.

ENVIRONMENT AGENCY EMERGENCY HOTLINE
0800 80 70 60

ENVIRONMENT AGENCY

Designed by The Design Factory
AN-04/00-1K-B-BFHP

O U S E W A S H E S A S A F L O O D C O N T R O L M E C H A N I S M

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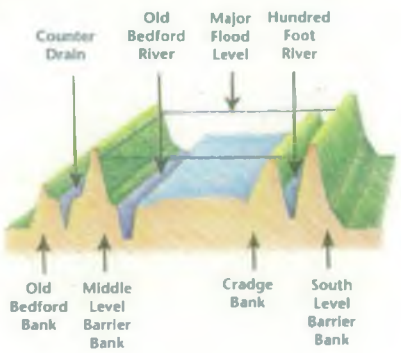
TYPICAL CROSS SECTION ACROSS THE OUSE WASHES



How Does it Work?

The Ouse Washes were created to effectively store and convey flood waters. This is achieved by a system of sluices, pumps and embankments that runs from Earith to Denver - some 32 km. Towns and villages in this area are protected by the Ouse Washes defences, as well as approximately 29,000 hectares of valuable agricultural land.

It is important to remember that the Ouse Washes are designed as a flood storage reservoir and act as a safety valve for flood waters in the Great Ouse Catchment. As such, the Ouse Washes must comply with the stringent safety requirements laid down by the Reservoirs Act 1975. The effective operation of flood defences in the Washes ensures that floodwaters are kept off areas that are essential in terms of population, agricultural and wildlife.

E N V I R O N M E N T A L I M P A C T

Although designed by man for his own purpose, the creation of the Ouse Washes has resulted in a wildlife sanctuary of international importance. While farmers benefit from the waters being kept off arable land, the flooded areas which are of little agricultural use have become havens for wildlife. Birds, plants and invertebrates have all benefited from this. As a result the Ouse Washes have considerable ecological and conservation significance.

- The area is designated a Site of Special Scientific Interest (SSSI)
- It has Ramsar convention status as an internationally important wetland area
- The Washes have been designated a Special Protection Area (SPA) for birds. Part of the Old Bedford river is a candidate for Special Area Conservation (cSAC) for the spined loach

Various conservation interests have a strong presence on and interest in the Washes. These include:

- The RSPB, who have a reserve on the Washes
- A Wildfowl and Wetland Trust at Welney
- English Nature
- Bedfordshire, Cambridgeshire and Huntingdonshire Wildlife Trust.

Birds

A wide variety of species either make their home on the Washes or visit annually. The Washes are particularly noted for communities of ruff and black-tailed godwit. Visitors include swans from Arctic Siberia and Iceland, both species of which winter here. Other migrating wildfowl including teal, widgeon, gadwall, shoveler, pintail, pochard, tufted duck, coot, mute swans and cormorants enjoy the Washes in internationally important numbers.

Plants and vegetation

Over 300 species of higher plants flourish on the Washes including two rare protected species: ribbon leaved plantain and least lettuce. Nationally scarce species such as fringed yellow water-lily and river water dropwort can be found in the Old Bedford/River Delph.

Invertebrates

The rivers, ditches and ponds of the Washes encourage a rich variety of invertebrates who thrive in one of the last remaining areas of regularly flooded freshwater grazing marsh in the UK.

Recreation

In addition to the benefits to agriculture and wildlife, the Ouse Washes provide a popular recreational area used annually by thousands of residents and visitors. Typical pursuits include fishing, boating and recreational walking.

THE OUSE WASHES IN THE 21ST CENTURY

The landscape of the Fens is completely different from that 400 years ago. It is man-made, but has become a valuable agricultural resource, a populous and pleasant residential area, a conservation and wildlife haven and a popular recreational amenity. All of this is dependent on the continued upkeep, maintenance and improvement of the mechanism that is known as the Ouse Washes. This flood storage reservoir and relief channel must function effectively at all times to allow the current landscape to continue. To that end, the state of the Washes is constantly monitored and improved wherever possible. The Environment Agency continues to work in close liaison with the Ministry of Agriculture Fisheries and Food, farmers and landowners, residents, Internal Drainage Boards and conservation agencies to manage the Ouse Washes today and into the future.

Flora and fauna

Wildlife

Drainage

The Ouse Washes in flood

THE OUSE WASHES SUMMER FLOODING

ENVIRONMENT AGENCY

AN ENGINEERED ENVIRONMENT

The fens, rivers and banks that create the Ouse Washes are virtually entirely man-made. The Washes function as a flood storage reservoir, acting as a safety valve for flood waters in the Great Ouse Catchment. The area extends for 32 km and at its widest point is about 1 km across. It is one of the few of man's engineering marvels that is visible from space.

The purpose and design of the Washes is to prevent flooding of the surrounding countryside. Many towns and villages, as well as approximately 29,000 hectares of agricultural land are protected. This function has been maintained since the Washes were created in the 17th Century.

NEWCOMERS

Over the years, the area has gained another and completely different importance. It is, perhaps, ironic that a man-made system, designed to protect people and property and promote agriculture, has engendered a wildlife sanctuary of international importance. The fact that the flooded areas have little arable use means there is considerably less contamination from chemical fertilisers and pesticides than is present in much of the country. The Washes have become a haven for many birds, plants and invertebrates and are designated a Site of Special Scientific Interest (SSSI). As an internationally important wetland area it has Ramsar status and is a Special Protection Area (SPA) for birds. A diverse assortment of wildlife can today be found on the Washes.

Birds

The Washes are particularly noted for communities of both ruff and black-tailed godwit waders, as well as numerous other species. Particularly impressive annual visitors are 4,000 Bewick's swans from Arctic Siberia and 1,500 whooper swans from Iceland. A whooper swan can weigh up to 24 lbs, whilst the Bewick's is a little smaller at about 11-17 lbs.

These are joined by nationally important numbers of other migrating wildfowl, including teal, widgeon, gadwall, shoveler, pintail, pochard, tufted duck, coot, mute swans and cormorants.

Conservation has a strong interest in the Washes. The area supports an RSPB reserve, a Wildfowl and Wetland Trust Centre and Bedfordshire, Cambridgeshire and Huntingdonshire Wildlife Trusts, as well as other wildfowl interests.

Plants and Vegetation

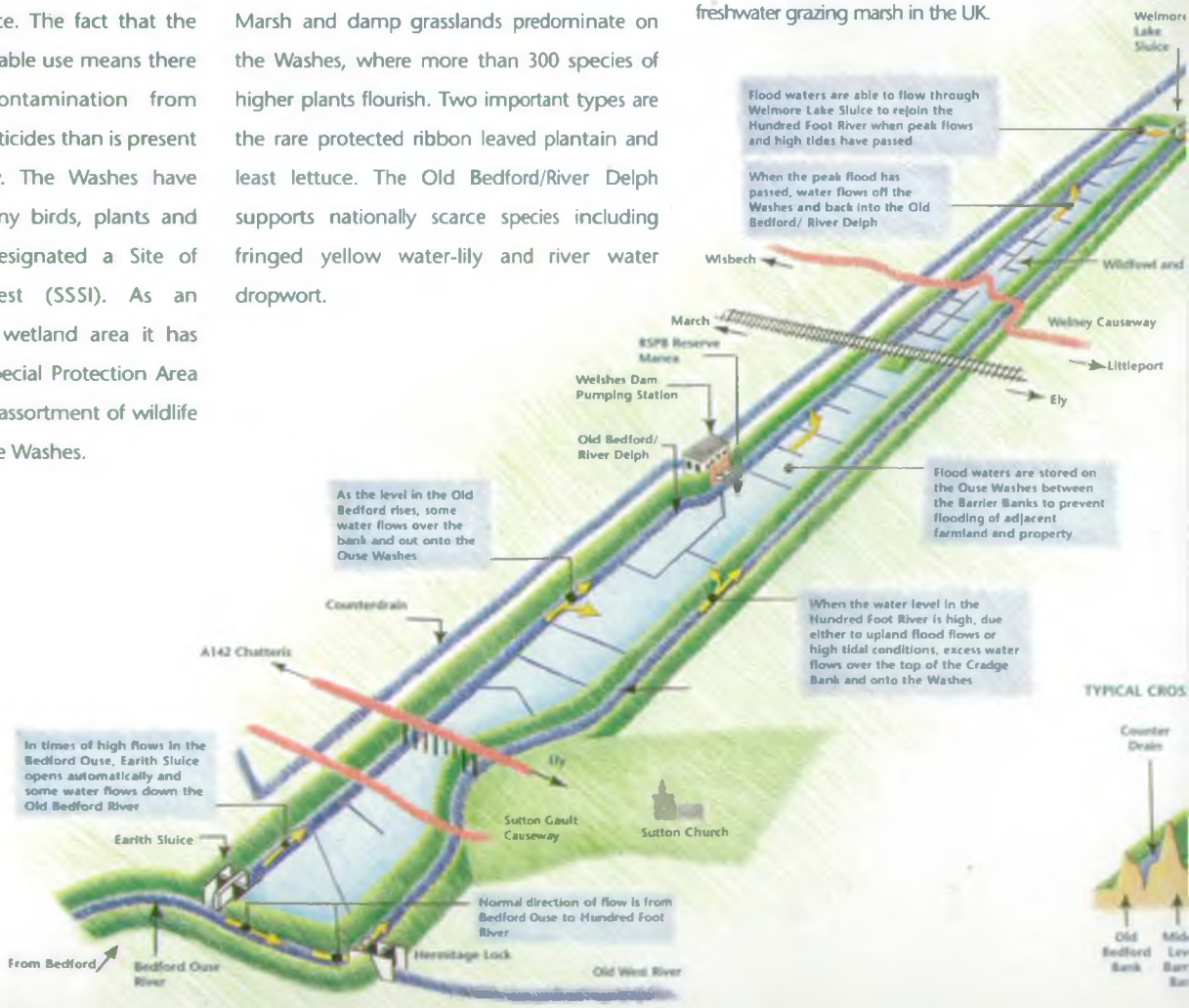
Marsh and damp grasslands predominate on the Washes, where more than 300 species of higher plants flourish. Two important types are the rare protected ribbon leaved plantain and least lettuce. The Old Bedford/River Delph supports nationally scarce species including fringed yellow water-lily and river water dropwort.

The Ouse Washes in flood

Whooper swan

Invertebrates

An extremely rich variety of invertebrates can be found in the ditches, rivers and ponds of the Washes. Like the birds and plants, these enjoy the benefits of one of the last remaining areas of regularly flooded freshwater grazing marsh in the UK.



It is important to remember the changing nature of the Ouse Washes. One significant change is the increase in the frequency and severity of summer flooding.

Welney bird hide

What is at risk?

The Washes were originally designed to protect surrounding countryside - creating arable land where it had not existed before outside the Washes and allowing major centres of civilisation (towns, cities, villages, etc) to grow and thrive. In order to fulfil that function the rivers and Washes must flow freely. As well as being long, the Washes are narrow, so it is vital to keep waterways clear to allow flood waters to flow freely through to the outlet at the northern end.

Summer grazing

A key factor in achieving the free flow of waters is summer grazing. Sheep and cattle grazing the land keep vegetation low, helping to maintain clear channels. However, increased summer flooding prevents sufficient numbers of sheep and cattle grazing the land during the summer months. If adequate grazing cannot be maintained, the present species of grass will be replaced by the more dominant sweet red grass known as Glyceria. Glyceria is unsuitable for grazing cattle. Thus the vicious circle begins, as fewer cattle graze and more and more of the current grasslands are lost. Unchecked, this would alter the nature of the Washes, with the current grassland giving way to a coarser scrub vegetation that would obstruct the flow of flood water. The efficiency of the Washes as a flood storage reservoir would be greatly reduced, endangering people, property and arable land.

Wetlands Trust, Welney

The diverse wildlife on the Washes is also at risk. The Glyceria which would replace the present grasses is totally unsuitable for nesting birds. Increased summer flooding would threaten the breeding success of ground nesting birds and many species would be lost.

Earith Sluice built 1952

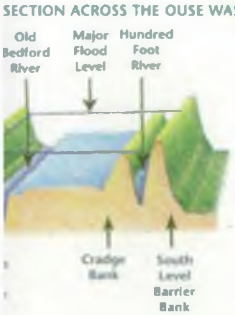
Why has Summer Flooding increased?

