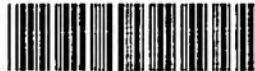


SCHEME NUMBER 9140407

Norfolk Broadland  
Halvergate Marsh Erosion Protection Scheme  
Contract Number 7  
Engineer's Report

AJG/LS/40407  
July 1992

ENVIRONMENT AGENCY



136111

### Introduction

This report considers the need for and the works required in Contract 7 of the Halvergate Marsh Erosion Protection Scheme in Norfolk Broadland.

The works include bank revetments and rand (berm) protection over a reach of 1.7km on the North Bank of Breydon Water, commencing at Breydon Pump, 5.2km upstream of the confluence with the River Bure at Great Yarmouth.

The estimated cost of Contract 7 is £1.905m at current prices and the report concludes by advising that the works should commence immediately funds are available.

Name of Authority National Rivers Authority (Anglian Region)

Authority Reference Number 9140407

Engineer's Report on Norfolk Broadland  
Halvergate Marsh Erosion Protection Scheme  
Contract Number 7

Section of Water Resources Act 1991 Section 165

1. Summary

1.1 Location

The location of the proposed works is on the North Bank of Breydon Water (River Yare, left bank), commencing at the Breydon Pump and proceeding upstream (south) 1.7km towards the Berney Arms Public House.

National Grid References TG 478069 to 471053.

1.2 Purpose

The purpose of the works is to prevent further erosion of the river bank.

1.3 Extent

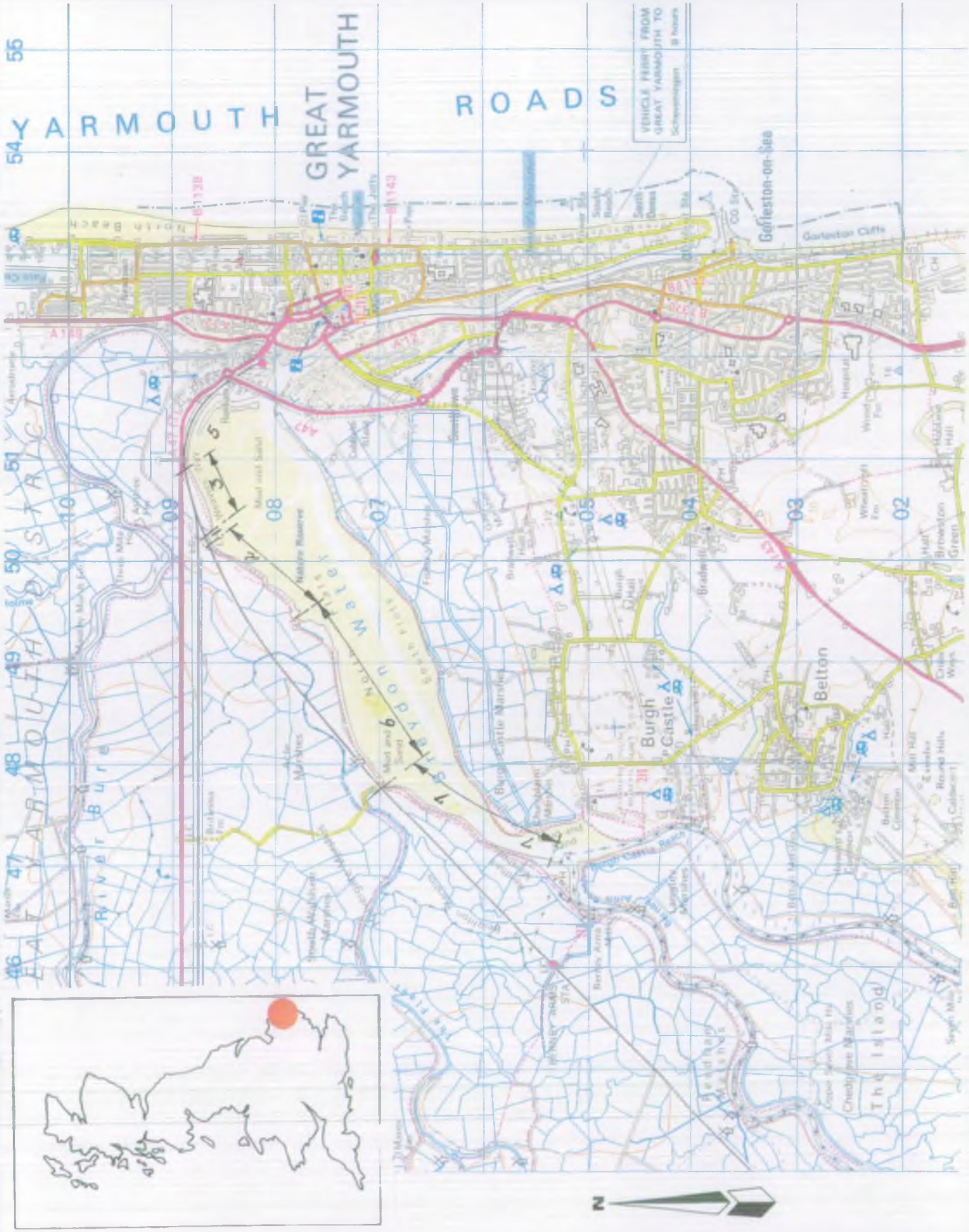
The proposed works will protect 1.7km of river bank.

