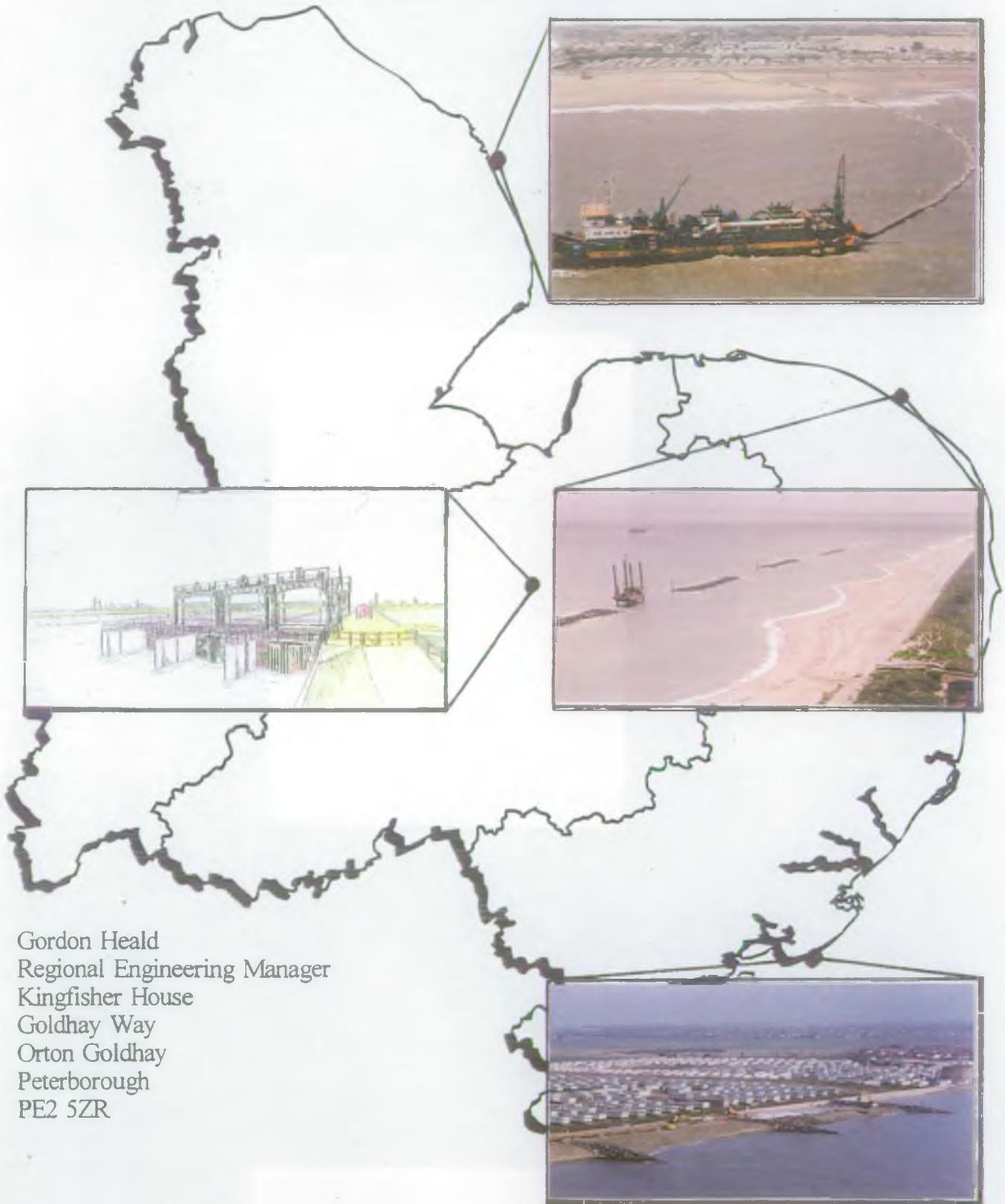


# ENGINEERING THE ENVIRONMENT

## PROFILE OF THE ANGLIAN ENGINEERING DEPARTMENT



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## **Engineering the Environment**

### **Foreword**

This brochure gives insight into the activity of the Anglian Engineering Department which is heavily orientated to delivery of the Capital Programmes of Flood Defence and Water Resources.

Read on to learn how the Engineering Department is also achieving the softer aims and objectives of the Environment Agency whilst setting new standards for project management.

The brochure is deliberately written to be read quickly. If you require further information please contact me:-

Gordon Heald, Regional Engineering Manager.

### **Contents**

1. Engineering a response to the Agency's 'Ten Point Plan'
2. Vital Statistics of the Engineering Department
3. Managing the Capital Programmes
4. Challenge to Change
5. Fringe Benefits
6. Emergency Response
7. Tomorrow's World

### **Appendices**

- A. Recent Projects Portfolio
- B. Human Resources
- C. Who does What
- D. Brochures from Suppliers

**Planning Library**

Reference: 208

**Please return to  
Technical Planning**

## 1. **ENGINEERING AND THE AGENCY'S TEN POINT PLAN 98/9**

The Agency Corporate goals are summarised in the 'Ten Point Plan'. The Anglian Engineering Department is developing project management and personal behaviours to assist in the achievement of the plan.

1. **Climate Change** - Flood defences are constructed to accommodate climate change, in particular sea level rise. Internal practices of the Engineers seek to reduce CO<sub>2</sub> consumption from both minimising energy consumed in the construction processes and personal car usage.
2. **Air Quality** - No impact.
3. **Water Resources** - Low flow gauging stations are being constructed as part of the Anglian Regional Telemetry System. In the past, river support boreholes and pumping systems have also been constructed.
4. **Biodiversity** - Environmental Assessment forms a significant element of the Flood Defence projects. This frequently assists in maintaining biodiversity and other ecological benefits including fisheries.
5. **Fisheries** - As 4
6. **Integrated River Basin Management** - Delivery of the Flood Defence Capital Programme and Construction of Flood Defences and Water Resources works aids planning and management of River Basins. The development of strategies for holistic management of rivers to ensure that flood problems are solved without detrimental effects to other locations. The same process is applicable to management of coastal defences.
7. **Conserving Land** - As 8.
8. **Managing Waste** - Project Managers are able to make positive reductions in the use of primary material by maximising, where possible, use of recycled materials.  
  
In particular, the Government has set a target of 10% reduction in "primary aggregates" (ie material quarried from the earth). The Agency Engineers monitor their performance against this target and have achieved levels exceeding this in Anglian.  
  
Where it is not possible to obtain recycled or secondary materials then restoration plans or habitat creation are developed to mitigate the extraction.  
  
Waste products arising from projects are, wherever possible, built back into the works. If disposal is absolutely necessary then waste matter is taken to licensed disposal sites.
9. **Regulating Industry** - No impact.

10. **Openness/Businesslike** - Project Management is developing new techniques and practices following the lead identified in the Gardiner & Theobald Report Jan 97. Partnering with Consultants and Contractors assists in improvements to quality. Open discussion of risks and constraints encourages better project management and alignment of objectives. Better relationships with Consultants and Contractors, encourage teamwork and efficiency and better value for money.

In development of projects, consultation with conservation bodies and landowners is essential and again an open and businesslike approach is encouraged.

## 2. VITAL STATISTICS

- Capital Programmes 98/99 £34m Flood Defence  
£0.5m Water Resources
- Project Management Focus
- Management of Consulting Engineers £3.4m p.a.
- Management of Halcrow Framework Agreement c. £0.7m p.a. for Anglian
- National Co-ordination of the Halcrow Framework Agreement c. £5m p.a.  
nationally
- Management of Term Consultancy in Anglian c. £0.7m p.a.
- 25 Staff (see Appendix B for details)
- External Influence
  - Represent Agency on Construction Clients' Forum
  - Represent Agency at New Engineering Contract User Group
  - Represent Agency on Institution of Civil Engineers Coastal Engineering  
Advisory Panel
  - Committee Membership of CIWEM (Rivers & Coastal and Anglian Groups)
- Agency National Influence
  - Member of Gardiner & Theobald Review Group (G&T Group)  
(Project Management Procurement Review)
  - Member of G&T sub groups
  - Member of the Flood Defence Improvement Board
  - Chair & membership of Engineering Project Management Group  
and sub groups
  - National Lead for Public Private Partnerships (Broadland)
- R&D Project Leadership
- Electrical Safety Advice regionally

### 3. MANAGING THE CAPITAL PROGRAMMES

#### The Task

- Flood Defence Capital Programme £34m p.a.
- Water Resources (Engineering) Capital Programme £0.5m p.a.