There has been an identifiable increase in summer flooding of the Washes over the past 20 years. In 1995, The Ouse Washes Summer Flood Control Strategy investigated why the Washes were flooding more frequently and how this could best be managed. Although no single cause was determined, two possible contributing factors were discussed:

- Climate change
- Land use change in the upper catchment

Increased summer flooding may be caused by a number of factors in combination, so there is no one-off solution.

SECTION ACROSS THE OUSE WASHES



WHAT CAN BE DONE TO REDUCE SUMMER FLOODING ?

The Ouse Washes Summer Flood Control Strategy study was undertaken to consider possible changes affecting the long term effective functioning of the Washes. The investigation included detailed liaison with all users of the Washes, environmental bodies and recreational interests. Two key problem areas were identified:

- Increased frequency and duration of summer flooding.
- Poor condition of some internal structures within the Washes.

As a result of this study, the Ministry of Agriculture, Fisheries and Food (MAFF) approved an £8 million package of measures to achieve the following:

- Continue to maintain the flood defence system
- Support an Ouse Washes Management Strategy
- Rebuild Welmore Lake Sluice and incorporate land drainage pumps
- Consider the diversion of summer flood water to the Old West River
- Re-evaluate the operating levels of the Earith Summer drawmark.

Reconstructed Welmore Sluice built 1999

The Ouse Washes in flood

LOOKING TO THE FUTURE

There are clearly two distinct elements under the protection of the Ouse Washes. First is the original benefactor - population, property and arable land. The second element is the wildlife that thrives on the unique nature of the Washes.

Recognising the need to address the two elements at risk from summer flooding, various interested groups recently formed the Ouse Washes Habitat Protection and Funding Project. The group comprises representatives from the Environment Agency, English Nature, Royal Society for The Protection of Birds, Wildfowl and Wetlands Trust, Internal Drainage Board's, Inland Waterways, Kings Lynn Conservancy, Norfolk County Council and MAFF. Their purpose is to consider what additional measures could be implemented to either reduce the frequency of summer flooding or limit its effect.

Although the two concerns of flood defence and conservation might sometimes seem to have conflicting interests, there is a common factor. The waterways must be maintained to allow an efficient flow of water through the Washes. That is the only way that population, property and wildlife will remain protected. It is therefore essential that management of the Washes continues to address the problem of summer flooding.

ENVIRONMENT AGENCY

Designed by The Design Factory, Oundle

BRIEFING NOTE
THE OUSE WASHES FLOOD STORAGE AREA: AFFECT ON FLOODING ON HABITATS DIRECTIVE SITE

The visit has now been arranged, through DEFRA, for the three Ramsar Commissioners to come to the Anglian Region on the 5th to 8th November. (The programme for the visit is attached and profiles for the Commissioners that are visiting). On the 6th November the "Mission" will spend the day meeting members of the Agency, English Nature, RSPB and members of the Ouse Washes Management Strategy Group and Funding Group. It is also planned to include some site visits to parts of the Washes and key structures in the operation of the Washes.

The visit will be a fresh opportunity to bring a fresh prospective into our consideration of a very difficult set of problems.

On Thursday 8th November, the Mission will give a presentation of preliminary views of the UK Ramsar Committee in London.

Subsequently the Ramsar Bureau will submit a full repot though the UK Ramsar administrative authorities, to the members of the RAM and all other institutions formally contacted through the Mission.

The Ouse Washes Funding Project Group is awaiting advice from the mission before progressing further.

Risks to the Agency

- The RAM Mission will not support the approach of the Environment Agency and partners so far to problem solving.
- Negative media attention, if a solution cannot be found that solves flooding and conservation issues.
- The Agency may not be fulfilling its statutory duties with regard to the management of internationally important conservation areas, could be subject of judicial review.
- Options proposed by RAM cannot be funded by the Environment Agency.
- Loss of support of partners if they do not agree with proposed solutions.
- Alternative habitat creation is not seen by the RAM Mission as a way forward i.e. Designations are "within" the Washes.
- Alternative habitat sites created outside the Washes does not reap the expected benefits.
- Risk of funding solution, even with partnerships, may delay other Environment Agency projects.

BRIEFING NOTE
THE OUSE WASHES FLOOD STORAGE AREA: AFFECT ON FLOODING ON HABITATS DIRECTIVE SITE

Water Quality Project

A three year project, Phosphate in the Ouse Washes and the Habitats Directive Reviews of Consent is being undertaken by the Environment Agency Planning Team. The aims of the project are to ascertain the level of phosphate necessary in the River Great Ouse to protect the conservation features of the Ouse Washes and look at whether this level is realistically achievable, by amending consented discharges. The project will also establish a baseline for the assessment of impact on the Ouse Washes of future development in the Great Ouse catchment.

Funding

So far the Great Ouse Local Flood Defence Committee have been very supportive of the Agency's actions in dealing with the removal of water from the Ouse Washes. In addition to their contribution to the Ouse Washes Summer Flooding Strategy and the Siltation Study they have funded pumping operations to remove water from the Washes for a number if years.

Since a sustainable solution to the problems of siltation in the Tidal River could not be justified on the basis of Flood Defence Benefits then if followed that alternative funding would be required in order to comply with the requirements of the Habitats Directive in relation to the Ouse Washes.

Ouse Washes Habitat Protection and Funding Project Group

This group was set up in 1999 made up of representatives from the major conservation bodies, including English Nature and RSPB and others affected by the operation of the Washes. The overall aim of the group is to identify the most practical and sustainable solutions to the problems in the Ouse Washes and the Tidal River, identify costs of solutions and investigate means of funding solutions both within the representative organisations and from the Government or European funding.

The group has met three times and has had presentations on all the options considered in all previous studies, has identified options for further consideration and a consultant's report on these options is currently in draft form. Comments from the group members are being incorporated in the report.

The Montreux Record

In 2000 the RSPB proposed that DETR should consider registering the Ouse Washes on the Montreux register, a list of those sites designated under the RAMSAR convention which are under going a detrimental ecological change. The inclusion of a site in the Montreux Record draws attention to the need for action or support e.g. through a Ramsar Advisory Mission, as a result of this, the Ouse Washes Funding Group requested a visit from the RAM Mission to advise on a way forward.

However, despite the above effort removal of water from a large area of the Washes both during and after flooding is hampered by high bed levels in the Tidal River caused by the accumulation of silt.

Tidal River Siltation Project

This project came about as a result of the Wash River Outfalls Siltation Study (WROSS) and investigates the problems of siltation with particular reference to the Tidal River Ouse.

The strategy identifies options to reduce siltation including:

i. Increased use of the Denver sluices to discharge water to the Tidal River and enhance fluvial flushing.
ii. Improvements to Wash training walls
iii. Localised dredging at outfall structures
iv. General or localised training of the Tidal River between Denver and Kings Lynn.

The report does not recommend the dredging of the bed of the Tidal River (other than in iii. Above) since this is not considered to be a sustainable solution.

The report does not promote the generalised/localised training of the Tidal River on the grounds of its high cost (probably between £5m and £10m) against low flood defence benefits.

It should be noted that as a result of the sustained high winter flows experienced over the past three years, bed levels in the Tidal River are lower than experienced for many years. Despite this, the wet winter and spring has led to the prolonged discharge of water into the Washes, thus delaying the reduction of levels in the Washes to WLMP targets and again seriously affecting the bird breeding season. Improved flow capacity in the Tidal River enables better discharge out of the Ouse Washes but has only a limited effect in preventing flood water entering the washes through Earith Sluice.

RSPB Habitat Creation Project

In order to address the immediate problems faced, particularly by the Black-tailed Godwit, the RSPB have embarked on a habitat creation project on the land adjacent to the Ouse Washes. The Environment Agency and the Project Group support this RSPB initiative.

BRIEFING NOTE
THE OUSE WASHES FLOOD STORAGE AREA: AFFECT ON FLOODING ON HABITATS DIRECTIVE SITE

Introduction

The Ouse Washes are a designated SSSI, as an internationally important wetland have RAMSAR status, a Special Protection Area for Wild Birds and Special Area of Conservation. A wide variety of wetland vegetation, wildfowl, waders and invertebrates are present and include many nationally rare species.

The Ouse Washes are also vital as a flood storage protecting some 29,000 hectares of high grade agricultural and 880 propertied from serious flooding. It comes within the ambit of the Reservoirs Act 1975.

Flooding the Washes during the winter months, November to April is accepted and causes no great environmental problems except those associated with the flooding of the A1101, Welney Road. However, flooding of the Washes during the summer period, May to October, has the potential to seriously affect the environmental value of this site and could eventually lead to such a loss of habitat as to affect its conservation designations under the Habitats Directive.

The Environment Agency and its predecessor organisation, the NRA, have long recognised the problems associated with summer flooding and in the early 1990's embarked on a strategy to reduce the incidence of flooding and speed up the evacuation of water from the Washes after flooding had occurred.
This strategy included:

i. The reconstruction of Welmore Lake Sluice
ii. Inclusion of a permanent land drainage pumping facility in Welmore Lake Sluice
iii. Improvements to the Crdge banks to reduce overtopping
iv. Diversion of 5cum/s of summer flood water to the Old West River at Hermitage
v. Variation to the Draw Mark at Earith
vi. Continue to maintain the flood defence system and support the Ouse Washes Management Strategy

The reconstruction of Welmore Lake Sluice was completed in September 1999 at a cost of £5.2m. The new sluice has 50% more discharge capacity than the old and has greatly increased the speed of flood water evacuation from the Washes.

Cradge bank improvements are complete.

The diversion of water to the Old West and changes to the Earith Draw mark (which would require an act of Parliament) have been considered, but are thought not to give sufficient worthwhile additional benefit.

Costs associated with this strategy are in the order of £8 million and have been funded by MAFF Grant Aid and precepts/levies raised through the Local Flood Defence Committee.

and for the richness of the aquatic fauna and flora within the associated watercourse. The capacity of the site to hold wintering and breeding waterfowl and waders is of international significance. Of particular note in the winter are the large numbers of teal (Anas crecca), pintail (Anas acuta) wigeon (Anas penelope), shoveler (Anas clypeata), pochard (Aythya ferina) and Bewick's swan (Cygnus bewickii).

The grassland communities of the area are characterised by such grasses as reed and floating sweet grass (Glyceria maxima and G.fluitans), reed canary-grass (Phalaris arundinacea), marsh foxtail (Alopecurus geniculatus) together with a variety of sedges and rushes. Typical herbs include amphibious bistort (Polygonum amphibium), water pepper (Polygonum hydropiper), and tuhular water-dropwort (Oenanthe fistulosa).

The associated dykes and rivers hold a great variety of aquatic plants, the pondweeds (Potamogeton spp) are particularly well represented. Other aquatic species include the fringed water-lily (Nymphoides peltata), greater water-parsnip (Sium latifolium) and the four species of duckweeds (Lemna spp.)

The limnological interest of the Ouse Washes is further diversified by the Old Bedford River and River Delph, both good examples of base-rich, sluggish, lowland rivers. The flora includes the fan-leaved water crowfoot (Ranunculus circinatus), yellow water-lily (Nuphar lutea), arrowhead (Sagittaria sagittifolia), long-stalked pondweed (Potamogeton praelongus), perfoliate pondweed (Potamogeton perfoliatus), and river water-dropwort (Oenanthe fluvitalis).

The associated aquatic and semi-aquatic fauna is similarly diverse.

File Ref: S/354

COUNTY: Cambridgeshire/Norfolk SITE NAME: Ouse Washes

DISTRICT: East Cambridgeshire and West Norfolk

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981

Local Planning Authority: East Cambridgeshire District Council/Fenland District Council/West Norfolk District Council

National Grid Reference: TL393747 to TL 571987 Area: 2,403 (ha) 5,937 (ac)

Ordnance Survey Sheet 1:50,000: 143 1:10,000: TL37SE, TL37NE, TL47NW, TL48SW TL48SE, TL48NE, TL58NW, TL59SW, TL59NW, TL59NE

Date Notified (Under 1949 Act): 1955 Date of Last Revision: 1971
As the Bedford Level Wash

Date Notified (Under 1981 Act) : 1984 Date of Last Revision:

Other information: The Ouse Washes lie between The Hundred Foot/New Bedford River to the south-east and the Old Bedford River/Counter Drain to the north-west. These rivers fall within the boundary of the Site of Special Scientific Interest. The Old Bedford river in particular is of national nature conservation importance in its own right.