1.4 Estimated Cost

The estimated cost of Contract 7 is £1.905m.

1.5 Basic Method of Construction

Precast concrete "open" revetment blocks and polymer reinforced cement sheets.



**NRA**  
National Rivers Authority  
Anglian Region

**Title**  
HALVERGATE MARSH E.P.S.  
LOCATION OF CONTRACTS  
ON NORTH BREYDON

<b>Scale</b> 1:50,000		<b>Date</b> JULY 92	
<b>Drawn</b> AJG	<b>Traced</b>	<b>Checked</b>	<b>Approved</b>

**A4**

## 2/3. Background and Problems

In March 1990 the Authority submitted to the Ministry the "Engineer's Supplementary Report" on the Halvergate Marsh Erosion Protection Scheme. This report collated previous reports, propounded a 50 year erosion protection strategy and financially justified that strategy at an estimated cost of £9,038 million.

A copy of the Supplementary Report is enclosed in the Appendices of this report.

The Authority's policy towards the erosion protection of the "Compartments" within the Norfolk Broadland was confirmed in the Authority's former New Works Engineer's (now Engineering Manager) letter to the Ministry dated 18 October 1990, (Ref AJG/SG/4000) and is included in the appendices of this report.

The appraisals of Compartments 35, Haddiscoe Island and 36, South Breydon have been completed and submitted to the Authority and Ministry. No work on these compartments is presently planned.

Compartment 22, Norton and Burgh marshes has been appraised and Contract 1 has been completed. Contract 2 is in the course of preparation.

The appraisals of No.6 Hickling, No.9 Fleggbrugh and No.10 North Bure have been put in abeyance until further work has been completed on the Broadland Flood Prevention Study and the necessary information, within context can be extracted from this study.

On Halvergate Marsh, Compartment 11, Contract 1 was completed in 1991 and Contracts 3 and 4 are in the course of construction. It should be noted that the "Contracts" are numbered for convenience only and the numbers are not related to job location or priority.

Recent inspection of the river banks included in Contract 7 have revealed that over the greater length the revetments have either collapsed or are seriously eroded and are no longer providing effective protection against natural erosion. These revetment failures have been accelerated by a flawed original design which did not provide adequate toe foundations to the revetments.

The whole stability of the river banks is now threatened and the remedial work now required is beyond the scope of a normal maintenance programme.

The problems and present condition of the revetments are illustrated on Plates 1-5.

The difficulty of the construction and future maintenance on the North Breydon Banks is compounded by problems with access across environmentally sensitive areas. Access from the Acle to Great Yarmouth Road (A47) is via the Britannia Farm to Breydon Pump Drove. This Drove has a concrete pavement. This pavement has not only broken up but is also of insufficient width and alignment for modern plant and large vehicles.

A timber jetty was constructed at chainage 6.3km, the only deep water point on North Breydon. This jetty is now rotten and unsafe for all but pedestrian use.





CONDITION OF REVETMENT APRIL 1992.







CONDITION OF REVETMENT APRIL 1992.







CONDITION OF JETTY AT 6300m APRIL 1992.







CONDITION OF REVETMENT APRIL 1992.







CONDITION OF REVETMENT APRIL 1992.





Two approaches are being investigated to provide long term access to the upper reaches of North Breydon.

- a) The reconstruction of the jetty at chainage 6.3km to provide water borne access.
- b) The reconstruction and widening of the A47 - Breydon Pump Drove.

The construction of a permanent drove behind the flood embankments between Great Yarmouth and Reedham is not considered to be a practical or financially viable proposition.

In the past British Rail have not been co-operative at the suggestion to use their lines to supply materials to specific locations of the works. At the present time it appears that there is likely to be little change in their policies.

4. Proposed Scheme

The works proposed for Contract 7 are shown on drawing number 40407/01 attached to this report. Where there are no natural berms these works will increase the impermeability of the flood banks and the revetment on the river face will protect the embankments against wave action by waves which may exceed 0.75m in height during storm/tidal surge events. There is vehicular access along the top of the flood embankment and the armouring of this surface is necessary on this reach.

At each end of this scheme there are salt marsh berms which are being rapidly eroded, mainly by boat wash. It is proposed to protect and recover these berms with vertical bank protection works utilising PVA reinforced cement sheets and backfilling with indigenous salt marsh material.

It is proposed that Contract 7 shall be carried out by contract during 1992 and 1993.



5. Environmental Considerations

An Environmental Statement for the Halvergate Triangle (Marsh) was written by the University of East Anglia in January 1989. This Statement was advertised and circulated in accordance with the requirements of Statutory Instrument 1217 (1988). No objections which jeopardised the concept of the scheme were received.

In accordance with the arrangement agreed with the Ministry, in that every scheme or separate part of a scheme should be advertised and drawings made available for public inspection and comment prior to the commencement of Works; Contract 7 has been advertised in the local newspapers. A copy of this notice is included in the Appendices.