#### The Process

- Customer Focus - Area Flood Defence Manager/Water Resources Manager
- Project Manage - individual projects to Quality, Cost and Time targets
- Teamworking - in multifunctional project groups (Operations, Fisheries, Environment, Recreation, Estates, Finance, Procurement)
- Pre-qualification, Selection and Management of Consultants
- Monitor performance of Consultants
- Management of Business Case preparation
- Management of Environmental Assessment Process
- Presentation of Project justification to PAB for approval
- Consultation with stakeholders, environmental bodies and landowners
- Achieving Approval of MAFF Grant Aid
- Development of Risk Assessments at all project stages
- Review of Consultants' Designs
- Co-ordination of Health & Safety Plans and Files
- Pre-qualify and select Contractors
- Monitor performance of Contractors
- Handover completed project to operating client

#### The Style

- Project Management via Teamworking with Consultants and Contractors
- Promotion of projects to consultees and public through presentations and consultation
- Selection of suppliers on Quality Criteria and Price
- Encouraging innovation from suppliers
- Avoidance of adversarial attitudes through pro-active management
- Seeking environmental improvements where possible
- Reduction of use of primary materials and energy where possible

#### 4. CHALLENGE TO CHANGE

The Agency seeks to achieve Best Practice Client status. The G&T Review Group are promoting this aim. Anglian Engineering Department are:-

- Represented on the G&T Group (GCH)
- Members of G&T working Groups
  - Risk Management - GCH
  - Supplier Conditioning - GCH
  - Client Definition - GCH
  - Alternative Procurement - SJH
  - Procurement Strategy - RN
  - Project Management/ Procurement Interaction - JA
  - Procedures - RN
  - Framework Agreements - SW
- Conducting three projects as pilots for alternative procurement to capture lessons learned and develop knowledge with G&T Group, for the benefit of Project Managers.
- Operating the Halcrow and Term Consultancies as Framework Agreements
- National co-ordination of the Halcrow Agreement
- Committed (in conjunction with procurement colleagues) to evaluation of tenders against quality criteria as well as cost.
- Evaluating risks in delivery of projects
- Experienced in operating contracts using Partnering Charters and Teamworking techniques.

Anglian Engineers are committed to a process of continual improvement and support the aims of the G&T Group and the objective of the Agency obtaining Best Practice Client status and recognition.

## 5. FRINGE BENEFITS

### Quality Standards

The Engineering Department has for many years maintained a series of quality standards (Engineering Instructions). In many instances these have formed the basis for National standards developed through the Engineering Project Management Group. These include:-

Civil Engineering Contract Administration	(Ref PIN 21)
Consultant's Engagement	(Ref PIN 22)
H&S CDM Standards	(to be included in PIN 19)
Site Investigation	(to be included in PIN 19)

The Department also provide technical secretariat to the National development of the Consultant's Manual, Civil Engineering Contract Administration Manual and Mechanical/Electrical Manual.

### Risk Management

Following the publication of CIRIA special report 125 "Management of Risk", Anglian Engineering promoted the adoption of Risk Management Techniques. This was subsequently developed by the EPMG to an agreed National standard.

The Regional Engineering Manager has presented risk assessment and management proposals to PAB to encourage a risk aware culture in the Agency and to extend this culture through a Risk Support Group in the Region.

### Regional Electrical Safety Advice

The Regional Electrical Advisor, Jim Hogg is a Senior Engineer within the Engineering Department. Jim provides electrical safety advice in accordance with Health & Safety requirements, for all parts of the Agency, from development of new electrical engineering schemes through to improvements and safe working practices for existing operational works. In addition, his role crosses other functions including Fisheries for electro-fishing and other portable electrical equipment through the Office Manager.

### Reservoir Management

David Cotterell, Senior Engineer maintains a record of all large raised reservoirs in accordance with Reservoirs Act 1975, to ensure that the Agency is fulfilling its statutory duties in maintenance of its reservoirs and thereby to avoid catastrophes. Peter Cowie and Jon Coultrup, also Senior Engineers, provide reservoir supervision and monitor the condition of large raised reservoirs to ensure that they comply with the Act and also to ensure that they are properly maintained and safe to operate.

Many of the reservoirs only operate in times of flood and this poses additional difficulties in their operation since like many flood defence assets, they sit virtually unused for many years and then have to operate at full capacity without warning.

### **Professional Development**

The Anglian Engineering Department is an accredited training employer for the Institution of Civil Engineers. Training can be provided for graduate and technician engineers in order for them to achieve their appropriate professional status.

In addition to ICE training, the Department encourages individuals, to improve their technical and managerial competence, through training courses both in-house and external to the Agency. All Engineers are encourage to participate in the professional engineering institutions and to attend their learned meetings.

Through individuals 'Personal Development Plans', all staff are encouraged to develop in their field.

### **National Contractor's Database**

The Department manages a database of Contractors who have pre-qualified to work for the Agency (by assessment of their technical and financial capacities). The database holds records of performance of these Contractors and their particular specialisms. The database is used to streamline the pre-qualification of Contractors for specific contracts and to enable tender lists to be drawn up efficiently.

## 6. EMERGENCY RESPONSE

The purpose of the Engineering Department is to ensure satisfactory long term planning of Capital Works and so to manage the flood defences to reduce risks in emergencies. However, at times such as the Easter 1998 floods, engineering staff were heavily involved in the management of the emergency and collecting data to feed into future scheme planning.

The list below identifies the staff and how they were used in the recent emergency.

### **Easter Flood - Emergency Response**

Regional Engineering Mgr	Gordon Heald	Gold Control, Hinchingsbrooke
Principal Engineer	Richard Nunn	Gold Control, Hinchingsbrooke
Senior Engineer	Peter Cowie	Gold Control, Hinchingsbrooke
Principal Engineer	Nigel Pask	Reconnaissance on River Nene
Senior Engineer	David Cotterell	Seconded to Bedford Area
Senior Engineer	Jim Hogg	Central Control Room
Senior Engineer	Paul Miller	Reconnaissance, Tidal Nene
Senior Engineer	Chris Allwork	Whittlesey Flood Patrol
Assistant Engineer	Jim Anderson	Reconnaissance River Welland
Assistant Engineer	Ian Dodson	Reconnaissance, Great Ouse
Assistant Engineer	Andy Bennison	Reconnaissance, Great Ouse
Technical Coordinator	Simon Wood	Reconnaissance, Great Ouse
Assistant Engineer	Alastair Woodley	Reconnaissance, Great Ouse

## 7. TOMORROW'S WORLD

Throughout the years of National Rivers Authority and the Environment Agency, the Engineering Department has developed a highly specialised expertise in Flood Defence Engineering and Project Management of flood defence, river and water resources projects.

A high degree of professionalism is maintained through the benefits of critical mass which is available in the Engineering Department regionally.

Since the advent of the Anglian Shoreline Management System and the more recent pressures from the Ministry of Agriculture to develop Shoreline Management Plans there has been an emphasis on the development of strategies for flood defence projects rather than a piecemeal individual project approach.

The strength of the Engineering Department lies in its ability to develop such long term strategies in consultation with Operations and other departments and to respond to changes in approach and legislation.

Within the Agency, there is potential for management of the Capital Programme through a National Service or a National Capital Programme Manager. This would enable projects to be viewed on a more National basis and allow cross regional boundary projects to be set up more readily. We already have experience of this through our work on the Humber; with North East and Midlands Regions.

The Agency is also considering changes to its project management procurement approach. The Gardiner & Theobald group are looking at this for the Agency and Anglian Region is well represented in that Group.

The overall aim is to gain the Environment Agency recognition as a 'Best Practice Client' by improving the project management skills of Agency Engineers and thereby further improve the efficiency of delivery of capital projects. Management of the supplier chain is essential in this. Anglian Engineering are already heavily committed in this respect through the 'framework' agreements with Halcrow and with Posford Duvivier, and through the teamworking partnership arrangements which have been managed on several projects (Happisburgh II, Seawick and Welmore Sluice). In these projects, Consultants, Contractors and the Agency have worked together in a spirit of collaborative teamwork to ensure the best possible outcome for the Agency in the final finished product.

Into the future, whilst retaining a sound technical skillbase, it is essential that Project Managers develop the necessary skills to influence suppliers, consultees and stakeholders, to encourage innovation in project delivery, eliminate waste and through reducing 'whole life costs' obtain better value for money. The key behavioural competences required by the Agency's 'Next Steps' process will become evident here as we move into project management through more effective management of the supplier chain.