The Ouse Washes play a major land drainage role as a flood water storage area and the wash land is thus subject to regular winter flooding. In the summer months the area provides grazing and hay.

The regular winter flooding and the continuance of traditional management of cattle grazing and hay cutting maintains the nature conservation value of the area. The majority of the site is under nature reserve management by the Bedfordshire and Huntingdonshire Naturalist Trust, the Cambridgeshire and Isle of Ely Naturalists' Trust, the Royal Society for the Protection of Birds and the Wildfowl Trust.

The Ouse Washes are listed under the Government ratified RAMSAR Convention of 1972 in view of their international importance as wetland habitat. This is also a Nature Conservation Review Grade 1* site.

A Boundary modification has been made at this revision to exclude an area of arable land outside the flood plain.

Reasons for Notification: The site is one of the country's few remaining areas of extensive washland habitat. It is of particular note for the large numbers of wildfowl and waders which it supports: for the large area of unimproved neutral grassland communities which it holds

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Reasons for recommendation as a possible Special Area of Conservation

Area Name: **Ouse Washes**

County/District: **Cambridgeshire**
Norfolk

Component SSSI: **Ouse Washes**

This area is being considered as a possible Special Area of Conservation (SAC) because it contains habitat types and/or species which are rare or threatened within a European context. The SSSI citation describes the special interests for which the site was notified in the British context. [NB Not for marine interests below mean low water mark]. The interests for which the site was selected as SSSI may differ from the interests selected in a European context.

The habitats and/or species for which this area has been proposed as a possible SAC are listed below. The reasons for their selection are listed, together with a brief description of the habitats and species as they typically occur across the UK. This area contains the interests described although it may not contain all the typical features. (Please see the accompanying Natura 2000 booklet for further information on the approach to site selection.)

The area supports the following interest(s).

European interest(s):

1. **Spined loach.†**

- **for which this area is the only outstanding locality in the United Kingdom.**

†*Cobitis taenia*: The spined loach is a small bottom-living fish restricted to rivers and drainage ditches in central England and East Anglia.

For agency use only:

Date compiled:_____

Reference number or date of map:_____

EN/36

EC Directive 79/409 on the Conservation of Wild Birds: Special Protection Area

Ouse Washes (Cambridgeshire, Norfolk)

The Ouse Washes Ramsar site and proposed Special Protection Area is a wetland of major international importance comprising seasonally flooded washlands which are agriculturally managed in a traditional manner. It provides breeding and winter habitats for important assemblages of wetland bird species, particularly wildfowl and waders.

The boundaries of the proposed Special Protection Area are coincident with those of the Ouse Washes SSSI, apart from the exclusion of a section of the Old Bedford River in the north of the SSSI.

The Ouse Washes qualifies under Article 4.1 of the EC Birds Directive by supporting, in summer, a nationally important breeding population of ruff *Philomachus pugnax*, an Annex 1 species. In recent years an average of 57 individuals have bee recorded lekking, a significant proportion of the British population.

The site also qualifies under Article 4.1 by regularly supporting internationally or nationally important wintering populations of three Annex 1 species. During the five year period 1986/87 to 1990/91, the following average peak counts were recorded: 4,980 Bewick's swan *Cygnus columbarius bewickii* (29% of the north-west European wintering population, 70% of the British wintering population), and 590 whooper swans *Cygnus cygnus* (3% of the international population, 10% of British). In addition, between 1982-87 an average of 12 wintering hen harrier *Circus cyaneus* was recorded, representing 2% of the British wintering population.

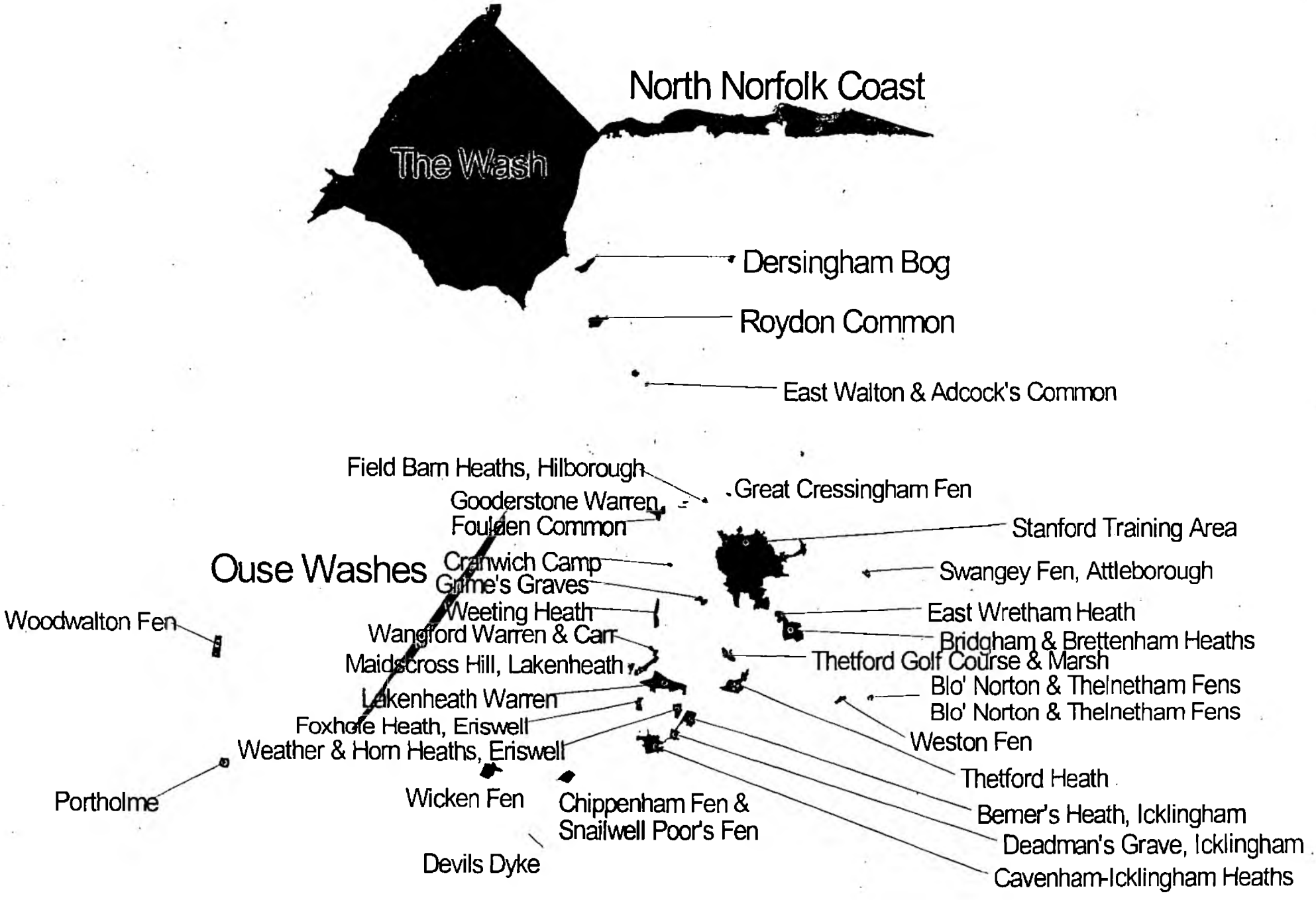
The Ouse Washes qualifies under Article 4.2 by supporting, in summer, in recent years, nationally important breeding populations of five migratory species: 111 pairs of gadwall *Anas strepera* (20% of the British breeding population); 850 pairs of mallard *Anas platyrhynchus* (2% of British); 14 pairs of garganey *Anas querquedula* (20% of British), 155 pairs of shoveler *A. clypeata* (12% of British), and 26 pairs of black-tailed godwits *Limosa limosa* (44% of British).

The site further qualifies under Article 4.2 as a wetland of international importance by virtue of regularly supporting over 20,000 waterfowl, with an average peak count of 60,950 birds recorded in the five winter period 1986/7 to 1990/91. This total included internationally or nationally important wintering populations of the following migratory waterfowl (figures given are average peak counts for the five winter period 1986/87 - 1990/91): 270 cormorant *Phalacrocorax carbo* (2% of the British wintering population); 490 mute swan *Cygnus olor* (3% of British); 38,000 wigeon *Anas penelope* (5% of the north-west European population, 15% of British); 320 gadwall *Anas strepera* (5% of British); 4,100 teal *A. crecca* (1% of NW European, 4% of British); 1,450 pintail *Anas acuta* (2% NW European, 6% of British); 750 shoveler *Anas clypeata* (2% of NW European, 8% of British); 2,100 pochard *Aythya ferina* (4% of British); 860 tufted duck *Aythya fuligula* (1% of British); and 2,320 coot *Fulica atra* (1% of British).

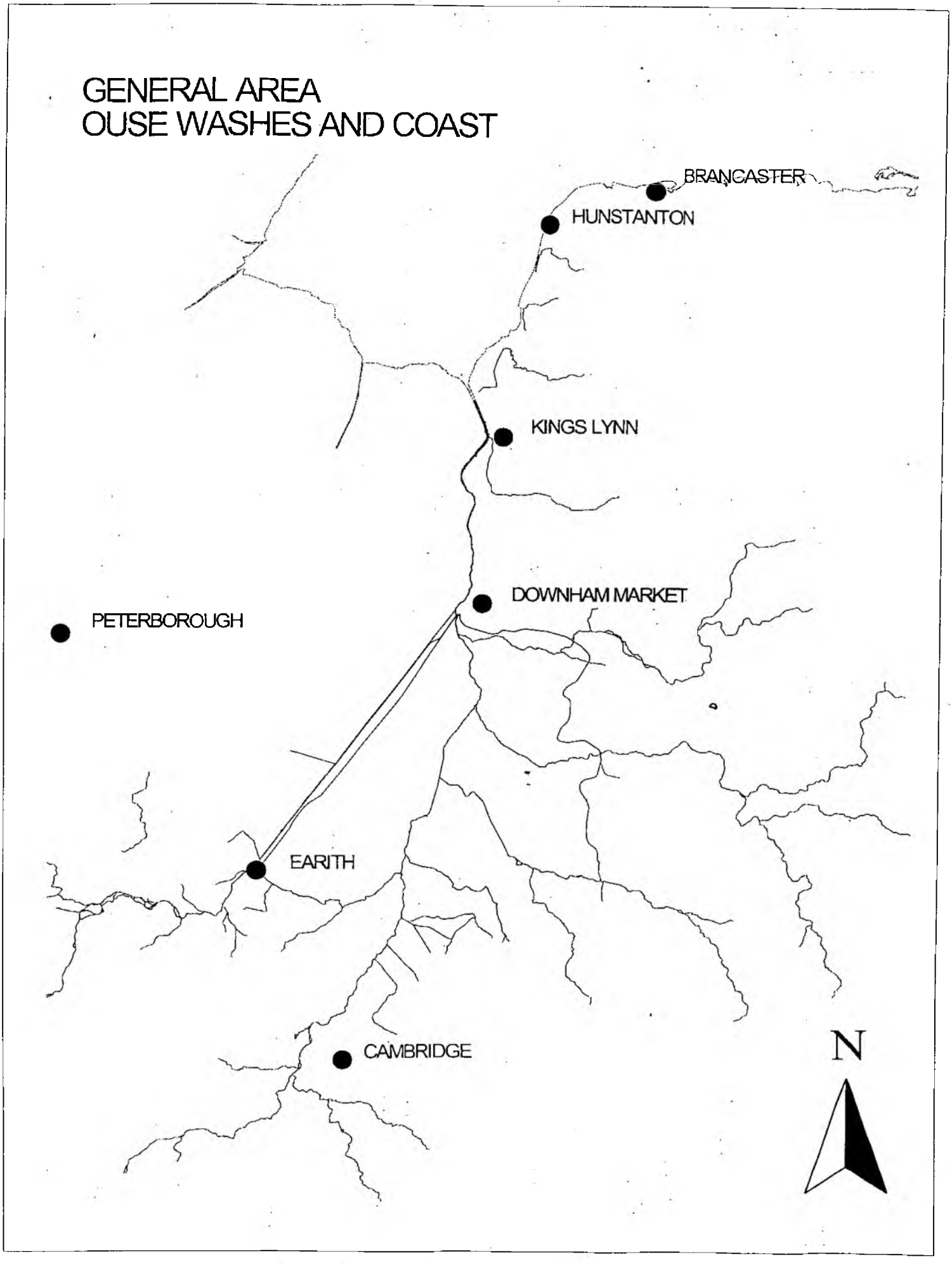
The site also qualifies under Article 4.2 by virtue of regularly supporting, in summer, a diverse assemblage of the breeding migratory waders of lowland wet grassland, including: oystercatcher *Haematopus ostralegus*, redshank *Tringa totanus*, snipe *Gallinago gallinago*; Ruff *Philomachus pugnax*, lapwing *Vanellus vanellus*, and black-tailed godwit *Limosa limosa*; and a diverse assemblage of breeding wildfowl with mute swan *Cygnus olor*, shelduck *Tadorna tadorna*, gadwall *Anas strepera*, teal *A. crecca*, mallard *A. platyrhynchus*, pintail *A. acuta*, garganey *A. querquedula*, shoveler *A. clypeata*, pochard *Aythya ferina*, tufted duck *Aythya fuligula*, moorhen *Gallinula chloropus* and coot *Fulica atra* occurring regularly. Many of these species are rare and much restricted in Britain and the European Community owing to habitat loss and degradation. The site thus has an important role in maintaining the ranges of several of these species which have been affected by changes in habitat elsewhere in Britain.