The following parties have been individually consulted:-

The Landowner - Mr Sherman  
The Landowner - Royal Society for the Protection of Birds  
The Broads Authority  
Broadland District Council  
Norfolk County Council  
The Internal Drainage Board  
English Nature  
British Rail  
English Heritage  
Countryside Commission

To date there have been no objections to the principle objectives of this scheme. However, the Broads Authority were concerned about the Authority's original proposal to strengthen the flood embankments with indigenous material obtained from adjacent borrow pits. In this scheme all materials will therefore be imported.

Generally the Contractor will be restricted to working within an area between the flood embankments and the existing borrow pits.

The Weavers Way footpath will be diverted along the north bank of the existing borrow pits. Special consideration will have to be given to ensure the safety of walkers at the restricted area of Breydon Pump during the course of the works and the need for a temporary footbridge across the pump outfall channel will be investigated.

## 6. Design

As previously stated the design and form of the works is greatly influenced by environmental and financial considerations.

No details mathematical analysis has been carried out on the proposed arrangement as it has a proven record of stability and effectiveness under similar conditions on other sites, eg Contracts 1 and 3 of the Halvergate Marsh EPS.

It is proposed that the berms at the upstream and downstream ends of the scheme should be protected against erosion with toe piling manufactured from corrugated PVA reinforced cement sheets suitably painted to minimise their visual effect. This is a relatively new material, although it has been successfully used to protect the banks of the Old West River, near Ely. The material has a better structural performance and impact resistance than the asbestos cement material it has replaced, originally for health reasons. Unlike timber and steel it is not subject to rot and corrosion.

Although the proposed works will not increase the theoretical return period of flooding over the top of the embankments they will ensure increased impermeability and stability to overtopping level.

## 7/8. Estimated Cost

The following estimated cost has been based on rates received from tenders received in January 1991 for Contract 3 and updated to allow for inflation.

		£xi,000	
a) Preliminary Investigations			20
b) Engineering Works	Erosion Protection	1,400	
	Access Road	250	
	Jetty	15	
	BR Crossings	25	
	Footpath Diversions	20	
		1,710	1,710
c) Land Purchase and Compensation			20
d) NRA Staff Costs			50
e) Consultants Design Fees			25
f) Contract Administration			80
Total Estimated Cost			1,905

This is equal to a cost of £1,120 per metre of river frontage. It should be noted that although the access road has been fully costed to Contract 7 it will also be required for supplying materials to the 2.45km long adjacent Contract 6.

The Authority do not expect to receive any contributions towards the cost of Contract 7.

9. Scheme Justification

Visual inspection of the low lying land behind the flood embankment after a high tide shows that the embankment which is constructed from indigenous clay/silt material is extremely porous. The typical state of the river face revetment as illustrated in plates 1 to 5 shows this to be in poor condition, can no longer fulfil its erosion protection function and has been allowed to deteriorate beyond normal maintenance work. Failure of this embankment is now only a matter of time.

Total reconstruction of the embankment and river face revetment is urgently required. This work will be in accordance with the Authority's publically stated policy of maintaining the defences of the Halvergate Marsh.

The Supplementary Report considered various scenario's to value Halvergate Marsh. These scenarios gave values between £5.12m and £22.4m. However, the Ministry have indicated acceptance of the £16.04m valuation calculated by the University of East Anglia in its report entitled "A Flood Alleviation Strategy for Broadland". It should be noted that this latter valuation was calculated over a 30 year period and £17.5m over a 40 year period.

As calculated in Section 7 the total estimated cost of Contract 7 is £1.905m for a river frontage of 1,700m. The cost of access is:-

Roadworks	£250,000
Rail Crossings	£ 25,000
Design	£ 10,000
Construction and Maintenance Supervision	<u>£ 20,000</u>
Total	<u>£305,000</u>

The access road is required to service both Contracts 6 and 7 with a river frontage of 2,450m + 1,700m = 4,150m.

Therefore the cost of access is estimated at  $\frac{£305,000}{4,150} = £73.50/\text{m}$   
of river frontage for Contracts 6 and 7.

The estimated cost of Contract 7 proportioning access between 6 and 7 =  
 $\frac{£1,905,000 - £305,000}{1,700\text{m}} + £73.50/\text{m} = £1,015/\text{m}$   
of river frontage.

Due to the cost of access and the greater than average width of the concrete revetment Contract 7 will be more expensive per unit length than the average contract for Halvergate Marsh. Nevertheless the figure of £1,015/m is used in the following discussion.

The Halvergate Marsh has a river frontage of 28.1km and the Erosion Protection Strategy assumes a replacement cycle of 40 years together with an annual maintenance cost of £0.50/m.

The total capital and maintenance cost of the 40 year Halvergate Marsh Erosion Protection Strategy is presently estimated as  
(28,100m x £1,015/m) + (£0.5/m x 40 years x 28,100m) = £29.1m  
with an average annual expenditure of  $\frac{£ 29.1\text{m}}{40 \text{ years}} = £0.73\text{m}/\text{year}$



An expenditure of £0.73m/year for 40 years discounted at an annual rate of 6% equals £11.0m.

The proposed expenditure of £1,905,000 on contract 7 therefore remains financially viable within the revised estimated cost of the Halvergate Marsh 40 year Erosion Protection Strategy.