**Recent Projects Portfolio**

Lincshire Phase 2  
Humber Defences  
River Ancholme Bridges  
Lower Witham Strategy  
Trent-Witham-Ancholme Water Transfer  
Nene Stabilisation  
Northampton Feasibility  
River Glen Stabilisation  
Tidal River Ouse  
Welmere Lake Sluice Reconstruction  
Waveney Ultrasonic Gauging Station  
Happisburgh - Winterton Phase 2  
Broadland R. Yare  
Seawick Defences  
Clacton and Jaywick Sea Defences

# Engineering the Environment

## Lincshore I and II - Mablethorpe to Skegness

### Location

Lincolnshire

### Project Manager

Harry Lunt

### Consultant

Halcrow

### Contractor

HAM Dredging

### Cost

£46 million

### Completion

December 1998



The Lincolnshire coast is one of the most exposed vulnerable shorelines in Britain. Heavy seas, violent storms and massive tidal surges have fashioned its dependence upon its sea defences. More than 35,000 people live behind the 24 kilometres of sea defences between Skegness and Mablethorpe, which also protect 20,000 hectares of low lying land including more than 15,500 residential properties and 18,000 residential caravans as well as extensive agricultural, commercial, industrial, commercial, industrial and service related activities.

In 1990 a survey of the between Mablethorpe and Skegness found that the majority of beaches were narrow, steep and lacking in beach material with the result the existing defences would be at risk of undermining and were not providing a reasonable flood defence standard.

Having evaluated in detail the engineering, environmental and financial issues and options, work on the Lincshore project started in August 1994 and involved rebuilding 19 kilometres of beaches from north of Skegness to Mablethorpe. The first phase, the 2 kilometre section near Skegness, was completed in August 1995 at a cost of £9 million and involved the placing of 1.5 million cubic metres of sand.

The second phase of the scheme, costing £37 million, and which involves placing 6 million cubic metres of sand to the 17 kilometres up to Mablethorpe started in September 1995 and is due for completion in December 1998. Both phases were awarded to HAM Dredging Ltd, who have been granted a licence by Crown Estates to extract the 7.5 million cubic metres of sand from the sea bed some 20 kilometres off the Lincolnshire coast.

# Engineering the Environment

## Humber Defences - Collaboration to Develop a Strategy

### Location

Humber Estuary

### Regions

Anglian  
North East  
Midlands

### Cost

£100m plus

### Completion

2015



### The Team

Sir William Halcrow & Partners  
Posford Duvivier  
Binnie, Black & Veatch  
Anglian Project Manager - Nigel Pask

The Environment Agency in Partnership with English Nature, Associated British Ports, Yorkshire and Lincolnshire Wildlife Trusts and the local Authorities is developing a long term strategy for the flood defences around the estuary to protect urban, industrial and environmental assets.

Staff from three Regions of the Agency are collaborating to develop an understanding of the Estuary's behaviour. To produce a strategic solution to the flood defence needs, this will ensure the preferred solution works with nature to provide sustainable defences. Whilst the strategy is being developed, an urgent works programme is being implemented to maintain the integrity of the flood defences.

The Regional Engineering Team is leading on a comprehensive review of the multi-functional monitoring programme, the monitoring needs for the Urgent Works Programme, development of the Strategic Risk Assessment and an investigation into the beneficial use of dredgings.

# Engineering the Environment

## River Ancholme Bridges

### Location

The River Ancholme flows North and outfalls into the Humber Estuary at South Ferriby. The seven bridges over the River Ancholme provide local access

### Project Manager

C Allwork

### Cost

£360k

### Completion

December 1996



### The Works

Refurbishment work to seven bridges over the River Ancholme, including new timber members and repairs to steelwork

### Standards

The seven bridges over the River Ancholme, all of which are of high historic value and five of which are listed, failed to comply with current structural requirements and necessitated extensive strengthening work to meet their current usage and to meet the Agency's legal obligations. The strengthening work was carried out in such a way as to maintain the bridges aesthetic qualities and preserve their considerable historic interest

The carrying capacity has been increased significantly on all bridges at a cost of £360k and completed in December 1996

# Trent Witham Ancholme Transfer Scheme Enhancements

Location	Rivers Trent, Witham & Ancholme, Lincolnshire.
Client	Environment Agency - Anglian Region.
Project Manager	Jim Hogg.
Cost	£1.457 million.
Completion	April 1997.
Consultant	Posford Duvivier.
Contractor	Drake & Scull.



The Trent Witham Ancholme Transfer Scheme is owned and operated by the Environment Agency and transfers water from the River Trent to the Rivers Witham and Ancholme in Lincolnshire. The scheme was constructed in the early 1970s. Since then demand for water has risen gradually and during droughts the scheme is expected to operate at its physical capacity. Much of the original equipment was at the end of its working life and becoming unreliable. The decision was taken to update the pumping capacity to meet current demands, and refurbish existing equipment to bring it up to current standards of reliability, efficiency and ease of operation.

The scheme was thoroughly surveyed by consulting engineers Charles Haswell and Partners and recommendations made for the work required to meet the Environment Agency's future operational requirements.

Design of the Enhancements and supervision of the work has been carried out by consulting engineers Posford Duvivier Ltd. The Enhancement work was awarded as a single comprehensive contract to Drake and Scull Engineering Ltd (Western Region, Bristol).

The scheme has two major locations and the work content was as follows:

1. **Torksey Pumping Station** - the pumps have been replaced and increased in number from three to four; new electrical switchgear, distribution and cabling was installed and the manual service crane replaced by an electric unit.
2. **Short Ferry Pumping Station** - the three pumps have been refurbished and updated, new 415 volt and 3,300 volt switchgear has been installed. The existing fine weed screens have been refurbished and the coarse weed screens have been replaced. All valves and actuators in the pumping stations and on the pipelines have been refurbished or replaced. The manual service crane has been replaced by an electric unit.

A SCADA system has been installed at the Torksey and Short Ferry Pumping Stations, and a control room at Short Ferry allows remote operation of the Torksey pumping station. Control of the pumping and auxiliary services at each site is through a local plc with operator indication and control on a pc-based SCADA software system located at Short Ferry. Communications between the two sites is by BT lease-line. The abstraction licence for Torksey includes conditions that pumping must not take place one and a half hours each side of high tide. The local Torksey plc stores 12 months tide tables in its memory to make compliance with the licence conditions automatic.

All the valves on the pipeline from Short Ferry to Toft Newton and at the Toft Newton outfall have been refurbished. The building at Toft Newton has been refurbished and modified to allow its use as a fishing lodge for the trout fishery established in the balancing reservoir. The position of valves at Toft Newton are transmitted through the regional telemetry system so that they can be incorporated into the SCADA displays at Short Ferry.

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# Engineering the Environment

## Tidal River Nene Stabilisation Phase B

### Sutton Bridge to the Twin Lighthouses

#### Project Manager

Jim Anderson

#### Cost

£1.6 million

#### Completion

Sept 1999

#### Protected

#### Area

581 km<sup>2</sup>

#### Standard of Protection

1 in 200 years



The installation of a 115,000 tonnes of machine placed stone toe and revetment to protect 4.2 km of flood defences.

The tidal part of the River Nene flows from Peterborough (Dog-in-a Doublet) to the Nene's outfall into the Wash at the Twin Lighthouses, a distance of 39km.

The Catchment is principally rural in nature with large areas taken up with arable farming. Wisbech and Fengate and Stanground in Peterborough are the major urban areas.

A flood defence Strategy Study was carried out for the tidal part of the River Nene in June 1990. The Strategy Study was updated in October 1995 in conjunction with undertaking a Strategic Environmental Assessment which confirmed the works as environmentally acceptable.

The Strategy Study highlighted areas of the River Nene where the erosion protection to the flood defences is not effective. As a result the channel batter is eroding and parts of the protective berm are being lost. The Strategy proposed a 5 year programme of works to protect the banks by placing a stone revetment.

Works have been consolidated into packages which has produced demonstrable savings to the Agency

Nene, Phase B,  
Nene, Phase B,  
Nene, Phase B,

Parts 1 & 2  
Parts 3 (RHB), 4 & 5  
Part 3 (LHB)

- Works completed May 1997  
- Works completion date August 1998  
- Proposed completion date Sept 1999

# Engineering the Environment

## Northampton Feasibility

### Location

Northampton is at the upper end of the River Nene with two principal tributaries known as the Brampton Branch and the Kislingbury Branch

### Project Manager

C Allwork

### Consultant

Halcrow

### Cost

£200k

### Completion

May 1999



### The Works

As part of the Agency's response to the floods of Easter 1998, this project will undertake a comprehensive review of the flood defences through Northampton. This will include updating the existing hydraulic model of the R. Nene and re-evaluating the hydrology for the town and assessing the feasibility of carrying out improvements to the standard of flood defence and warning.

### Standards

The study will ensure that Northampton has an appropriate standard of flood defence and identify any improvements that can be justified. Updating the hydraulic model will ensure the hydrology of the catchment contributing to the flows through Northampton is robust and give confidence to flood forecasting and hence flood warning.