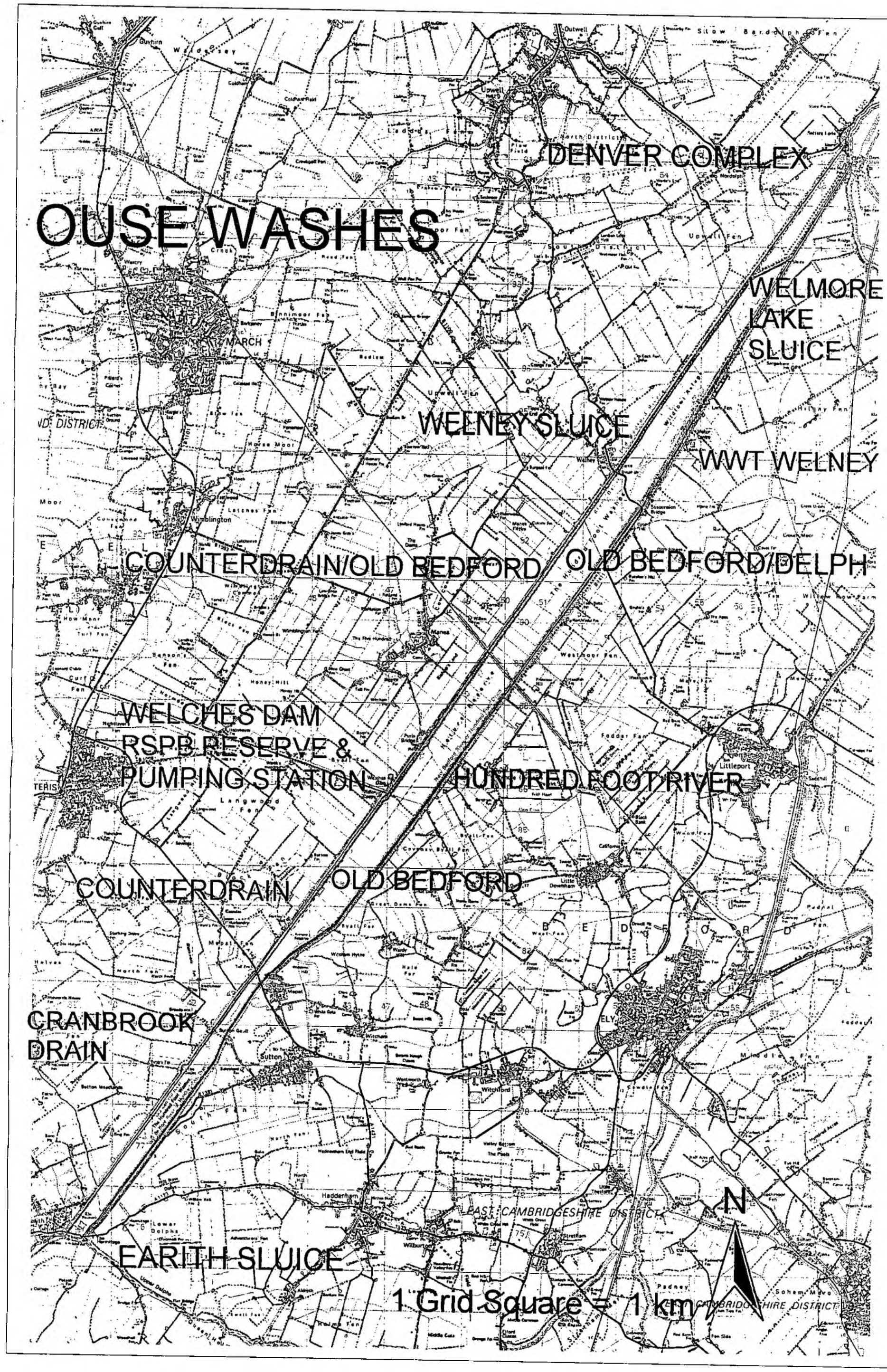
During severe winter weather elsewhere, the Ouse Washes can assume even greater national and international importance as wildfowl and waders from many other areas arrive, attracted by the relatively mild climate, compared with continental European areas, and the abundant food resources available.

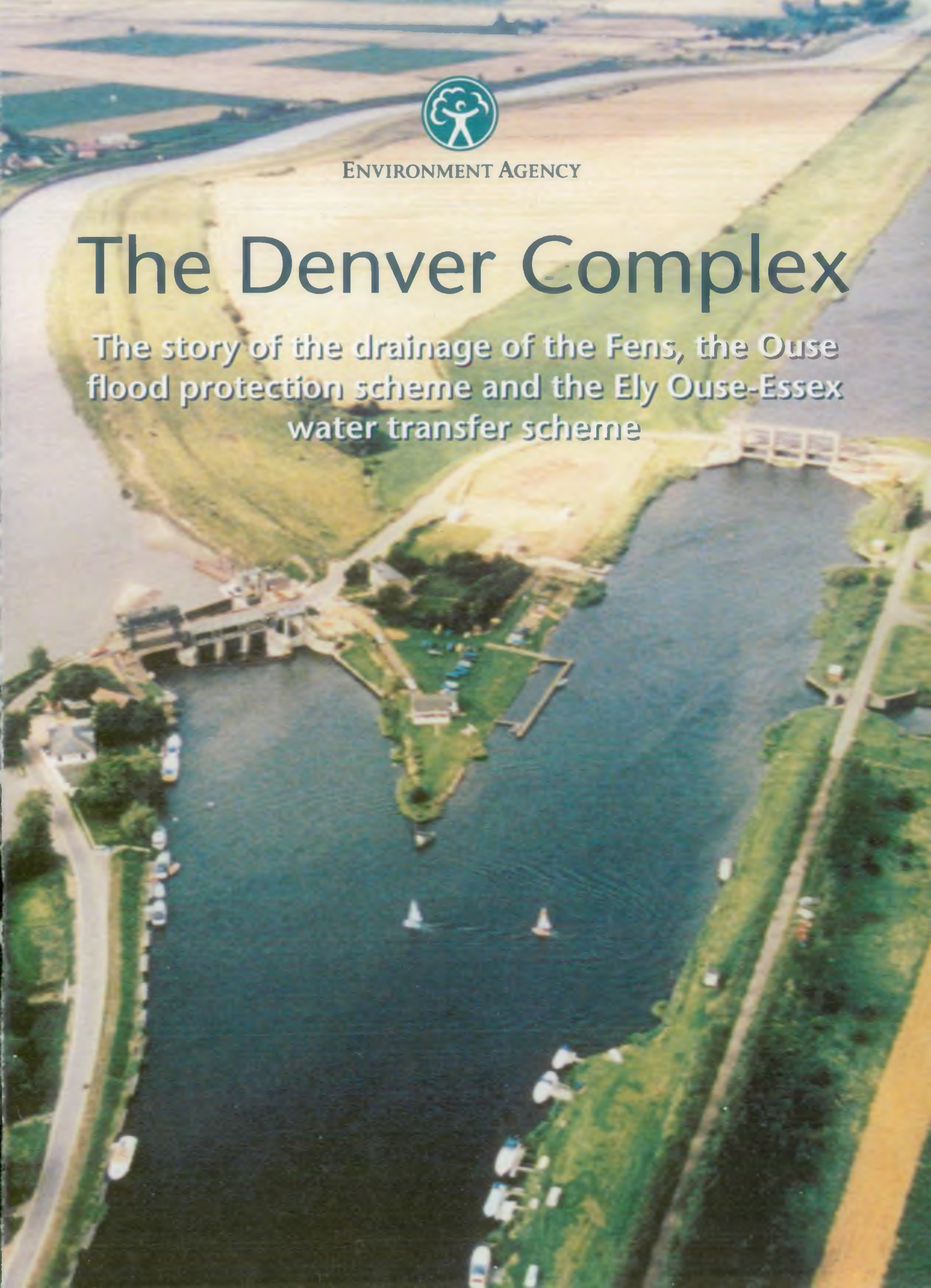
The continued international importance of this site is dependant on the maintenance of a winter flooding regime and a high, but controlled summer water table.


North Norfolk Coast
The Wash
Dersingham Bog
Roydon Common
East Walton & Adcock's Common
Field Barn Heaths, Hilborough
Gooderstone Warren
Foulden Common
Ouse Washes
Cranwich Camp
Grime's Graves
Weeting Heath
Woodwalton Fen
Wangford Warren & Carr
Maidscross Hill, Lakenheath
Lakenheath Warren
Foxhole Heath, Eriswell
Weather & Horn Heaths, Eriswell
Portholme
Wicken Fen
Chippenham Fen &
Snailwell Poor's Fen
Devils Dyke
Great Cressingham Fen
Stanford Training Area
Swangey Fen, Attleborough
East Wretham Heath
Bridgham & Brettenham Heaths
Thetford Golf Course & Marsh
Blo' Norton & Thelnetham Fens
Blo' Norton & Thelnetham Fens
Weston Fen
Thetford Heath
Berner's Heath, Icklingham
Deadman's Grave, Icklingham
Cavenham-Icklingham Heaths

GENERAL AREA
OUSE WASHES AND COAST




OUSE WASHES
DENVER COMPLEX
WELMORE LAKE SLUICE
WELNEY SLUICE
WWT WELNEY
COUNTERDRAIN/OLD BEDFORD
OLD BEDFORD/DELPH
WELCHES DAM RSPB RESERVE & PUMPING STATION
HUNDRED FOOT RIVER
COUNTERDRAIN
OLD BEDFORD
CRANBROOK DRAIN
EARITH SLUICE
1 Grid Square = 1 km
N
EAST CAMBRIDGESHIRE DISTRICT



ENVIRONMENT AGENCY

The Denver Complex

The story of the drainage of the Fens, the Ouse flood protection scheme and the Ely Ouse-Essex water transfer scheme