11. Drawings

Drawing number 40407/01, showing the General Arrangement of Contract 7 is included with this report.

12. Conclusions

The Authority and Ministry are requested:-

- a) To note that the revised cost of Halvergate Marsh 40 year Erosion Protection Strategy is £29.1m.
- b) To approve and to grant aid the Halvergate Marsh Erosion Protection Scheme Contract 7 at an estimated cost of £1.905m, the works to be undertaken by contract during 1992 and 1993.

Appendices

Engineer's Supplementary Report - March 1990.

Authority's Policy Letter to MAFF - October 1990.

Breydon Water SSSI Notice - June 1987.

Notice under SI 1217 - 1988



NORFOLK BROADLAND

HALVERGATE MARSH EROSION PROTECTION SCHEME

ENGINEER'S SUPPLEMENTARY REPORT

MARCH 1990

AJG/DS/AJG1

*National Rivers Authority*  
*Anglian Region*

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## HALVERGATE TRIANGLE

### ENGINEER'S SUPPLEMENTARY REPORT

#### 1. Introduction

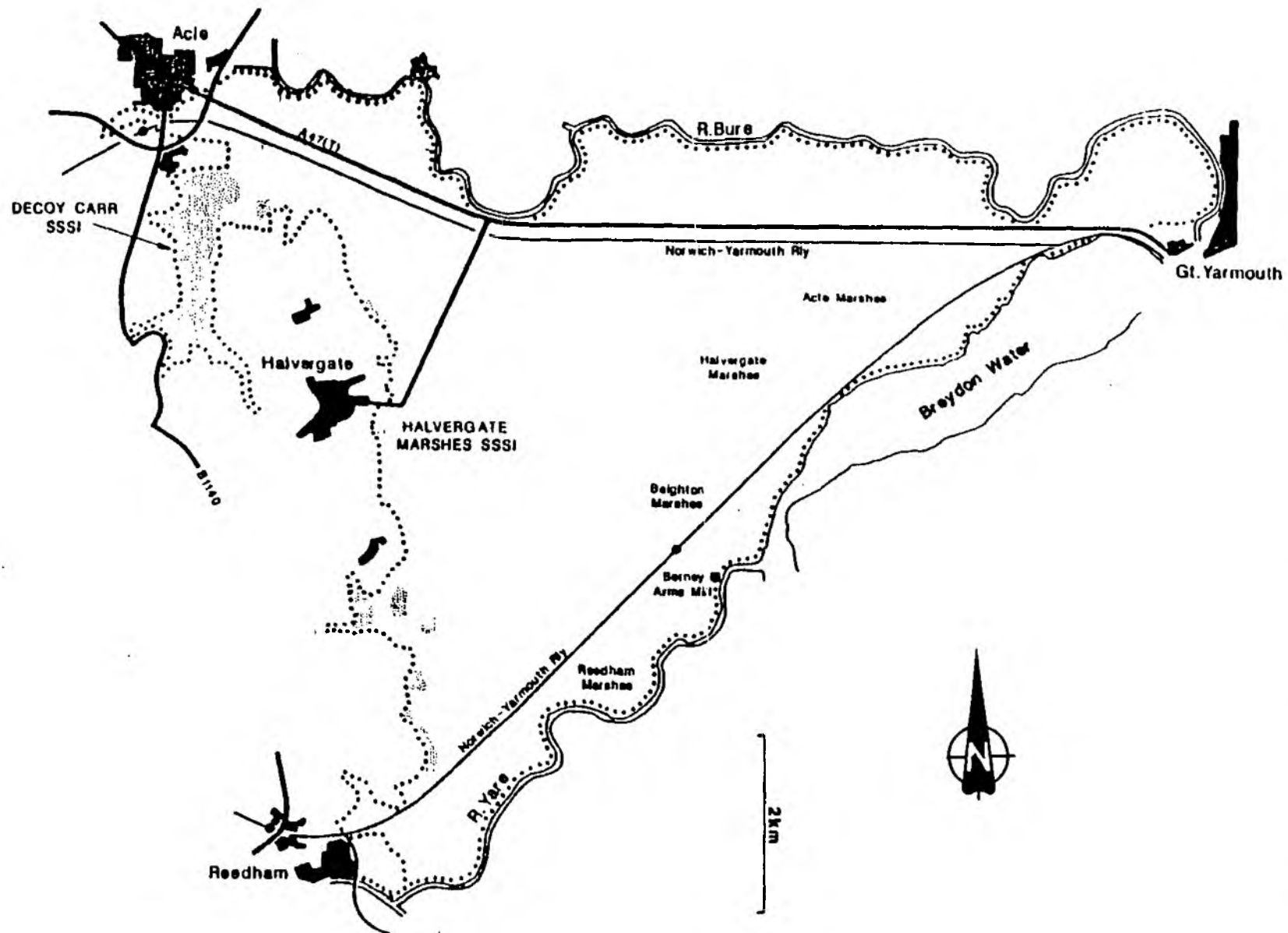
Until a decision whether or not to proceed with the construction of the River Yare Barrier is made and the effectiveness of the barrier can be assessed it is the Authority's policy to maintain the present level of flood protection in the Norfolk Broadland.