# Engineering the Environment

## River Glen Stabilisation Works

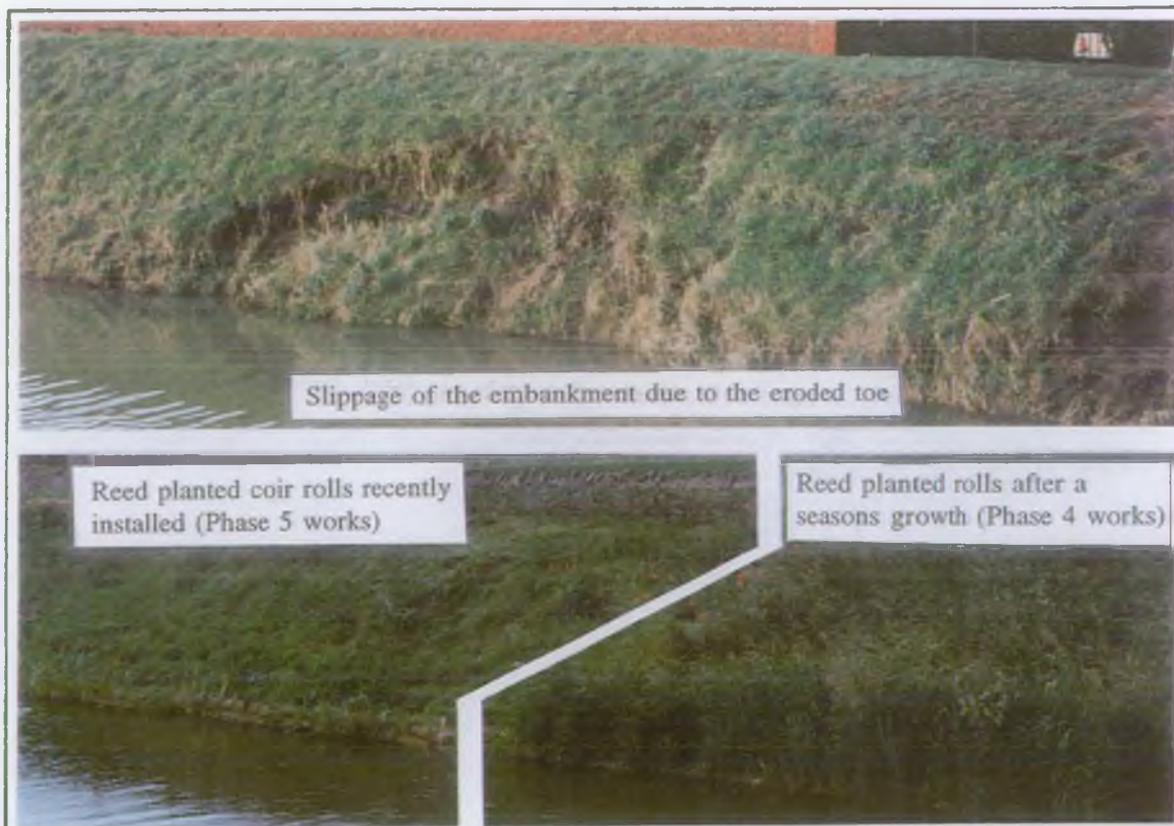
Location	River Glen between Market Deeping and Spalding in Lincolnshire
Cost	£1.8m
Completion	Yr 2002
Contractors Used	Wrekin Construction Drake Towage Marine Contractors Linpave Ltd Environment Agency

The River Glen is a tributary of the River Welland and drains a catchment of approximately 340km<sup>2</sup> in the south west of Lincolnshire.

A strategy study compiled by the Agency in 1993 recommended a 10 year programme of improvement works to stabilise the banks of the River Glen and enhance the aesthetic value of the water course.

The eroded bank toe is re-established using a granular material held in place by either timber or steel piles forming a robust founding for reed planted coir rolls, this will stabilise the river bank and increase the wildlife habitat within the river system.

Five phases of work have been successfully completed and the Agency are currently implementing the sixth year of works. To date the works have utilized approximately 76 tonnes of the by-product coir, 670m<sup>3</sup> of recycled crushed concrete and planted 27,000 reeds stabilising 4.5Km of embankment and creating an attractive habitat for the wildlife.



# River Great Ouse Tidal Defence Improvements Denver Sluice to King's Lynn

Location	The tidal River Great Ouse flows from the Wash, through King's Lynn in Norfolk, to the tidal limit at Denver Sluice, Cambridgeshire. A distance of approximately 27 km.
Client	Environment Agency - Anglian Region.
Project Manager	David Cotterell/ Peter Cowie.
Cost	£8.5 million.
Completion	November 1996.
Protected Area	1,500 km <sup>2</sup> .
Population Protected	Over 1650 people.
Length of Flood Defence Improved	37 km.
The Works	30 km of flood defence raised using conventional earthworks. 7 km raised using reinforced concrete and brick walls.
Standard of Defence	Protection against a 1 in 100 year flood.



Approximately 1,500 km<sup>2</sup> of high quality agricultural land are protected from flood water inundation by the Great Ouse River Defences. The Tidal River Ouse Embankments, which extend some 21 km on both banks of the river, form a vital part of these defences.

In 1989, a detailed investigation concluded that the degree of flood protection afforded by the embankments was inadequate and that the situation was deteriorating; at best the defences could only protect against a 1 in 25 year flood risk. As a result, a 5-year programme of improvement works was implemented with construction commencing in 1991.

The works have been successfully completed within the specified programme and at a cost of £8.5 million.

The improvements were designed to offer protection against a 1 in 100 year risk of flooding and make maximum use of the existing flood banks. Where sufficient space was available adjacent to the existing flood banks, imported clay was used to widen and raise them. In areas where this was not possible, a concrete and brick wall was constructed along the bank crest to the design height.

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**Project** Welmore Lake Sluice Reconstruction  
**Location** Outlet to the Ouse Washes Flood Storage Reservoir and SSSI.

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## The Team

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**Project Executive** Richard Nunn  
**Project Manager** Peter Cowie  
**Consultant** Lewin, Fryer & Ptnrs  
**Civil Contractor** Jackson Civil Eng  
**Mechanical and Electrical Contr** Waterlink UK (formerly AES)

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## Contract Details

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**Programme** Works commenced July '97. Date for commissioning July '99  
**Cost** £5.2 million (est)



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## The Project

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**Protected Assets** 32,000 ha high quality fenland. 830 residential properties  
Ouse Washes, SSSI, SPA and RAMSAR site

**Project Management** To ensure effective project management for this high profile project a partnering approach has been encouraged and developed by the Agency. The works were commenced with a 'Build the Team' workshop at which common objectives were agreed by the principal parties to the project.

**Purpose of Sluice** When a peak flood has passed, flood waters stored on the Washes are able to gravitate through the sluice.

**Problems with the Existing Sluice** The structure is 60 years old and has suffered operational difficulties in efficiently discharging flood water. These relate to:

- Expensive temporary pumping plant.
- Build up of silt which inhibits the gates from opening.
- Insufficient discharge capacity.

The new structure has been positioned 70m downstream bringing it closer to the confluence with the Tidal River Ouse. Principal features include three sluiceways, upstream vertical steel lift gates and three pairs of timber mitre gates and permanent land drainage pumps.

The Ouse Washes form a vital component of the Middle and South Levels of the Cambridgeshire Fens, providing flood storage and conveyance when the normal channels are at full capacity. When a peak flood has passed, flood waters stored on the Washes are able to gravitate through Welmore Lake Sluice.

# River Waveney Ultrasonic Gauging Station

Location	Upstream of Ellingham Mill, Nr Bungay, Norfolk.
Client	Environment Agency - Anglian Region.
Project Manager	Andy Bennison.
Cost	£32,000.
Consultant	In House Project Management.
Contractor	Accusonic Division, ORE International.
Services	Design, Supply, Construction & Installation.
Completion	Early November 1996.

The Environment Agency has an obligation to monitor hydrological and environmental effects of major surface water abstractions (S.19 WR Act 1991).

The River Waveney is recognised to have a catchment of high conservation value and is consequently designated an environmentally sensitive area. The river also provides significant water resource for irrigators and public water supply. The Agency has a responsibility to balance the needs of the environment against that of the abstractor. At present there is a public water supply abstraction intake on the River Waveney at Shipsmeadow. The gauging station transmits a pulse of sound diagonally across the flow in both upstream and downstream directions. Comparisons of the two are made, from which a flow reading is derived. This will enable the Agency to accurately assess the residual flows (especially low flows) in the environmentally sensitive Lower Waveney, with low environmental impact.



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# Engineering the Environment

## Happisburgh to Winterton Sea Defences

**Location**  
Norfolk

**Project Manager**  
Steve Hayman

**Consultant**  
Halcrow

**Contractor**  
Van Oord ACZ Ltd

**Cost**  
£18.5 million

**Completion**  
July 1997



The Environment Agency has a sea defence management strategy for the 14 kilometres of eroding coastline between the Norfolk villages of Happisburgh and Winterton, on the East Anglian coast. The strategy is to protect several villages and 6,000 hectares of low lying land, including the Norfolk Broads, from flooding by the sea.