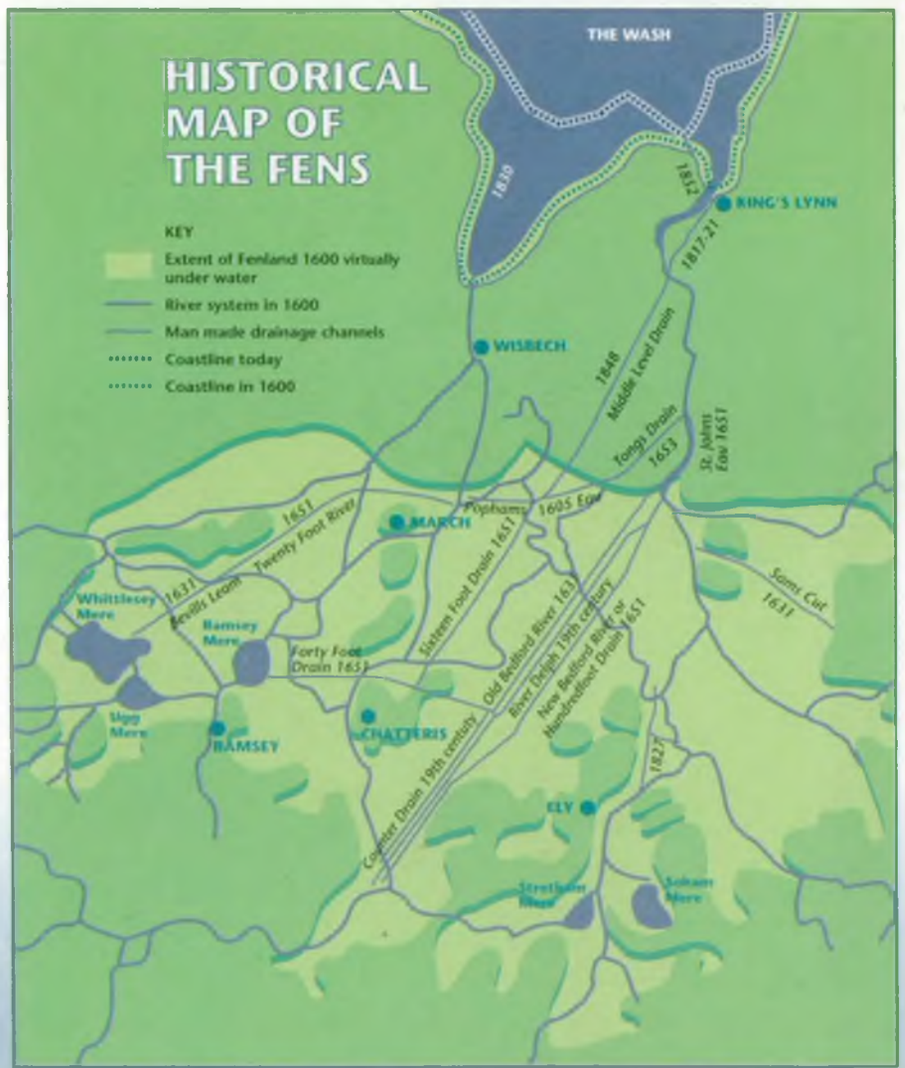
THE DENVER COMPLEX

INTRODUCTION

The Denver Complex forms the focus of the flood defence system that protects the low lying lands of the Fens from inundation by the sea and fluvial (or freshwater) flood. Its construction has a long history, and The Environment Agency now has the responsibility of ensuring this vital flood protection to the lands, people and infrastructure of the Fens is secured.

HISTORY

In a massive arc around the Wash lies the great Fenland plain. Only 5% of the total area of England and Wales is classified as first class agricultural land, and yet almost the whole of the Fenland falls into this category. Today, these are England's most prosperous agricultural areas, but their plenty has been hard won.



This is the Fen Country where, down the ages, land and water have been in such precarious balance that the difference between fertility and flooding has been measured in centimetres. Here, generation after generation has seen its livelihood engulfed by the wild waters of disaster. Only in the last three decades has the area finally been made secure by modern engineering and the application of millions of pounds of investment.

In the 16th and 17th centuries the Fenland was not an hospitable area. Upland river and gale-driven tide alternated their push and pull across large areas, some of which were dry enough for summer pasture but submerged in winter, whilst others were flooded all the year round. Thus the scanty population, who called themselves the Breedlings, developed a special, if harsh, way of life. They were a people apart, among whom other Englishmen rarely ventured. Militantly protective of their way of life, the Breedlings reacted violently to plans to drain the fen area. Indeed, for many decades armed guards were needed to protect the sluice gates and other mechanisms that were installed according to the new designs.

The first major attempt to drain the Fens was undertaken in 1630 by Francis, 4th Earl of Bedford, who was joined by thirteen associates or "Adventurers". Bedford engaged Sir Cornelius Vermuyden, from Holland, as engineer. Familiar with Dutch methods of keeping out the sea, Vermuyden had already demonstrated his skill in drainage works at Hatfield Chase in Yorkshire. The work consisted principally of making a new straight cut from Earith to Salters Lode on the tidal River Ouse, thereby cutting off the loop of the river through Ely and shortening the distance to sea by 16km. In 1631 the first of the great cuts, known as the Old Bedford River, was completed. It was 21m wide and 34km long, with a sluice at its upper end regulating the amount of water diverted from the River's ordinary course, and a tail sluice (or staunch) at the lower end resisting inflow from the tidal water and the sea.

However, in the 1640's man-made destruction presented a greater danger even than the waters as the western rim of the Fen country became an active theatre

The Holme Fen Post. A cast iron pillar, from the Crystal Palace Exhibition was erected in 1851 on the south west edge of Whittlesey Mere. It replaced the wooden posts which had been erected in 1848 to indicate peat shrinkage caused by drainage. The post was driven 6.7m through the peat into buttery clay until its top was flush with the ground. Within 10 years the ground level had fallen nearly 1.5m through shrinkage. A second post was erected in 1957 with its top at the same level as that of the original post. Plaques fixed to this post show the ground level at various succeeding dates. As one stands by the pillar now, on peat which actually quivers underfoot, it is difficult to realise that men who watched the last of the mere 120 years ago stood level with its top which is over 4m above today's ground level.

of war. Amidst the confusion of the Civil War, the Breedlings saw their opportunity for sabotage. When the war ended, Cromwell promptly set Vermuyden to work again, along with William, the recently acceded 5th Earl of Bedford. During the 1650's a vastly extended network of cuts and drains and sluices was completed. Parallel to the Old Bedford River, a new river, called the New Bedford River, or Hundredfoot, was cut. In 1651 the first Denver Sluice was constructed across the Ely-Ouse at the lower end of the Hundredfoot River. This excluded the tidal water from the South Level Rivers and turned it up the Hundredfoot.

A flood storage reservoir of 2270 hectares was created between the two new rivers, and embankments built to contain flood water and tides. This area became known as the Ouse Washes (or Hundredfoot Washes).

In 1713 disaster struck again when a combination of high tides and exceptional floods burst Denver Sluice. Once again the tides could flow unchecked into the South Level rivers. Land was inundated, much of it became derelict, and incursions of the tide were frequent. In fact, in 1715 a 2.3 m long sturgeon was caught in Thetford Mill Pool.

It was obvious that Denver must be rebuilt, and in 1750 this work was undertaken by a Swiss engineer named Labelye. The sluice which Labelye constructed remained in use until 1834 when Sir John Rennie built the three main sluice-gates which exist today in their original position. At that time the upstream gates were not, as today, vertical lift gates, but were in fact, wooden pointing doors.

Windmills were first used to drain the land in the 18th century. This, however, gave rise to another problem as the Black Fen fields began to shrink below the channels that drained them. To understand this new difficulty, it is necessary to understand the geological structure of the area. The post-glacial deposits in the shallow fenland basin are of three types; the coastal silts of marine origin, the peats lying inland off the silt belt, and the fen clays deposited during a period of marine transgression. The moisture content of waterlogged peat may be as much as 800% and when it is drained the immediate effect is a shrinkage of the top layer from which the water has been abstracted. This initial shrinkage may be more than 30cm in the first year. This is followed by the oxidation of the dried surface, which results in further wastage. Loss from this cause, which continues so long as the peat is dry, may be 25 to 50 millimetres a year.

The Black Fens gradually became an upside-down world with rivers higher than the surrounding land. Thus began the separation of the fenland drainage network into a high level system carrying the upland rivers through the fens and low level systems carrying the drainage water to the mills or pumps.

RECENT HISTORY

Modern diesel and electric pumping machinery developed in the 1930's and 1940's removed any further technical difficulty in providing good fen drainage. The remaining problem, which we are still dealing with today, is protecting the fenland from flooding caused by overtopping, or breaching, of the flood banks. Between 1930 and 1954 nearly £10 million (at least £100 million at current prices) were spent on continually raising the flood banks in an attempt to counteract the continuous sinking. However, this did not really solve the problem. After major floods occurred in 1936, 1937 and 1939, the former Great Ouse Catchment Board asked Sir Murdoch MacDonald and Partners to prepare a report. As a result, a Great Ouse Flood Protection Scheme was proposed which offered an alternative solution to raising the flood banks further. The plan was to increase the safety margin of the flood banks in the South Level over maximum flood level not by raising them, but by reducing the flood level itself. This scheme was, however, shelved because of the intervention of the Second World War in 1939.

FLOOD PROTECTION METHODS

Parts of the fenland are as much as 1.5m below mean sea level; high flood level is 3.5 to 4m above it. Thus the Agency's challenge is not fen drainage, it is the protection of the fens from flooding by the failure or overtopping of the river embankments. This would seem to suggest that the remedy is to make the flood banks high enough and strong enough to contain the floods. Alas, the solution is not quite so straightforward; another kind of fenland soil comes into the picture - the buttery clay. This is an apt description of the soft, silty clay which overlies most of the fenland floor beneath the upper coating of peat or silt.

From ground level to the hard Kimmeridge clay, gault or chalk may be as much as 5 or 6 m; even more in a few places. The flood embankments rest upon the peat and buttery clay layers, rendering them liable to sinking, instability, and seepage below.

The flood banks sink as the peat and the soft clay consolidate slowly under their weight. As they sink, the safe margin above flood level (freeboard) diminishes and they have to be heightened. The weight of the clay added to them in the heightening starts off a new sinking process - and so on. Thus it is becomes obvious that continually raising the banks does not resolve the situation.

Although the problem was disputed at length for centuries, the solution had actually been suggested by Sir Cornelius Vermuyden nearly 300 years ago. He

recognised that the major problem was that the flood waters were not "getting away". Sir Murdoch MacDonald and Partners' report of 1939 identified this factor as the key to the dilemma.

There was, however, an obstacle to the discharge of the South Level waters through Denver Sluice. In times of flood the water level from the old and new Bedford-Ouse outside the Sluice was higher than the waters coming from the Ely Ouse and its South Level tributaries. However, the low water level at King's Lynn under high flood conditions is about 3.5m lower than at Denver. It would seem that bypassing the Denver Sluice and bringing the point of discharge to King's Lynn would take advantage of this lower water level, thereby enabling the flood waters from the South Level rivers to get away. Therefore, a relief channel was cut from Denver with sluice gates at each end. To ease the flood level in the Ely-Ouse itself, the Cut Off Channel, from the River Lark near Mildenhall crossing the River Little Ouse and the River Wissey, takes flood waters from all three rivers and conveys them to the Relief Channel for discharge at King's Lynn. In addition to the new channels, the Ely Ouse River was widened to increase its capability.

When the incoming tide rises, the tail gate sluices at King's Lynn close and the outflow of the flood water ceases. The water is then contained in the Relief Channel and rises inside the gates until the tide once again falls, the gates open and the discharge of the flood water is resumed.

The basic principles of this scheme were as put forward by Vermuyden in 1638. With the completion of the scheme in 1964 the old problem of how to move excess water from the Fens into the sea was finally largely overcome. Improvements continue on into the 1990's - projects have recently been completed once again to raise and strengthen the embankments of the Ouse Washes and the Tidal River, at a cost of some £20 million.

THE DENVER STRUCTURES

Three structures perform the flood defence role on the site (although others exist for water resource transfer purposes) and these are the Denver Sluice itself, the adjacent Navigation Lock and the A G Wright (or Head) Sluice. The Lock is used for navigation between Denver and the Middle Level and also down the Tidal River to the Wash.

The sluices are used to discharge flood waters out of the Ely Ouse into the Tidal River Ouse, but this can only be done when the water level in the Tidal River is lower than the water in the Ely Ouse. This downstream level may at times be significantly higher than Ely Ouse water levels, either due to high tides or high river flows coming down the Hundredfoot River.

DENVER CONTROL STRUCTURES

- A Denver Sluice
- B A.G. Wright Sluice
- C Impounding Sluice
- D Residual Flow Sluice
- E Diversion Sluice

DENVER SLUICE

First built by Vermuyden in 1652, the present structure was rebuilt in 1834 by Sir John Rennie and enlarged in 1923 with the construction of the Big Eye. In 1984 the navigation lock was enlarged by replacing the twin pairs of traditional vertical doors with two vertical guillotine gates. This increased the lock size from 23 metres to 30 metres in length, with a width of 5.5 metres.

IMPOUNDING SLUICE

Built as part of the Ely Ouse Essex Water Transfer Scheme, the sluice is used to maintain and control levels in the Cut-off Channel. With the gates closed the Cut-off Channel becomes a pound for the transfer of water via the Blackdyke Farm Intake to Kennett and on to the Essex Region.