#### 2. General

Between the port of Great Yarmouth and the village of Acle 13 km to the west, is situated an area of Broadland locally known as the "Halvergate Triangle". The Triangle covers an area of some 4000 ha and comprises the entire area of the Lower Bure, the Halvergate Fleet and the Acle Marshes Internal Drainage Districts. The Triangle is bounded by the River Bure in the north and the River Yare in the south east, totalling 30.6 km of Authority Tidal "main river". The higher land between Acle and Reedham is considered to be the western boundary of the triangle.

The Triangle lies mainly below the level of High Water Spring Tides (H.W.S.T.) and is a sparsely populated pumped agricultural freshwater marsh. Three causeways cross the Triangle, the A47 Norwich to Great Yarmouth Trunk Road and the Acle to Great Yarmouth and Reedham to Great Yarmouth railway lines. These causeways have a total length of 27 km and again have pavement and rail levels below the level of H.W.S.T.

The town of Great Yarmouth serves a resident population of 100,000, which is considerably enlarged by summer holiday visitors... In 1988 the Port of Great Yarmouth handled 2 million tonnes of cargo of which, it is estimated, 50% entered or exited the port area via the Triangle.



## HALVERGATE TRIANGLE

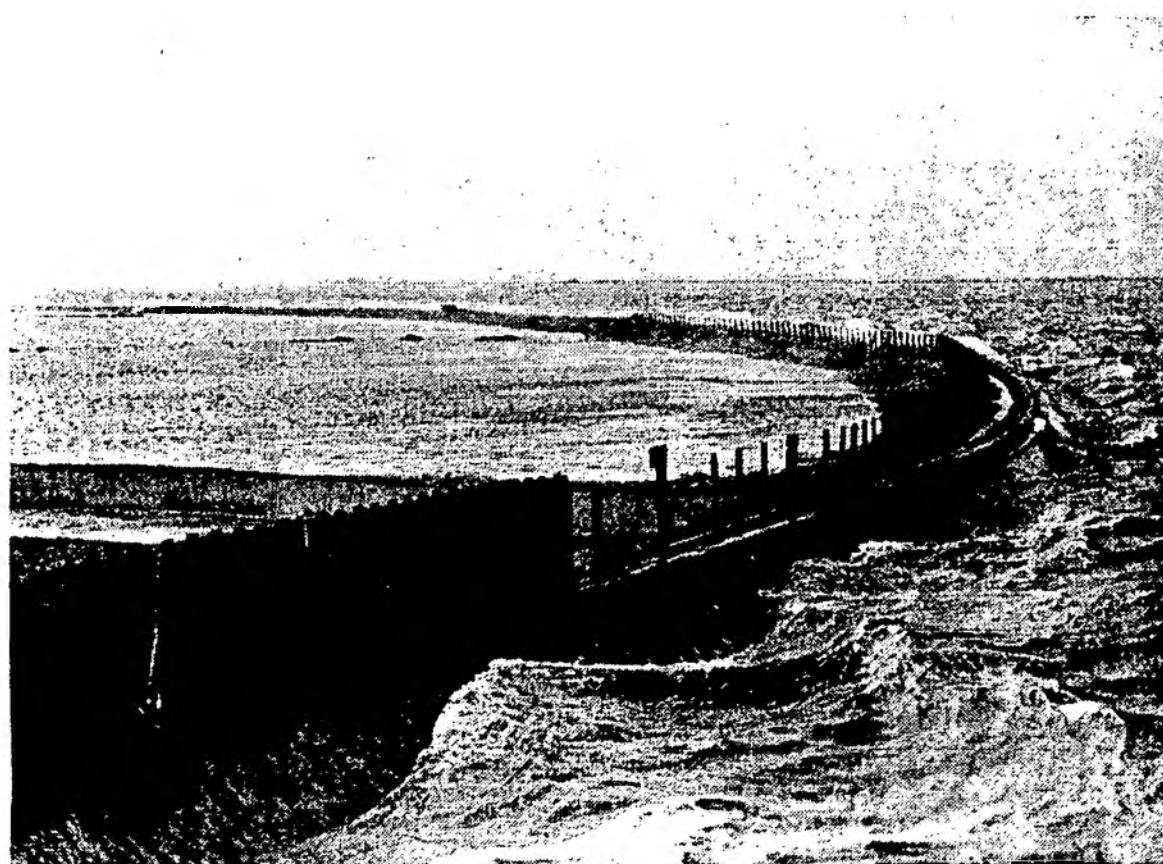
FIG. 2.

FIG.3.

Reproduced from the Grt. Yarmouth Mercury  
6th Feb. 1953.

Believed to be taken from the site  
of the New Yare bridge and looking along  
the South Bank of Breydon Water.

Estimated Wave height 0.35m.



'Above—Whipped into angry waves by the gale, Breydon Water sweeps over the bank and across the marshes. Cattle were washed away.'

"A flood Alleviation Strategy for Broadland, Final Report" dated September 1989 prepared by the University of East Anglia (U.E.A.), refers to the Triangle as Compartment 11.

An Environmental Statement for the Halvergate Triangle dated January 1988 has been written by the U.E.A.