The objective of the Agency's strategy for this frontage is to hold the present defence line by maintaining the existing seawalls, beach and dune system. Additional aims are to ensure that there are no adverse effects on adjacent lengths of coastline, and to preserve the environmental and amenity values of the beaches and dunes. Following extensive investigations and modelling, consulting engineers Sir William Halcrow and Partners Ltd recommended a 50 year strategy comprising the phased construction of a series of offshore reefs in combination with beach recharge.

The second phase of the scheme comprised the construction of five offshore reefs using 197,000 tonnes of rock and 1,260,00 cubic metres of beach nourishment. A contract was awarded to Van Oord ACZ Ltd and the works were carried out between September 1996 and July 1997 at a total cost of £18.5 million.

The rock reefs were constructed approximately 200 metres offshore using imported rock from Scandinavia with the intention to attenuate nearshore wave energy to retain a stable beach and prevent failure of the seawall. Beach recharge material was sourced from existing licenced sites offshore of Great Yarmouth.

A post-award Partnering Charter between Client, Contractor, Sub-contractors, Engineers and Design staff contributed to the successful completion of the scheme within budget and 5½ months early. The Partnering Charter set out the working relationships/behaviours agreed by all parties to support, but not replace, the contractual arrangements.

# Broadland Compartment 22 Urgent Works - Phase 1 River Yare/Haddiscoe Cut Confluence

<b>Location</b>	At the confluence between the River Yare and Haddiscoe Cut, near Reedham, Norfolk
<b>Client</b>	Environment Agency - Anglian Region
<b>Project Manager</b>	Bernard Ayling
<b>Cost of Works</b>	£340,000
<b>Completion</b>	July 1997
<b>Protected Area</b>	2,250 hectares of agricultural land, 171 properties and infrastructure
<b>Consultants</b>	Posford Duvivier/Balfour Maunsell
<b>Contractor</b>	Environment Agency Eastern Contracts Group



## The Works

Broadland can be regarded as consisting of 40 distinct flood areas which are called "Compartments". It contains a diversity of landscapes and wetland habitats found nowhere else in the country and is recognised as being of international conservation importance. It is also notable for its recreational attraction and its tourism industry.

Compartment 22 is located to the south west of the Rivers Chet, Yare, Waveney and Haddiscoe Cut. The Compartment consists of agricultural land, is very low lying and is, therefore, particularly susceptible to flooding, either from freshwater river flows or, more frequently, from high tide levels.

The object of the scheme was to maintain the existing standard of the flood defences in the Compartment and the works were planned in consultation with conservation and environmental interests including English Nature and the Broads Authority.

The Works, which consisted of 190 metres of low level anchored steel sheet piling, were urgently required to prevent undermining of the floodbank and subsequent failure of the flood defence.

# Engineering the Environment

## Seawick Defences

<b>Location</b>	Seawick Beach near Clacton, Essex.
<b>Project Manager</b>	Paul Miller
<b>Consultant</b>	Posford Duvivier
<b>Contractor</b>	Van Oord ACZ
<b>Cost</b>	£2.1 million
<b>Completion</b>	February 1998



Eroded beach prior to construction

A long term trend of erosion of the foreshore along this frontage has removed beach material to expose the underlying clay during the past few years.

Without an adequate beach, the seawall was becoming more exposed to greater wave attack and overtopping of the defences, together with the potential for complete failure of the concrete wall if the erosion was allowed to continue.



Rock groynes complete with Beach recharge in progress

A detailed appraisal study, which included extensive scale model testing of the frontage, produced the best arrangement for a sustainable defence. The works comprised of six rock groynes with recharge of sand and shingle to the whole 800 metres of the defence.

The contract for the construction was awarded to Van Oord ACZ who specialise in marine construction and have successfully carried out works elsewhere for the Agency. Construction started in September 1997 to avoid the Summer holiday period and any disruption or inconvenience to the residents of the 1800 holiday homes and caravans protected and behind the seawall. Despite storms over the Christmas and New Year, Van Oord completed the construction in February 1998 and over a month ahead of programme.

Almost 45,000 tonnes of rock and 55,000 cubic metres of shingle have been used on these works, both are recycled, with the by-product rock from Norway and the shingle having been dredged from Harwich Harbour to improve the Ports operational capabilities.

# Engineering the Environment

## West Clacton & Jaywick Sea Defences

<b>Location</b>	Clacton in Essex.
<b>Project Manager</b>	Paul Miller
<b>Consultant</b>	Posford Duvivier
<b>Contractor</b>	Still to be Awarded
<b>Cost Estimate</b>	£8 million
<b>Construction Start</b>	Autumn 1998



In the 1980's major work was carried out along this frontage when rock 'fishtail' breakwaters and beach recharge were constructed. Since the completion of those works, the beach has developed embayments with substantial deposit behind the breakwaters, yet eroding areas in the centre of each embayment.



Even under only moderate storm conditions the lower beach levels allow larger waves to attack the seawall, with increasing risk of flooding to the low lying land which includes over 1500 properties. This area is very vulnerable to flooding, with 37 people drowning at Jaywick alone in the 1953 East Coast disaster.

Data gathered using the Shoreline Management System has been analysed which indicates that recharging with beach material alone will not provide long term improvements, and further rock structures are required to stabilise the frontage.

Due to the complex nature of the coastline and coastal processes, it has been necessary to use both computer and scale modelling techniques to determine the optimum layout for the new defences, in fact the scale model is still the largest mobile bed constructed in the UK. The proposed works consist of both shore linked and detached rock breakwaters together with sand recharge to the whole 4 km frontage. The complete project will take approximately two years to construct with all the materials being brought to site by sea to minimise any local disruption. Every effort is being made to use recycled materials for these works, and of particular interest is the nearby Harwich Harbour dredging work which may prove to be a valuable source of suitable material for the recharge.

Appendix B

**Human Resources**

**ANGLIAN ENGINEERING DEPARTMENT**

**APPENDIX B**

**HUMAN RESOURCES**

Regional Engineering Manager	<b>Gordon Heald</b>	1
Principal Engineers	<b>Bernard Ayling, Steve Hayman, Richard Nunn, Nigel Pask</b>	4
Senior Engineers	<b>Jon Coultrup, Peter Cowie, David Cotterell, Jim Hogg, Harry Lunt, Andrew Osborne, Chris Allwork, Paul Miller, Steve Peck</b>	9
Assistant Engineers	<b>Jim Anderson, Philip Bell, Andrew Bennison, Steve Crooks, Mike Davison, Ian Dodson</b>	6
Technical Co-ordinator (PESS)	Simon Wood (currently Jenny Buffrey on secondment)	1
Technicians	Shirley Graves, Vacancy, Vacancy	3
Secretaries	Bev Walsh/Pat Laverack (Jobshare)	<u>1</u>
Total establishment		<u>25</u>

**Bold type denotes Chartered Engineer**

Appendix C

**Who Does What ?**

# ANGLIAN ENGINEERING DEPARTMENT - WHO IS DOING WHAT

APPENDIX C

Sheet 1 OF 2

## GORDON HEALD - REGIONAL ENGINEERING MANAGER

Capital Programme Flood Defence, Water Resources, Coastal & Estuarial R&D, ICE Graduate & Technician Training, Project Management, Engineering Quality Procedures  
 Chairman Engineering Project Management Group, Flood Defence Improvement Board, Gardiner & Theobald Project Management Review, Construction Clients' Forum,  
 New Engineering Contract User Group, Regional Risk Champion

Bev Walsh/Pat Laverack - Secretary (job share) - Secretarial support to Gordon Heald, PEs Support, Department Administration, Timesheets, Filing System

### RICHARD NUNN

Gt Ouse LFDC Capital Programme  
 Water Resources Capital Programme  
 Management of Halcrow Framework Agreement  
 and Term Consultant  
 Procedures  
 National & Departmental  
 Engineering Standards  
 - Consultants Manual  
 - Mech/Elec Manual  
 Institution of Civil Engineers Coastal  
 Engineering Advisory Panel  
 MAFF Shoreline Management Advisory Group

### Peter Cowie

Middle & South Level Barrier Banks  
 Ouse Washes Summer Flood Control  
 Welmore Lake Sluice Reconstruction  
 Gt Ouse Tidal River Banks (KL to Denver)  
 Counter Drain System Welches Dam P.St.  
 River Nar Improvements  
 Reservoir Supervision

### David Cotterell

Middle & South Level BB Erosion  
 Gt Ouse Tidal River Siltation  
 Reservoir Supervision Enforcement  
 Gt Ouse Training Walls  
 Denver Operational Review  
 Engineering Project Management Manual