A G WRIGHT SLUICE

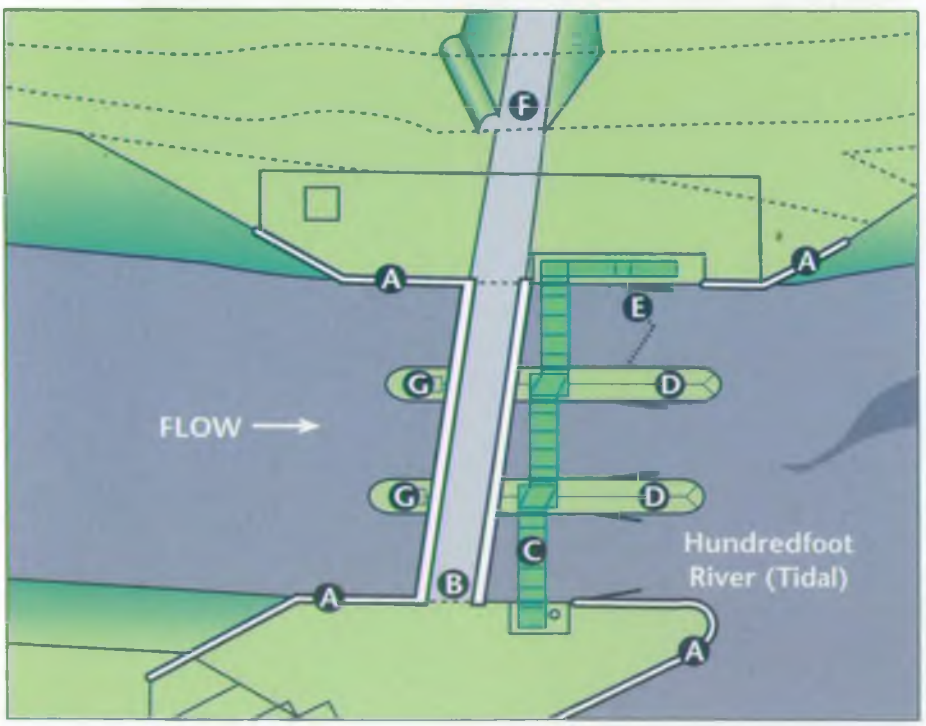
The A G Wright (or Head) Sluice was designed after 1947 saw the greatest flood ever recorded in this area, with 16,000 hectares of fenland under water. Built between 1956 and 1958, it forms the gateway to the Relief Channel, the major part of the flood protection scheme.

DIVERSION SLUICE

Built in 1969, the Diversion Sluice has a drop leaf gate which when lowered allows water to flow from the Ely Ouse River to the Cut-off Channel.

RESIDUAL FLOW SLUICE

Built in 1969 as part of the Ely Ouse Water Transfer Scheme, this sluice is capable of measuring low flows of water during a drought period.



WELMORE SLUICE

The present structure was built in 1930 and is to be replaced during 1997-1999 with a larger three gate construction as shown above. Welmore Sluice regulates flows from the Ouse Washes to the tidal river for discharge to The Wash.

- **A** Steel sheet piling to form seawalls
- **B** Heavy duty access bridge
- **C** Guillotine gates and lifting gantries for river level control
- **D** Central piers
- **C** Mitre gates for tidal control
- **F** Access ramp
- **C** Land drainage pumps to evacuate Ouse Washes flood water which is unable to be discharged by gravity

RECREATION

The benefits afforded by the Denver Complex are not limited to flood control. By ensuring a regulated depth of water in the Ely Ouse and its tributaries (Wissey, Little Ouse, Lark, Old West and Cam), the Denver structures facilitate both angling and boating. Additionally, navigational access can be gained to the Bedford Ouse system and thus on to Bedford via Denver Lock or Hermitage Lock on the Old West River.

Just upstream of the sluices are large channels suitable for sailing. There you will find sailing and boating clubs as well as boat hire operations. Along the banks are moorings owned by the Agency, which are available for hire. In association with the King's Lynn and West Norfolk Borough Council, the Agency has created a picnic area between the two sluices. Here, day visitors can enjoy the water setting complete with public car parking, toilets and boat launching ramp.

By a quirk of history, one of The Environment Agency's riverside buildings is a pub - the Jenyn's Arms - which is to be found just to the west of Denver Sluice. The tenant provides meals as well as the usual beverages and the property enjoys a river frontage.

Just to the east of the A G Wright Sluice is the control building from which the complex is operated. Although not open to the public, the building is a venue for lectures on the Denver Complex and associated drainage and water resources systems. These informative talks are available by prior arrangement for a small fee.

THE ELY OUSE ESSEX WATER TRANSFER SCHEME

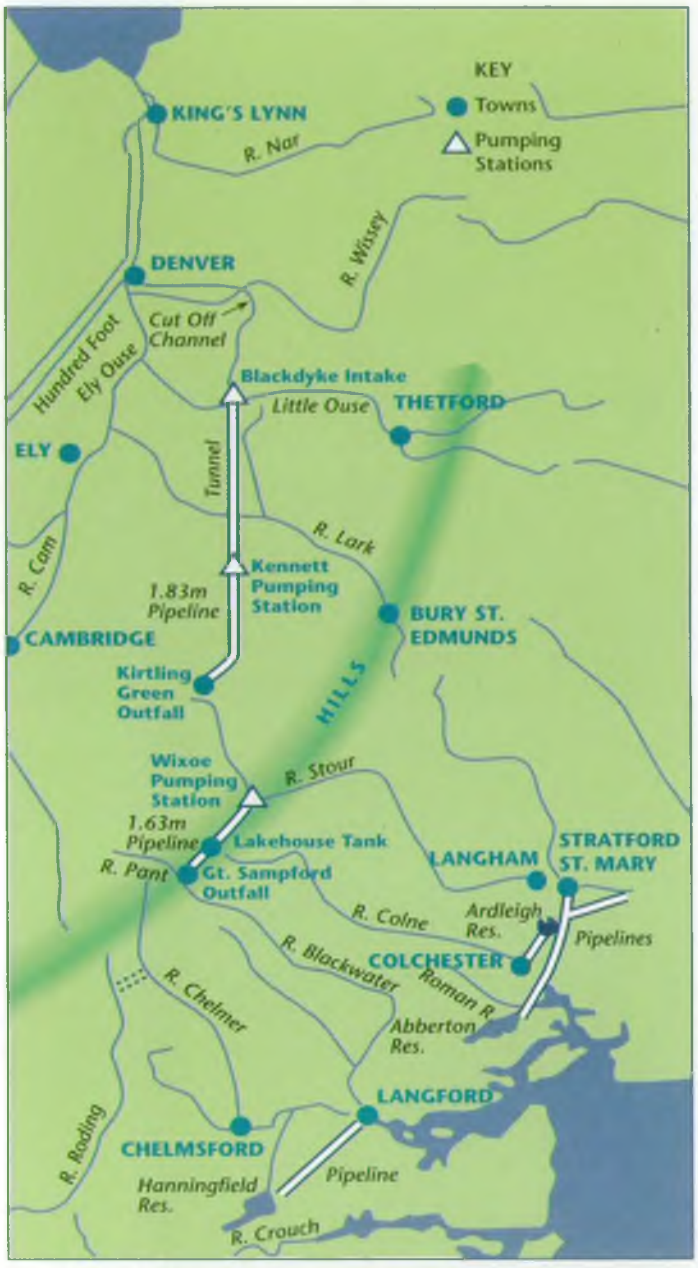
In 1964, a Ministry of Housing and Local Government Study highlighted future problems with water supply in the 1970's, due to expansion and development and the general population increase anticipated in the South Essex area. The solution was to transfer surplus water from the Ely Ouse to head waters of the Essex rivers, thereby increasing their flows and making extra water available to the Essex rivers. To this end, the Ely Ouse-Essex Water Act 1968 was promoted jointly by the former Great Ouse and Essex River Authorities. One great merit of the multi million pound scheme was that it augmented existing reservoir capacity, thus avoiding the loss of agricultural land to create new reservoirs.

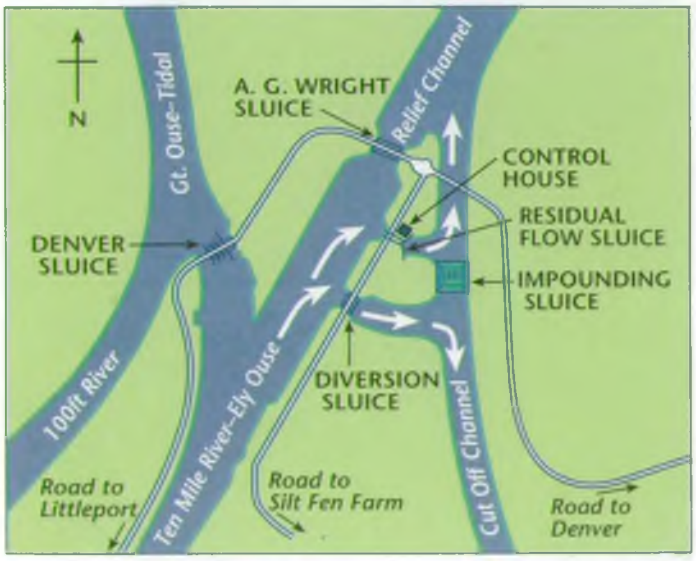
The Ely Ouse River drains a catchment of approximately 3640 kml (1410 sq. miles) upstream of Denver. It is fed by four main tributaries; the Cam, Lark, Little Ouse and Wissey. The sluice at Denver retains all these rivers at a similar level downstream of Bottisham, Isleham, Hockwold and Stoke Ferry respectively. Surplus water is discharged into the tidal channel at Denver and reaches the Wash near King's Lynn.

Under the Ely Ouse-Essex scheme, surplus water from the eastern part of the catchment, which would otherwise be lost to tidal waters and eventually to the Wash, is transferred to the flood protection scheme Cut Off Channel at Denver. The Impounding Sluice there is designed to enable the water level in the channel to be raised approximately 0.6 m, thereby producing a reversal of flow. The water is sent in a reverse direction approximately 25 km south east to Blackdyke, Feltwell. Here it is drawn off into a 20 km long tunnel which terminates at Kennett. The water is then pumped from the tunnel and through a 14.3 km long pipeline to the River Stour at Kirtling Green. Part of this discharge is drawn off at Wixoe 13.7 km downstream and pumped 10.3 km to the River Pant.

The water transferred from Denver travels 141 km to Abberton reservoir and 148 km to Hanningford reservoir. For about two-thirds of this distance, use is made of existing watercourses.

In times of high floods the gates are raised to permit The Cut Off Channel to serve its original purpose of flood protection.





FOR THE TECHNICALLY MINDED

BLACKDYKE INTAKE

At the intake, water is drawn from the Cut Off Channel and passed through coarse screens and self-cleansing bandscreens and a short length of 1.68 m diameter pipe.

Blackdyke intake, Lakenheath

TUNNEL

The tunnel is 20 km long and 2.4 m in diameter. It was driven in the gault clay by mechanised digging shields and lined with precast concrete segments.

KENNETT PUMPING STATION

The 3 main pumps are vertical spindle 114 thousand cubic metres per day (tcmd) fixed speed borehole type pumps of 3500 hp each, set in the shaft cap and with groups of 2 and 3 impellers at depths of 51 m and 9 m from the surface respectively. A further set of 6 lower capacity submersible pumps are provided for supplementing flows and for dewatering. The pumps operate in an open well below ground level and are serviced by a 65-tonne Goliath crane.