3. Purpose of this Report

This Report outlines and justifies the Authorities long term strategy for the erosion protection of the lower banks of the rivers Bure and Yare west of Scaregap. The area of the Triangle to the east within the "Bure Loop" will be the subject of a separate report.

4. Statement of Need

Without the flood embankments the Triangle will be regularly subjected to tidal flooding and will quickly revert to a salt marsh.

The embankments were raised using indigenous material which has little structural strength and very poor erosion resistance. It is therefore essential to protect the lower banks of the rivers with some form of armour to a level exceeding the swash level at High Water Spring Tides.

The standard of erosion protection armour will remain the same, whether or not the Yare or Bure Barriers are built.

5. Rivers

The part of the Triangle considered by this report is bounded by two tidal rivers: the River Bure 14.75 km long on the north side and the River Yare 13.35 km long on the south side.

## 6. Tides and Waves

The Proudman Oceanographic library predict that a tidal level exceeding 1.2m O.D.N. will occur monthly.

The Randell, Palmer and Tritton Report of 1977 on the Yare Basin concluded that a 1 in 1 year Tidal Surge would increase river levels to 2.0 m O.D.N. and a 1 in 5 year surge to 2.4m O.D.N. adjacent to the Triangle.

These levels will be increased if the Spring Tides and Tidal Surges occur at the same time as high fluvial flows. Figure 3 is a photograph of Breydon Water flooded by the 1953 tidal surge event, which is now calculated to be a 1 in 80 year event, indicates that the wave height was 0.35 m and swash against the revetment exceeded 1.0 m.

The normal flow velocity of the Rivers Bure and Yare is not sufficient to cause rapid bank erosion but will cause slow erosion and accretion which will induce natural but unwanted meandering.

## 7. Geology

The Halvergate Triangle is a low lying pumped-drained fresh water marsh with a conglomerate of silt, clay and organic material overlying sands and gravel at a depth of some 20 m. A report of the investigations carried out by A F Howland Associates in January 1990 show the results obtained from boreholes adjacent to the north bank of the River Yare at Breydon Water opposite Scaregap. These results are believed to be typical of the geology of the Triangle.



8. Topography of Triangle

A Topographical description of the Triangle is given in Volume III of the U.E.A.'s Strategy Report.

9. Existing River Bank Protection

The banks of the River Yare are protected with erodible berms (rands) toe piling, various forms of stone or concrete revetment, timber boarding and steel sheet piling.

The banks of the River Bure are mainly protected with steel sheet piling.

10. Strategy Justification

- 1) If the Authority were to declare a policy of "do nothing" on the Halvergate Triangle then the following sequence of events is probable.

As the maintenance of the road and rail links across the triangle is essential for the town and commercial part of Great Yarmouth and as there are no viable alternative routes to the west, the Highway Authority and British Rail would immediately have to take steps to protect their respective causeways by hardening or revetting their sides. This work is assumed, for the purposes of the financial assessment to commence in year 1 and to be completed during year 5. The maintenance of the revetments and those parts of the causeways banks awaiting revetments would commence in year 1 and continue throughout the life of the strategy (50 years).

The first breach in the flood embankments will occur during the 1st year, once one breach in the embankment has happened rapid destruction of the remaining embankments will follow. After the initial embankment failure, there will be a progressive loss of the Triangle by regular saline flooding caused by the normal tidal cycle, until by year 10 it will have reverted to a salt marsh.

The progressive reversion of the Triangle will lead to the abandonment of domestic, industrial and other buildings during years 3 to 8.

(a) Revetment to Road and Rail Causeways

- I) The cost of revetting both sides of the causeways to a level of H.W.S.T. is estimated to be £240/metre. Over their combined length of 37 km the total cost of these works is £8.88 m ( $2 \times 3\text{m revet} \times 37 \text{ km} \times £40/\text{m}^2$ ).

The estimated cost of maintaining the 74 km of causeway revetments is £0.27/m<sup>2</sup> = £60,000 per year.

- II) The cost of revetments required to provide a 1 in 25 year level of protection would be £29.6 m ( $2 \times 10 \text{ m revet} \times 37 \text{ km} \times £40/\text{m}^2$ ) and the annual maintenance cost £100,000 per year.

(b) Land Loss

The capital loss in land values by adopting the "do nothing" option is:-

I) For arable marsh totalling 980 ha	a) £3705 per ha = £3.63 m
II) For grass marsh totalling 3090 ha	a) £1975 per ha = <u>£6.10 m</u>
	Total <u>£9.73 m</u>

(c) Building Loss

There are approximately 135 buildings of various types on the Triangle. If these are valued at a conservative all-in valuation of £65,000 each then their total value is £8.77 m.

(d) Industrial Loss

Apart from agriculture there is no major industry on the Triangle.

(e) Recreation

Recreation is confined to the study of ornithology, botany and boating. There would be changes in the fauna and flora if the Triangle reverted to salt marsh, but little change in Broadland boating activities. "No loss" is therefore assumed for this item.

II) Conclusions of Do Nothing Option

The costings of the do nothing option is expanded in spread sheet No.1 which shows:-

(a) that the Capital Cost of the option, merely protecting the causeways to a level of H.W.S.T. is £30.17 m which discounted at 6% over 50 years has a present value of £23.24 m.