### Jenny Buffrey (Simon Wood)

Technical Co-ordinator  
 Halcrow National Co-ordination  
 Halcrow Anglian Regional Co-ordination  
 Term Consultancy 1997-2002 Management  
 Anglian Contractors Database  
 National Contractors Database  
 Consultants Database - Anglian  
 Consultants Performance Database

### Jim Hogg

Regional Electrical Advisor  
 Elec & Mech Regional Standards &  
 Project Advisor  
 Trent Witham Ancholme Transfer  
 Improvements  
 Additional Short Ferry Pump  
 Ely Ouse Essex Transfer Improvements  
 Kennett Improvements  
 Wixoe Improvements  
 Blackdyke Intake Improvements  
 Tunnel Inspection/Repairs  
 Cley Tide Barrier  
 Welmore Sluice (M&E)  
 Electricity Purchase  
 Renewable Power R&D  
 Electric Fishing R&D  
 Mech/Elec Manual

### Steve Peck

Ely Ouse FD  
 ARTS Phase 4A to 4D inc.  
 Hunstanton/Heacham Strategy  
 Snettisham Hard Defences  
 Heacham Hard Defences  
 Hunstanton Hard Defences  
 Heacham/Snettisham Beach Nourishment  
 Newport Pagnell

### Steve Crooks

Marsh Road Sluice Refurb  
 Hollesley PS Improvements  
 Northampton FAS  
 Welches Dam PS. Improvement  
 (in-house)

### NIGEL PASK

Lincolnshire LFDC Capital Programme  
 Welland & Nene LFDC Programme  
 Humber Estuary Strategy  
 Northampton FAS

### Chris Allwork

Humber Banks  
 Wash Banks  
 Ancholme Valley Improvements  
 River Freshney  
 Boston River Walls  
 Fosdyke Canal  
 Witham Outfall Stoning  
 Northampton Structures  
 W&N Flood Reservoirs  
 Peterborough Brooks  
 Bourne Eau  
 R. Ise  
 R. Glen

### Andy Bennison

Glen Stabilisation  
 Northampton Structures  
 Peterborough Brooks  
 Carrdyke & Bourne Eau  
 River Ise  
 Stour Ultrasonic Gauging Station  
 Chelmer Ultrasonic Gauging Station

### Harry Lunt

Lincshore Beach Nourishment &  
 Renourishment

### Andrew Osborne

Lower Witham Strategy  
 Kyme Eau Banks  
 Woldgrift Drain  
 Barrow Haven  
 Lincoln Floodwalls  
 Alford Culvert  
 Witham Outfall (Tidal limit)  
 Mablethorpe Skegness Structures  
 Bourne Eau Pumping Station  
 Marsh Road Sluice Refurbishment  
 Engineering Project Management Gp  
 Greatford Cut

### Jim Anderson

Stampend Lock to Fiskerton Sluice  
 Phases 1 and 2  
 Welland Stabilisation  
 Nene Stabilisation  
 Welland Siltation  
 Nene Siltation  
 Welland Train. Walls  
 Coronation Channel  
 Cowbit Road Sluice Refurbishment  
 Welland Cradge Bank  
 EPMG/CDM Sub-Group

ANGLIAN ENGINEERING DEPARTMENT  
WHO IS DOING WHAT - CONTINUED

APPENDIX C  
Sheet 2 of 2

**BERNARD AYLING**

Broadland FAS & Erosion Protection  
Public Private Partnership Projects

**Mike Davison**

Broadland FAS & Erosion Protection  
Compartments: 11, 35, 36  
Oulton Broad  
Broadland Environmental Monitoring

**Philip Bell**

Broadland FAS & Erosion Protection  
Broadland Compartment 22  
Broadland undefended Properties  
Reedham  
St. Olaves  
Brundall  
North Oulton Broad  
Somerleyton  
Surlingham  
Compartment 22 Phase 1 (Cont A & B)  
Broadland Compartment 22 Urgent Works

**STEVE HAYMAN**

Norfolk & Suffolk LFDC Capital Programme  
Essex LFDC Programme  
Essex Sea Walls Strategy  
Happisburgh to Winterton Sea Defences  
Ipswich Tidal Defences

**Ian Dodson**

Felixstowe Ferry Sea Defences  
Hollesey Pumping Station  
Gt Yarmouth Flood Defences  
Happisburgh to Winterton Sea Defences  
Hollesey to Bawdsey Sea Defences

**Shirley Graves**

Eastern Area Coordinator and Technical Support

**Paul Miller**

Essex:  
River Roach - Wallasea Island  
Jaywick to Colne Point (Seawick)  
Clacton Sea Defences  
Essex Seawalls Strategy  
Tendring & Holland  
SMP Modelling - Roach & Crouch  
Stambridge Mills  
North Norfolk:  
Holme  
Wells & Burnham Overy  
Wells East  
Salthouse

**Jon Coultrup (Kelvedon)**

Parkeston/Bathside Bay Tidal Defences  
Hullbridge Tidal Defences  
Battlesbridge Tidal Defences  
Reservoir Supervision  
Chadwell Cross Sewer  
Thames Tidal Defences  
R&D Embankment Fissuring  
Colne Barrier  
Regional S.I Contract  
National S.I Contract

**Project Brochures from Suppliers**

Brochures reprinted with permission from **Halcrow**

- Broadland - Berney Arms
- Lincshore Phase 2
- Humber South Bank
- Essex Sea Walls Strategy

Brochures reprinted with permission from **Posford Duvivier**

- Anglian Term Consultancy
- Marsh Road Sluice
- Hunstanton Heacham
- Seawick Defences

Brochures reprinted with permission from **Jackson Ltd**

- Welmore Sluice
- Aldeburgh Sea Defences
- Watercourse Maintenance
- Paglesham Tidal Defences

Brochures reprinted with permission from **Breheny**

- Coastal and River Defences
- Brightlingsea Tidal Defences Stage 1
- Halvergate Marsh Erosion Control

# Project Data Sheet

## BROADLAND EROSION PROTECTION SCHEME BERNEY ARMS REACH PILING

Halcrow was appointed to design a replacement mooring facility approximately 550m long on the River Yare at Berney Arms Reach, approximately 6km west of Great Yarmouth.

### COUNTRY

United Kingdom

### CLIENT

Environment Agency

### SCOPE OF SERVICES

Preparation and supervision of site investigation, project appraisal, environmental assessment, detailed design, tender assessment and technical support during construction phase

### PERIOD OF SERVICE

1995 - ongoing

### CAPITAL COST

£1.9 million

### FINANCED BY

Client

### KEY FACTORS

- Existing piling in fragile condition
- Environmentally sensitive area
- Protection of Berney Arms Mill (scheduled ancient monument), Berney Arms Public House, Ashtree Farm and a pumping station
- Provide a safe mooring facility for pleasure craft
- Pile length 550m
- Design life 50 years
- Construction to take place during autumn/winter period
- All access for the construction phase would be by river only



**HALCROW**

# Project Data Sheet

## BEACH NOURISHMENT PHASE 2

Halcrow was commissioned to provide a design for the nourishment of the beaches between Mablethorpe and Skegness on the Lincolnshire Coast.

### COUNTRY

United Kingdom

### CLIENT

National Rivers Authority  
(Anglian Region)

### SCOPE OF SERVICES

The design of a beach recharge system and extensions to 4 sea outfalls. Technical advice on Licence application for the offshore dredging area.

### PERIOD OF SERVICE

1994 - ongoing

### CAPITAL COST

£50 million

### FINANCED BY

National Rivers Authority (NRA)

### KEY FACTORS

- Design of beach profile
- Hydraulic and structural design of outfalls
- Tender documentation
- Supervision and collation of environmental studies
- Dredging licence application document



# HALCROW

# Project Data Sheet

## HUMBER ESTUARY TIDAL DEFENCE STRATEGY SECTOR 9 - WHITTON TO PYEWIPE

Halcrow was commissioned to provide a long term strategy for 47km of tidal flood defences along the south bank of the Humber Estuary between Whitton and Pyewipe.

### COUNTRY

United Kingdom

### CLIENT

National Rivers Authority,  
Anglian Region

### SCOPE OF SERVICES

Development of long term strategy

### PERIOD OF SERVICE

1992 - 1995

### VALUE OF SERVICES

£0.175 million

### FINANCED BY

Client

### KEY FACTORS

- Data collection
- Consultation with interested parties
- Definition of estuarial regime and establishment of design parameters
- Development of options to meet the scheme objectives and design parameters
- Evaluation of the options from engineering, environmental and economic viewpoints
- Definition of the strategy and preparation of environmental assessment
- Preparation of an engineers report for the Phase 1 works



**HALCROW**

## ESSEX SEA WALLS MANAGEMENT STRATEGY ENVIRONMENTAL INVESTIGATIONS

Halcrow have been commissioned to undertake a study into the environmental implications of the execution of future flood and coastal protection schemes on the Essex Coast.