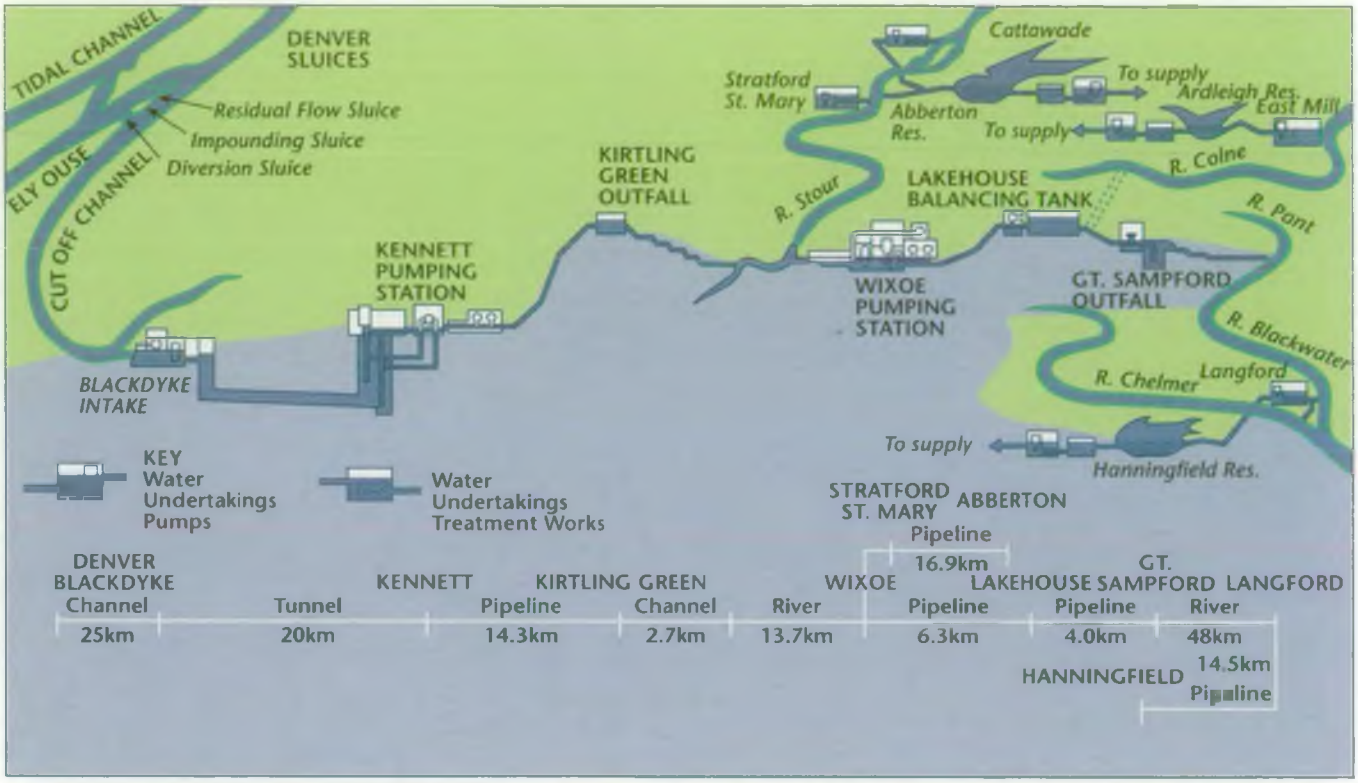
KENNETT-KIRTLING GREEN PIPELINE AND OUTFALL

The pipeline is 14.3 km long with a 1.83 m dia welded steel main. It is 13 mm thick, bitumen lined and sheathed and cathodically protected. The pipeline is laid in trench with a minimum cover of 1 m or 1.2 m depending on the nature of the ground.

There are washouts at low points, and 'pigging' chambers at each end for swabbing devices. Anti-vacuum valves and air valves are provided for relief of negative pressures in surge conditions.

At Kirtling Green water discharges through a stilling basin structure before flowing in an open channel to the river.

Kirtling Green Outfall Structure



WIXOE PUMPING STATION

Reasonably constant river levels are maintained by an automatic bottom hinged control gate. Water is drawn from the River Stour via a settling pound and through self-cleaning bandscreens by two fixed speed 91 tcmd pumps, one variable speed 45 tcmd pump and one two speed pump of 91/93 tcmd, all of which discharge into a 6.3 km long, 1.68 m internal diameter pipeline to the balancing tank at Lakehouse Grove.

GREAT SAMPFORD OUTFALL

Water flows by gravity from the balancing tank to the outfall on the River Pant through a 4 km long 1.68 m dia pipeline.

Surplus pressure energy of the water is dissipated through two 227 tcmd vertical sleeve valves with 760 mm outlets submerged in a stilling pool. The water then flows down a stepped channel to the river.

IMPROVEMENT TO RIVER CHANNELS

16.8 km of the River Stour below Kirtling Green and 16 km of the River Pant (Blackwater) below Great Sampford have been improved to accept the increased flows by widening and deepening certain stretches and enlarging waterways through some bridges and mills. Ten new automatic control gates were constructed on the River Stour and one on the River Pant.

Note. 4.55 tcmd = 1 million gallons per day (mgd).

Left: Wixoe Pumping Station - Two No. 91 Mid and one No. 45 Mid pumps

Below: Wixoe Pumping Station Intake settling pound from River Stour

MANAGEMENT AND CONTACTS:

The Environment Agency delivers a service to its customers, with the emphasis on authority and accountability at the most local level possible. It aims to be cost-effective and efficient and to offer the best service and value for money.

Head Office is responsible for overall policy and relationships with national bodies including Government.

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For general enquiries please call your local Environment Agency office. If you are unsure who to contact, or which is your local office, please call our general enquiry line.

ENVIRONMENT AGENCY
GENERAL ENQUIRY LINE
0645 333 111

The 24-hour emergency hotline number for reporting all environmental incidents relating to air, land and water.

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WELMORE LAKE SLUICE RECONSTRUCTION

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ABOUT THE OUSE WASHES

The Ouse Washes in flood

The Ouse Washes are the largest example of regularly flooded washland in Britain. Surrounded by the most fertile agricultural land in the country, the Washes protect over 29,000 hectares of high quality fenland, including 830 residential properties. The Ouse Washes hold a special ecological significance as one of the last remaining regularly grazed freshwater marshes. Internationally important numbers of migrating wildfowl including Bewick's and whooper swans, teal, widgeon, gadwall, shoveler, pintail, pochard, tufted duck, coot, mute swans and cormorants visit each year. Conservation groups such as the RSPB, and The Wildfowl and Wetland Trust have sites in the area. The Washes have been designated a Site of Special Scientific Interest, a Special Protection Area and a RAMSAR site.

The Washes are an intrinsic mechanism that depends on the maintenance of an open grassland that is regularly flooded in winter, but as dry as possible in summer. Recently, however, summer flooding has increased, threatening both the agricultural and domestic residents as well as the many rare species of birds and other wildlife.

IMPORTANCE OF WELMORE LAKE SLUICE

The sluice at Welmore Lake is the only means of removing water from the Ouse Washes into the tidal Hundred Foot River. From there, excess water drains into the sea.

Welmore Lake Sluice must deal with a double threat to the environment. It is there, 20 km south of King's Lynn, that the River Delph and the tidal River Great Ouse meet. The sluice holds back waters stored on the Washes during a flood. Once the peak flood has passed, it allows these waters to flow through and rejoin the Hundred Foot River and so to the sea. The structure must also keep saline water from the Tidal River out of the River Delph and the Ouse Washes.

History

The importance of the Welmore Lake site was recognised long ago. In 1756, more than 100 years after the first attempts to drain the area, it was decided to construct a new embankment across the Washes at Welmore Lake. For the first time the Washes were protected against tidal flooding. However, the method was not sophisticated. The only way to let the waters out following a flood was to deliberately breach the embankment, which would be reconstructed once the flood was past.

LOCATION

The 1825 sluice

The 1933 sluice

This less than ideal method was used until 1825 when a sluice was first built at Welmore Lake. This was a timber and brick construction with four sluiceways, which lasted over 100 years.

A new sluice constructed from reinforced concrete and steel was completed in 1933. Although this later construction had only two waterway openings, these were bigger and more efficient than the four openings in the earlier construction.

Problems with the 1933 Sluice

The sluice was built upstream of the original structure to avoid tidal flooding during construction. Although this helped the construction work, it eventually created problems due to a build-up of silt. As the structure was now further away from its outfall into the Tidal River, silt began to build up immediately in front of the tidal flap gates which inhibited the flow of waters and prevented the tidal flap gates from opening when required. This resulted in the need for dredging during the summer period.

Over the years, the tidal flap gates became distorted because of their susceptibility to damage from trapped debris, resulting in inadequate protection against saline and silt incursion.

Expensive temporary pumping equipment had to be used, particularly in the summer months, when gravity alone is not sufficient to get all the waters through and off the Washes.

NEW THREE SLUICEWAY SLUICE OFFICIALLY

Technical Interest

The reconstruction was an ambitious project with interesting technical details:

- Temporary cofferdam. A cofferdam is a watertight structure which allows underwater structures to be built in the dry. The new sluice was built within a temporary cofferdam, 45m in diameter. A length of the south bank of the River Delph was excavated to divert water flow around the cofferdam, thus ensuring continued management of the Washes during the rebuilding of the sluice.
- The sluice has three upstream vertical steel lift gates, approximately 7.4m wide and 6.7m high, each weighing 25 tonnes.
- The three pairs of mitre gates, made of ekki timber, are 4.7m x 7.0m and each gate weighs 12 tonnes.

The permanent pumping installation utilises two submersible canister type pumps installed in chambers in the upstream end of the piers. Their combined capacity is 1.5 cubic meters per second.

The completed structure – viewed from up stream

LOOKING TO THE FUTURE

The new sluice discharges 50% more water than its predecessor. Its permanent pumping facility will improve the summer drainage of the Washes. Relocation of the structure along with the installation of silt jetting equipment will reduce the consequences of siltation.

The importance of the Welmore Lake sluice in the fight against flood cannot be overstated. It is a crucial element of the Ouse Washes Summer Flooding Strategy. The strategy will improve the drainage of the Washes and could reduce the duration of summer flooding by half.

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Designed by The Design Factory

Temporary pumping at the 1933 sluice

OBJECTIVES FOR RECONSTRUCTION

After 60 years the sluice had come to the end of its design life.
In 1997, the Environment Agency began work on the new sluice.
Specifically, the objectives of the programme included:-

Relocation

The new sluice is relocated 70m downstream of the older structure. This is a key factor in reducing the problems associated with siltation as the sluice is now closer to the confluence with the Hundred Foot River, resulting in an improved discharge of floodwater into the Tidal River.

Increased Capacity

Three sluiceways were built, instead of the existing two. This has increased the amount of water that can flow through the sluice by 50%.

Permanent Pumping Facility

This is a major improvement which has two significant benefits:

- The new sluice incorporates two separate land drainage pumps, used to evacuate the last remaining volume of flood water which cannot be discharged by gravity into the tidal Hundred Foot River. Provided there are no high flood flows during spring and summer, which would cause the flood control sluices at Earith to operate, environmentally beneficial target water levels in the River Delph can be achieved and maintained.

- The permanent pumping facility replaces the temporary one which did not adequately discharge summer floodwater. The new installation, with a total of six discharge points, can also be used to facilitate the dispersal of silt in front of the tidal gates.

Silt Jetting

Although repositioning the sluice helps to alleviate the problems of siltation, it is not the complete answer. To further combat this problem and ensure that the tidal doors can always open when needed, a purpose built system of high pressure silt jetting nozzles has been incorporated into each of the tidal pointing doors. When the sluice is not discharging water, this equipment can be operated, thus avoiding a build up of silt in front of the pointing doors.

Pipework within the piers of the new sluice for land drainage pumping

OPENED 18 APRIL 2000

RECONSTRUCTION DETAILS

The Contractors

Separate contracts were awarded for the civil works and the mechanical & electrical works. The team comprised:-

Project Management - The Environment Agency

Consulting Engineers - Lewin, Fryer & Partners

Civil Contractor - Jackson Civil Engineering

Mechanical & Electrical Contractor - Waterlink (UK)

LEWIN, FRYER & PARTNERS
consulting engineers

Jackson
CIVIL ENGINEERING

WATERLINK

Timing

Work began in July 1997 and was substantially completed in September 1999. It is interesting to note that during this period the 1933 sluice was required to deal with the Easter Floods of 1998, evacuating some 60 million cubic metres of water over a period of several weeks.

Cost

The overall cost of the two year project was £5.2 million. The reconstruction is a major part of the £8 million Ouse Washes Flood Control Strategy which will have flood defence benefits of over £70 million.

Temporary cofferdam

The new structure within the cofferdam

Mitre gates

H I S T O R Y

In 1948 an ambitious project to install two large pumping engines at Welches Dam was completed. This was seen as the best way to gain a positive control of water levels and provided effective protection for many years.