(b) that the Capital cost of the option involving the protection of the causeways to a 1 in 25 year standard is £48.86 m which has a present value of £42.47 m.

### III Other Analysis

Within the past 18 months other valuation exercises have been carried out for the Halvergate Triangle.

- (a) The Engineers Report of October 1988 estimated the asset value within the area to be £22.04 m. This did not include intangible assets.
- (b) The Authority's letter to the Ministry dated 9th February 1989 estimated the agricultural net margin to be £324,500 which discounted at 6% over 50 years has a present value of £5.12 m.
- (c) figures derived from "A Flood Alleviation Strategy for Broadland" calculate the Total Present Value of Benefits to be £16.040 m.

### IV Proposed Works

The works required to protect the Halvergate Triangle can be divided into two parts.

- (a) The erosion protection works required to protect the lower banks against erosion caused by normal fluvial flows, variations in water levels and wave action. As previously explained armouring of these affected areas is necessary.
- (b) Flood embankments which are necessary to protect the Triangle against higher than normal water levels caused by high fluvial flows combined with Tidal Surges. As these events are infrequent embankments formed from indigenous material reinforced with natural vegetation is normally sufficient. The exception is the banks at Breydon Water where significant waves are generated by the 7 km fetch.

Spread sheet No. 2 shows a financial strategy for the replacement and maintenance of the erosion protection armour to the lower banks of the Rivers Yare and Bure. This strategy is based on previous construction costs and knowledge of the effective life of various forms of bank armour.

The capital cost of this strategy is established to be £6.79 m to which has been added £2.25 m for maintenance totalling £9.04 m and a present value of £3.95 m.

In 1989 Sir Frederick Snow and Partners in conjunction with the U.E.A. carried out an investigation into the costs in raising the banks to various levels of protection, under present conditions (ie, without the Yare Barrier). It is estimated that the capital cost of raising the embankments to a 1 in 50 year standard would be £3.95 m, which inflated to December 1989 prices equals £4.66 m. No detailed analysis has yet been carried out to calculate the standard of flood protection which has the optimum benefit to cost ratio. The cost of a 50 year standard has merely been used as the maximum standard that would be considered for the Triangle. Lesser standards would, of course, cost less.

Spread sheet No. 3 shows a financial strategy for embankment raising. As the embankment would be raised using the soft indigenous material a sum of £1.0 m has been allowed in years 25 and 26 for embankment reconstruction and bank raising due to settlement and rising water levels caused by the "greenhouse" effect. An annual maintenance cost of £25,000 has also been included.



The capital cost of this strategy is £5.6 m to which has been added £1.24 m for maintenance totalling £6.9 m and a present value of £4.38 m.

The present value of armouring the banks of the Halvergate Triangle and raising and maintaining the embankments to a 1 in 50 year standard is £3.951 m + £4.38 m = £8.33 m.

#### 11. Conclusions

For political and environmental reasons the "do nothing" option is not an option open to the Authority neither can it be proved to be financially viable.

The estimated present value of benefits calculated by the U.E.A. for the Triangle is £16.04 m, this would appear to be the most reasonable value that can be placed on the compartment at the present time. Thus if the present value of the 50 year erosion and flood defence strategy is £8.33 m the strategy has a net present value of £7.71 m and a benefit to cost ratio of 1.9 to 1.

Until a decision is made on the Yare Barrier the Authority's policy of reconstructing failed bank armour and maintaining the existing embankments to their existing 1 in 5 year standard, (which policy will not inhibit future construction to a higher standard) remains the most favourable option.

SPREADSHEET NUMBER 1.

DISCOUNTED CASH FLOW SPREAD SHEET @ 6 %

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ALL VALUES IN £,000's

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### HALVERGATE 'TRIANGLE' FLOOD COST OF DO-NOTHING OPTIONS

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[illegible]

*****				
*	TOTAL VALUE OF CAPITAL COST OF 1,2,5 & 6	=	30.17	£ M *
*	TOTAL VALUE OF CAPITAL COST OF 3,4,5 & 6	=	48.864	£ M *
*	TOTAL PRESENT VALUE OF COST OF 1,2,5 & 6	=	23.240	£ M *
*	TOTAL PRESENT VALUE OF COST OF 3,4,5 & 6	=	42.468	£ M *
*****				

## SPREADSHEET NUMBER 2

DISCOUNTED CASH FLOW SPREAD SHEET @ 6 %

\*\*\*\*\*

ALL VALUES IN £,000'S

[illegible]

HALVERGATE 'TRIANGLE' NORFOLK EROSION PROTECTION WORKS TO RIVER YARE & BURE

\*\*\*\*\*

TOTAL LENGTH OF EMBANKMENT WORK = 28.1 KM

[illegible]