### COUNTRY

United Kingdom

### CLIENT

National Rivers Authority,  
Anglian Region

### SCOPE OF SERVICES

Environmental Appraisal of flood and coastal protection schemes

### PERIOD OF SERVICE

1994

### VALUE OF SERVICES

£40,000

### FINANCED BY

Client

### ASSOCIATED FIRMS

Institute of Estuarine and Coastal Studies, University of Hull

### KEY FACTORS

- Review of coastal and estuarine defences
- Preparation of baseline descriptions
- Consultations
- Geomorphological overview
- Environmental appraisals of engineering options

# Project Data Sheet



# HALCROW



## Posford Duvivier Awarded Environment Agency ● Five Year Term Consultancy

**T**HE Environment Agency, Europe's strongest environmental protection body, was set up on 1st April 1996 bringing together the National Rivers Authority, Her Majesty's Inspectorate of Pollution, local waste regulation authorities and some aspects of waste regulation formerly the responsibility of Department of the Environment. Posford Duvivier has had a long association with the Agency and its predecessors having undertaken commissions for all of its 8 regions ranging in scope from the design of a major flood barrier on the River Colne to the investigation of flooding in Chichester.

The Anglian Region of the Agency stretches from the Humber estuary in the north to the Thames estuary in the south. Since a quarter of the 5 million population of this area live below maximum recorded sea level, flood

defence is a priority and the Agency's budget for this exceeds £30 million for 1998. The Agency had previously procured engineering consultancy services for a large proportion of this very diverse work through term consultancies. Posford Duvivier had operated as Term Consultant in 1991 to 1992 and 1994 to 1999. In 1997 the Agency sought to develop closer ties with its key suppliers, and tendered a major five year term consultancy, worth up to £700,000 per annum.

Posford Duvivier, drawing upon its experience of Agency projects and Agency term consultancies in particular, made detailed proposals, relating not only to technical aspects of the consultancy, but also covering overall administration and appropriate fee methods. These proposals were accepted by the Agency with the award of a five year term

consultancy, on a single supplier basis, from November 1997. The Agreement has adopted partnering principles, with both the Agency and Posford Duvivier adopting the common aims of safety, quality, programme and adherence to budget.

It is early days, but a number of significant assignments have been awarded in the first three months of the Term Consultancy, including a major beach renourishment scheme for the Mablethorpe to Skegness coast, an inspection of flood defences in Great Yarmouth, environmental assessment for a drainage scheme in Essex, and site supervision for sea defence works at Seawick.

## Sluice Scheme Completed

Coronation Channel in January 1996 by contractors Atlantic Power and Gas of Great Yarmouth, and was completed on July 13th 1997.

repair the concrete structure, as well as refurbishing the cycloidal and vertical gates and steel superstructure. Environment Agency, Project manager Andrew Osborne said: 'The work involved the refurbishment and reconstruction of the structure to meet current safety standards and to give it a new 25 year life span.'

The sluice – which was built in the 1950's, has three channels each 30ft wide and 20ft deep and as the tidal limit, plays a key part of the flood defences of Spalding and surrounding fenland. Work consisted of sealing and dewatering the channel in order to

**A** £1.2 m refurbishment scheme to give Spalding's Marsh Road sluice an extra 25 year life span has been completed by the Environment Agency. Work began on the downstream end of the



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## HUNSTANTON TO HEACHAM SEA DEFENCES



**Client:** Environment Agency, Anglian Region  
**Country:** UK  
**Project Value:** £10,000,000

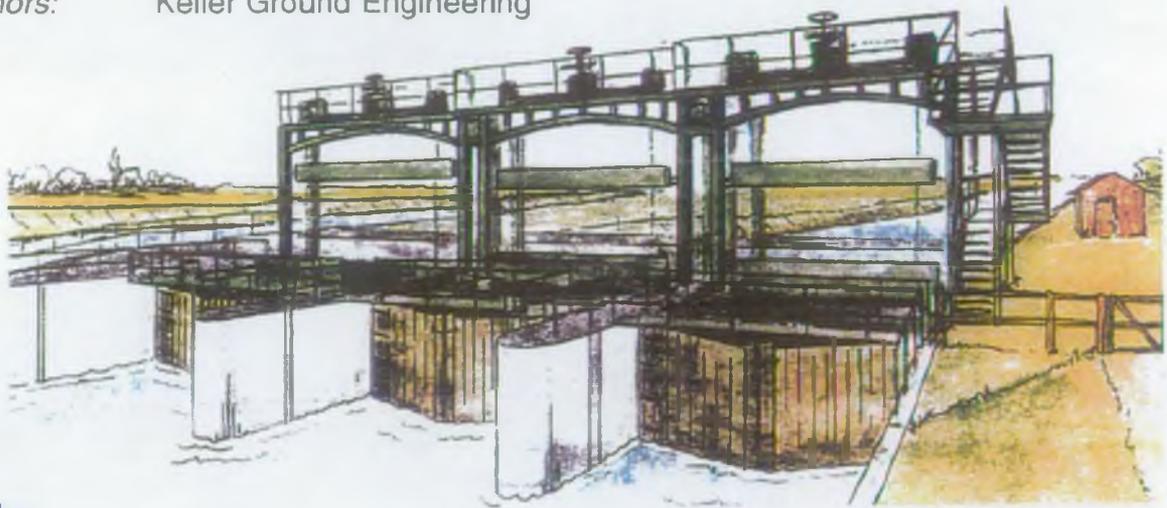
**Description:** The sea defences at Hunstanton and Heacham on the shores of the Wash protect those towns from flooding. In 1953, when they were breached the loss of life was higher than anywhere else in East Anglia.

Posford Duvivier were retained to assess the present standard of the sea defences which are constructed as concrete sea walls and shingle ridges. A strategic study was prepared which recommended that a combination of hard defence improvements and beach re-nourishment was necessary to provide adequate protection. Project appraisals and detailed designs were prepared followed by the administration and supervision of the construction.

# Welmore Sluice Technical Data

## Contract Details

<i>Client:</i>	Environment Agency
<i>Value:</i>	£ 3.2m
<i>Contract Period:</i>	July 1997 - July 1999
<i>Engineer:</i>	Lewin, Fryer & Partners
<i>Main Contractor:</i>	Jackson Civil Engineering
<i>Designer:</i>	MLM Consulting Engineers
<i>Piling Subcontractor:</i>	Fussey Engineering Services
<i>Ground Anchors:</i>	Keller Ground Engineering



## Scope of Works

The construction of a new sluice on the River Delph at its confluence with the Hundred Foot River.

The sluice will have three vertical lift gates and six mitre gates, in addition the sluice has an automatic over pumping facility.

The sluice will be constructed in the dry inside a 46m dia cofferdam.

The cofferdam has been constructed using 16m long Larssen LX25 piles.

The sluice structure is supported on 170 (approx.) 18m long 356 x 368 x 152kg/m steel H piles and requires 3,500m<sup>3</sup> of insitu concrete.

The cofferdam is restrained by two circular concrete walings - 1.6m wide x 0.9m deep.

The southern wing walls will be constructed by re-using some of the cofferdam piles either extracted or cut-off on completion of the main structure.

Following the commissioning of the new sluice the existing sluice will be demolished.