However, by 1998, the pumps were 50 years old and their continued operation caused considerable concern. The major problems included:

- The pumps were very old and could not be relied on to operate efficiently at all times. They failed to operate satisfactorily twice in the 1990s.
- The diesel engines were obsolete. Repair time was lengthy due to the increasing difficulty of finding or making spare parts.
- The pumps required constant supervision during operation.

I M P R O V E M E N T S

It was clear that improvements had to be made to continue to provide protection for surrounding farmland, homes and wildlife. Three bodies responsible for flood defence and land drainage in the area worked together to finance the £250,000 project - The Environment Agency, Manea & Welney Internal Drainage Board and Sutton & Mepal Internal Drainage Board.

Work was completed in 1998. Major improvements included:

- One of the original, slow running (400 rpm) diesel engines was replaced with a modern, high speed (1500 rpm) turbo charged diesel engine.
- The remaining original engine was retained as a standby. It is only on very rare occasions that both engines need to be run at the same time.
- The new engine was fully automated so that it will start as soon as a pre-determined flood level in the Counter Drain is reached.
- An automatic weedscreen cleaner was installed to prevent weeds and debris fouling the pumping equipment.

The original pump units were in good condition and therefore not replaced.

Technical Details

It is important that the pumping capacity be sufficient to move flood waters along the Counter Drain/Old Bedford River to the Tidal River, where they eventually flow into the sea. The capacity of each engine and pump set is 6.3 cubic metres per second, making the overall station capacity 12.6 cubic metres per second.

One of the objectives of the project was to provide reliable automated pumping equipment that is fuel efficient. Fuel consumption is approximately 55 litres per hour, per engine.

R E L I A B I L I T Y

Welches Dam Pumping Station helps to ensure efficient drainage of the Middle Level, evacuating flood water from the system as necessary. Farmers, landowners, residents and wildlife depend on the reliable operation of this station. These recent improvements ensure that Welches Dam Pumping Station will continue to play a vital role in drainage and flood control and provide effective protection to all in the area.

Pump set

Original engine

Pump set stripped for checking

New diesel engine

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FUNCTION

Welches Dam Pumping Station is a vital component of the Middle Level, helping to ensure efficient drainage of the area and keeping flood waters off farmland, countryside and populated areas.

Throughout much of the Ouse Washes system, flood waters are drained through the rivers and channels by gravity to the sea. However, in some areas this is not sufficient. Such is the case in the Middle Level where Welches Dam Pumping Station is used to relieve flood levels in the Counter Drain when gravity discharge is not possible or sufficient. The pumps at the station provide the extra impetus needed to keep water flowing through to the Tidal River.

The Middle Level Drainage System

The Counter Drain runs from Earith in the south to Salters Lode in the north, parallel to the Middle Level Barrier Bank but outside of the Ouse Washes flood area. Approximately 104 square kilometres of fenland are drained by a system of channels, ditches and pumping stations into the Counter Drain. Additionally, the Counter Drain is fed by water from 26 square kilometres of upland around the Somersham area. During low flow conditions the Counter Drain is able to flow by gravity into the Tidal Ouse at Salters Lode. Drainage in the Middle Level is undertaken by Sutton & Mepal, Manea & Welney and Upwell Internal Drainage Boards.

However, when high tides prevent discharge at Salters Lode, Welches Dam Pumping Station plays a key role in the Middle Level Drainage system. The pumping station is used to lift flood water up and over the Middle Level Barrier Bank and into the Ouse Washes.

Protecting Homes and Farmland

Many people live in the Middle Level. There are approximately 650 homes in the area. Agriculture is of great importance, with highly productive farmland that must be kept free of flood water.

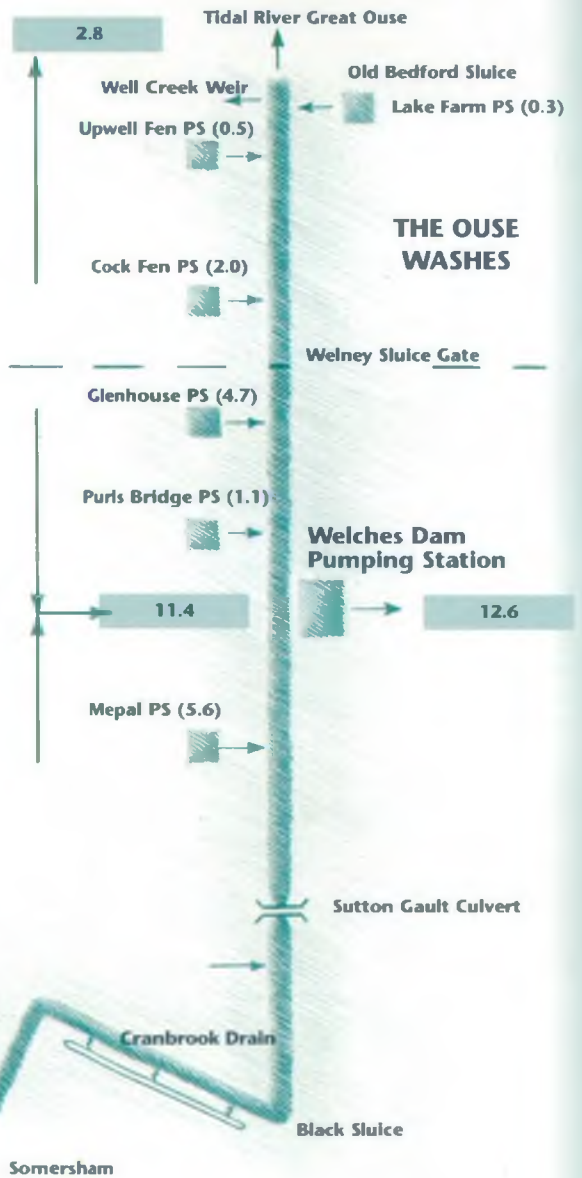
Wildlife

Welches Dam helps to ensure that a great variety of wildlife can continue to inhabit the entire length of the Counter Drain. The Counter Drain forms part of the area included within the Ouse Washes SSSI, which holds several important conservation designations:

- Site of Special Scientific Interest supporting nationally important aquatic plant communities.
- Special Area of Conservation is home to the spined loach, a rare bottom dwelling fish.
- Special Protection Area providing a habitat for large numbers of indigent and migrating birds.
- Ramsar site as an internationally important wetland area.

Additionally, the surrounding rivers provide excellent coarse fishing and are regularly fished by four angling clubs.

PUMPING CAPACITIES INTO & OUT OF THE COUNTER DRAIN
(CUBIC METRES PER SECOND)



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WELCHES DAM PUMPING STATION

IMPROVING THE BARRIER BANKS

Constant maintenance and improvement are essential to keep the Banks functioning as storage barriers to flood water.

The Middle Level Barrier Bank, which was suffering from low bank levels, instability and cracking, was improved at a cost of £14million. The Bank was raised and reprofiled to provide a 3m wide crest using imported fill material. Approximately 500,000 cubic metres of bank raising material was used. Haul roads were constructed which remain in place for access.

The problems addressed at the South Level Barrier Banks included bank instability and cracking. The major improvement involved strengthening the embankment and reprofiling where appropriate. 150,000 cubic metres of bank raising material were used. The overall cost of the work was £6million.

Construction

Ouse Washes Barrier Banks

Improvement Works Carried Out Between 1989 and 1996

	M188	SI88
Bank length improved	32Km	32Km
Haul road constructed	27Km	18Km
Principal type of bank work	Bank raising	Bank re-profiling
Imported haul road material	130,000m³	40,000m³
Imported bank material	500,000m³	150,000m³
Cost	£14m	£6m

Facts and figures

PROBLEMS AND SOLUTIONS

Erosion

The Middle Level Barrier Bank is at risk from erosion caused by wave action. Stored flood waters are subject to south westerly winds which generate significant wave action along the length of the Washes. Over a period of time, the action of the waves can cause serious erosion along the sloping face of the Middle Level Barrier Bank. Ongoing repairs must be made in order to maintain the integrity of the Bank.

A more permanent solution is needed. A durable form of erosion protection may be the only long term option. There are two major difficulties with this suggestion. Firstly, as the Middle Level Barrier Bank is over 30 km long, the cost of such an undertaking could be prohibitive. There are also likely to be concerns about the environmental impact of such work.

Toe erosion

Another erosion problem affects both the Middle Level and South Level Barrier Banks. Livestock grazing is essential to maintain a well managed grass cover to minimise the effects of erosion and general wear and tear. The grass cover also facilitates the visual inspection of the Banks that is essential to monitor potential problems caused by erosion, cracking or slips in the Bank.

Unless the numbers of sheep and cattle grazing the banks can be maintained, the alternative is mechanical mowing. This, unfortunately, is not only costly but environmentally unfriendly. The large numbers of birds, insects and fauna which inhabit the Washes would be at risk from this approach.

Summer grazing

Vigilance for the Future

It can be seen that ensuring the condition and integrity of the Barrier Banks is essential to the effective functioning of the Washes as a flood control mechanism. The Middle Level and South Level Barrier Banks are the key to the maintenance of the Ouse Washes and the effective drainage of the rest of the Fens. So whilst constant repair, improvement and vigilance are vital, care must be taken to identify and address ongoing and future problems.

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HISTORY

Creating the Washes

The Ouse Washes, which extend 32 km from Earith to Denver, are a carefully planned and maintained mechanism for controlling flooding on the Fens. They act as a flood storage reservoir and flood relief channel, enabling surrounding land to be inhabited and farmed. Almost entirely man-made, their creation began in the 17th Century when the Dutch engineer, Sir Cornelius Vermuyden, was engaged to excavate the Old Bedford and Hundred Foot Rivers and build the Middle Level and South Level Barrier Banks.

The Barrier Banks

The Middle Level and South Level Barrier Banks are an essential element of the system first created by Vermuyden. Simply, the Barrier Banks form the rim of the vast water retaining area known as the Ouse Washes.

VITAL PROTECTION

The Middle and South Level Barrier Banks are vital to protecting the Cambridgeshire Fens from flood. They contain Bedford Ouse flood flows, preventing flooding of towns, villages and approximately 29,000 hectares of the richest agricultural land in England.

Without the Barrier Banks, the Fens would flood all the way to Peterborough and Ely. More specifically, failure of the South Level Barrier Bank would affect 230 homes. Up to 11,000 hectares of arable land would be flooded. There would be a very high risk of loss of life. Farm and commercial buildings, machinery, vehicles and road and rail infrastructures would all be threatened. The total potential damage of such a disaster is estimated at £23 million. Even worse would result from the failure of the Middle Level Barrier Bank, with more than 600 homes and 18,000 hectares of agricultural land flooded at a cost of some £42 million.

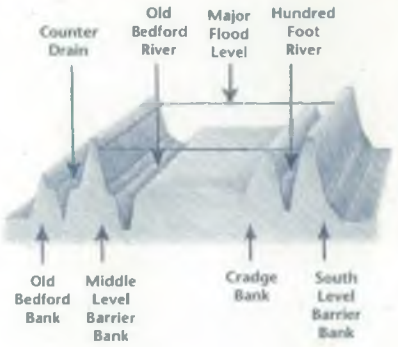
THE BARRIER BANKS AT RISK

Despite constant vigilance, the system has failed on several occasions over the past 300 years. The most dramatic event was the floods of March 1947, which saw the Banks give way in several places, flooding thousands of hectares of fertile farmland. Several lives were lost. More recently, the Banks withstood the flood of Easter 1998, containing 60 million cubic metres of water within the Washes at some 5m above the surrounding ground level. Fortunately, considerable improvement work had been done to the Banks during the first half of the 1990s. It is unlikely that they would have proved so stable had this work not been undertaken.

Several factors threaten the integrity of the banks:

- The whole of the fens area is underlaid by a stratum of peat which compresses under the weight of the embankments. This layer also shrinks as a result of land drainage activity. Consequently, the level of the land in relation to the sea has fallen in some areas by 5m since the Barrier Banks were built.
- Global warming and other environmental factors have resulted in a steady rise in sea levels.
- Major embankment failure due to deep-seated slips in the soft underlying layer could lead to breaching of the banks during a flood.

TYPICAL CROSS SECTION ACROSS THE OUSE WASHES



Barrier Banks

Mepal causeway

Welney Road in flood

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THE OUSE WASHES BARRIER BANKS

Our vision is a healthy,
rich and diverse environment in England and Wales,
for present and future generations.

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