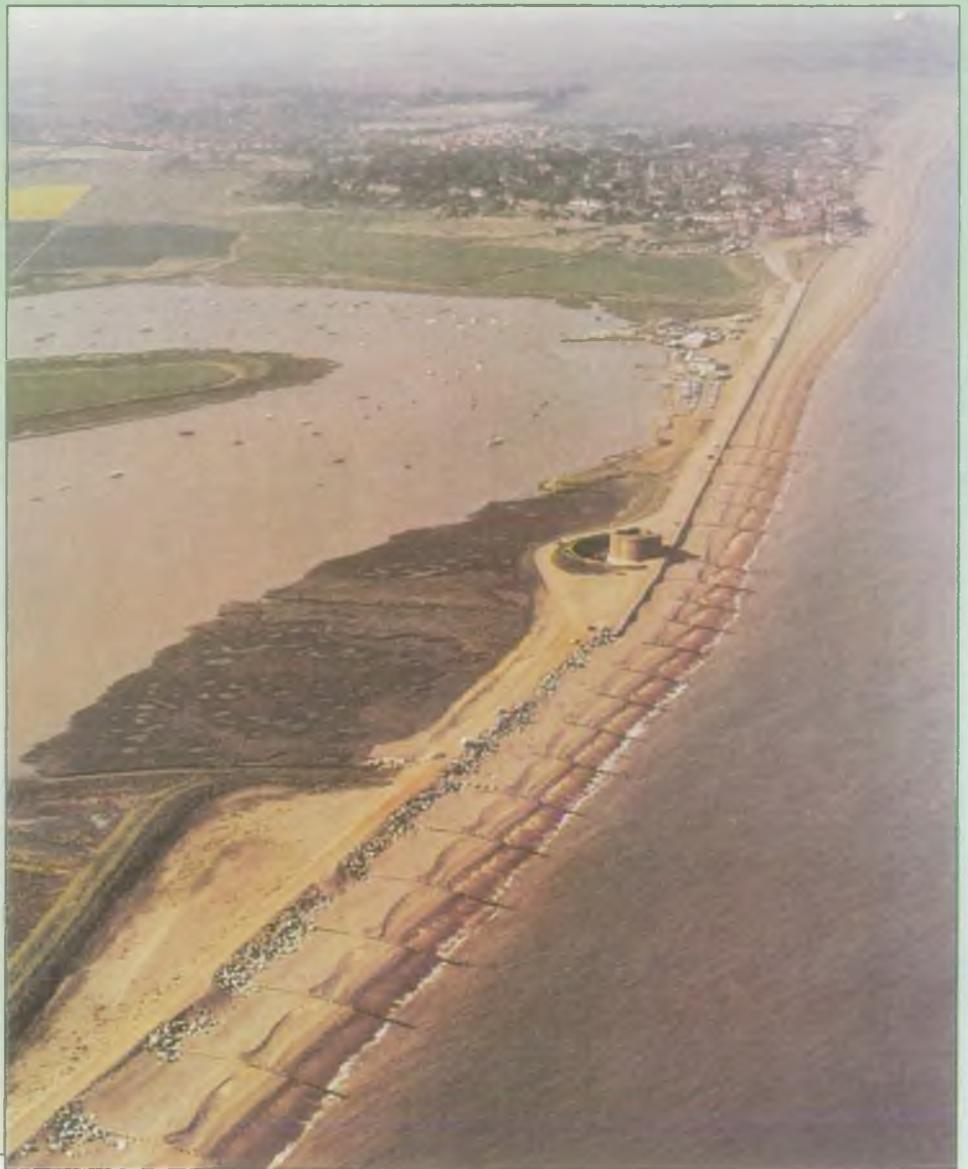


## Aldeburgh Sea Defences, Suffolk

The Suffolk coastline is notorious for its shingle banks and their changing patterns of erosion. At Slaughden, south of Aldeburgh, beach gravel loss had reached critical levels and a project was commissioned to improve sea-defences at this most vulnerable location.

Work consisted of the construction of 32 timber groynes, rock armour transition banks, concrete tripod banks, demolition of the existing sea-wall and beach nourishment.

50,000 tonnes of armour rock (each piece weighing up to 10 tonnes) was obtained from a quarry in Norway and transported across the North Sea on a converted 100m x 30m flat-topped barge. Each 7,500 tonne load



was off-loaded directly onto site thereby eliminating road haulage.

The groynes were constructed in Greenheart timber imported from a managed forest in South America. The total length of driven piles amounted to approximately 3 kilometres.

Following completion of the groynes, 75,000m<sup>3</sup> of beach nourishment was imported using a suction dredger.

Civil engineering projects such as this are a response to the constant onslaught of nature and the ever present North Sea which ceaselessly threatens this picturesque coastline.

### Contract Details

Client: National Rivers Authority

Architect: Dobbie & Partners

Value: £3.6M

Contract Period: 78 weeks



## Watercourse Maintenance, Cambridgeshire

The Cambridgeshire Fens are well known for their numerous man-made watercourses, the rich low-lying agricultural land and the drainage systems essential to ensure these two features never combine.

Whilst the remote landscape provides a wonderful haven for wildlife, the key elements of water and land share an uneasy truce. The remoteness provides difficulties for

those who are charged with the management of the water retaining dykes and barrier banks. Constant maintenance is essential to protect the vulnerable farmland and properties which rely so much on their integrity.

In recent years the Company has carried out twelve contracts to reinforce the clay banks, provide access roads, construct or repair pumping stations and other civil engineering infrastructure.

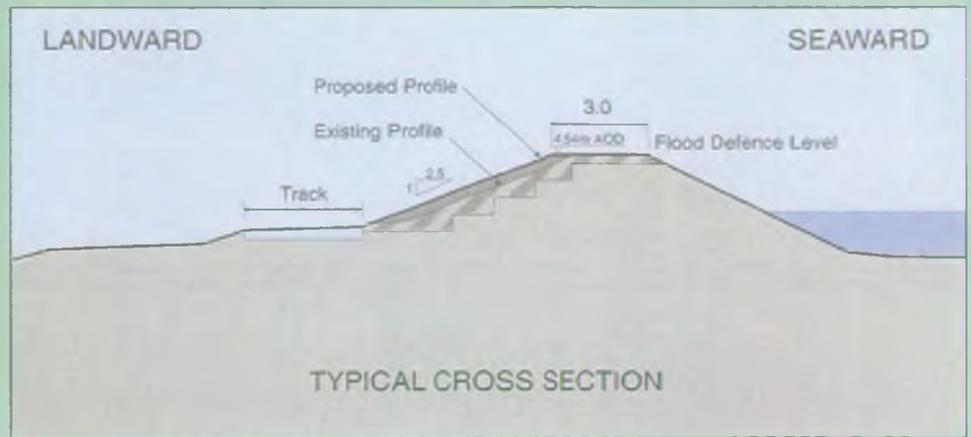
Work in the Fens relies on a special understanding of the needs of the area and repair or maintenance work is invariably carried out to suit local residents, flora and fauna each contributing so much to this unique corner of England.

### Contract Details

Client: National Rivers Authority

Overall Value: £5.0M





## Tidal Defences Paglesham, Essex

The tidal rivers and creeks which characterise the topography of South East Essex provide sanctuary for countless native and migratory wildfowl and a quiet retreat for recreational activities on and off the water. However, the area is also rich farmland, much of which is at or below sea level. Protection of this valuable asset is achieved by earth floodbanks lining the many miles of watercourse.

The National Rivers Authority awarded this contract to reinforce approximately 9km of existing flood bank alongside the River Roach and some of its tributaries.

Works comprised the raising of crest and rear face levels by the provision of imported clay filling and, in some constricted locations, by the installation of steel sheet-piles on the seaward side of the crest. To improve general access, a track was constructed on a new berm behind the flood defence bank. The site quickly returned to its natural appearance following resoiling and seeding.

Restricted construction access limited work to periods of favourable weather conditions. Completion of the project has provided continued security for those who live and work in this remote corner of Essex.

### Contract Details

Client: National Rivers Authority  
Engineer: Sir William Halcrow  
& Partners Ltd.

Value: £0.90M

Contract Period: 40 weeks



# COASTAL AND RIVER DEFENCES



The constant threat to our environment from flooding and coastal erosion has enabled Breheny to develop considerable experience in coastal and river defence works, comprising earthwork embankments, piling, revetments, sea or river walls and rock armouring.

River bank defences,  
Wiggenhall St. Germans,  
Norfolk

Halvergate Marshes, Norfolk ▲

*Client: N.R.A.*

▼ *Client: N.R.A.*



Foulton Hall Point, Essex ►

*Client: N.R.A.*



**BRIGHTLINGSEA**  
**Tidal Defences Stage 1**



**Client:** Environment Agency  
**Engineer:** Binnie, Black and Veatch  
Grosvenor House  
69 London Road  
Red Hill  
Surrey  
RH1 1LQ  
**Location:** Brightlingsea, Essex  
**Contract Value:** £1,585,629  
**Location:** 78 weeks commencing November 1996

Various flood defence measures, including 1,260m of new embankment, raising and widening 1,340m of existing embankment, 20,000 tonnes of rock armour, 525m of decorative concrete floodwall, 2 steel flood gates and the raising of 3 roads.

The site bordered both the River Colne and a SSSI containing a National Nature Reserve.

**HALVERGATE MARSH**  
**Erosion Control Contracts 2 & 6**



**Client:** Environment Agency  
**Engineer:** Environment Agency  
**Location:** Halvergate, Norfolk  
**Contract Value:** £1,686,978  
**Contract Period:** 78 weeks commencing June 1994

The project was designed to improve the existing flood defences of Halvergate Marsh, an important British wetland and SSSI, from the tidal effects of Breydon Water. The works comprised of bank raising with 28,700m<sup>3</sup> of imported fill, placement of 29,000m<sup>2</sup> of pcc revetment embankment armour, together with 6300m<sup>2</sup> of sheet piling and 3,200m<sup>2</sup> of rock fill to enhance toe stability and provide scour protection