* TOTAL VALUE OF CAPITAL COST OF 1,2,3,4 & 5	=	6.79	£ M	*
* TOTAL PRESENT VALUE OF CAPITAL COST OF 1,2,3,4 & 5	=	3.2036	£ M	*
* TOTAL VALUE OF 6 (MAINTENANCE ,REVENUE)	=	2.248	£ M	*
* TOTAL PRESENT VALUE OF 6 (MAINTENANCE ,REVENUE)	=	.75117	£ M	*
* TOTAL VALUE OF CAPITAL COST OF 1,2,3,4,5 & 6	=	9.038	£ M	*
* TOTAL PRESENT VALUE OF CAPITAL COST OF 1,2,3,4,5 & 6	=	3.9547	£ M	*

## SPREADSHEET NUMBER 3.

DISCOUNTED CASH FLOW SPREAD SHEET @ 6 %

\*\*\*\*\*

ALL VALUES IN £,000's

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HALVERGATE 'TRIANGLE' FLOOD EMBANKMENT RAISING TO 1 IN 50 YEAR STANDARD

\*\*\*\*\*

[illegible]

*****			
*	TOTAL VALUE OF CAPITAL COST' OF 1 & 2	= 6.895	£ M *
*	TOTAL PRESENT VALUE OF COST' OF 1 & 2	= 4.3813	£ M *
*****			



18 October 1990



Mr R Purnell  
MAFF  
Block B  
Government Buildings  
Brooklands Avenue  
CAMBRIDGE

*National Rivers Authority  
Anglian Region*

Our Ref: AJG/SG/4000

Dear Reg

Norfolk Broadland Erosion Protection Works

I refer to the recent correspondence from Steve Hayman and the meeting at your office on 8 October attended by Messrs Ayling, Guilbert and Hunt of my staff convened to discuss the future policy towards Broadland.

I understand that it was agreed that 6 of the Broadland compartments, as defined by the UEA should be appraised in detail and from these appraisals long term strategies are to be evolved.

It is acknowledged that until a decision is made whether or not to construct some form of tidal barrier and the effects of such a barrier calculated the Authority will continue to maintain erosion protection works to the Broadlands and to maintain the flood embankments to their present levels. Maintaining flood embankments to their present levels will, of course, result in a gradual reduction in the flood defence standards if there is a continued rise in sea levels.

Up to now, 3 compartments have been appraised, No 11 Halvergate, No 22 Norton/Burgh Marshes and No 35 Haddiscoe Island. Copies of these appraisals, each containing proposed long term strategies have been forwarded to the Ministry. No immediate Works are proposed to Compartment 35, but it was necessary to appraise this compartment in order to produce a long term strategy for Haddiscoe Cut.

Work has now commenced on the appraisal of Compartments No 9 Fleggbrugh, No 10 North Bure and No 36 South Breydon, which I hope to submit to the Ministry in the new year. These will be followed later in 1991 with Compartment No 6 Hickling.

Except in extreme emergencies the Authority will restrict its erosion protection and its embankment maintenance works to the above Compartments for the next 5 years.

Yours sincerely

M W Child  
New Works Engineer

This matter is being handled by A Guilbert, Ext 4430  
WP-1/SG180CT/6

DR. KEVIN BOND  
*Regional General Manager*

Kingfisher House  
Goldney Way  
Orton Goldney  
Peterborough  
PE2 0ZR  
Tel: 0733 371811  
Fax: 0733 231840



**Nature Conservancy Council**

60 Bracondale Norwich NR1 2BE

Telephone Norwich 20558

13

A.W. NORWICH D

25 JUL

ISSUED TO

Your reference

FILED FOR

Our reference EA/N/201/14 WDD JR

Date 23 June 1987

Recreation and Conservation Officer  
Anglian Water  
Norwich Division  
Yare House  
62 Thorpe Road  
Norwich  
Norfolk NR1 1SA

Dear Sir

WILDLIFE AND COUNTRYSIDE ACT 1981:  
SITES OF SPECIAL SCIENTIFIC INTEREST [SSSI]

**BREYDON WATER SSSI**

S28[1] of the Wildlife and Countryside Act 1981 requires the Nature Conservancy Council [NCC] to notify owners and occupiers of areas of land which in the Council's opinion is of Special Scientific Interest [SSSI]. The local planning authority in whose area the land is situated and the Secretary of State for the Environment have also to be notified.

S22[3] of the Water Act 1973, as amended by S48 of the Wildlife and Countryside Act, also requires the NCC to notify regional Water Authorities, including Internal Drainage Boards of any SSSIs lying within the Authority's or Board's areas of interest.

Accordingly, I now enclose formal notification documents comprising a site map, description, and list of operations likely to damage the special interest for the above site.

We ask that you consult NCC over proposals to undertake any kind of work which might affect the special interest of SSSIs notified to you under the 1981 Act. We would also appreciate continued consultation over SSSIs notified under the National Parks and Access to the Countryside Act 1949, pending their re-notification under the new legislation.

Should it be necessary to undertake emergency work without prior consultation, please inform NCC as soon as is practicable after the event.

I would be grateful if you would acknowledge receipt by completing and returning the appropriate acknowledgement slip to this office.

Yours faithfully

J R Moore [Mrs]  
Regional Administrative Officer  
East Anglia

Enc

COUNTY: Norfolk

SITE NAME: BREYDON WATER

DISTRICT: Great Yarmouth

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

Local Planning Authority: Great Yarmouth Borough Council

National Grid Reference: TG 500075

Area: 306.5 [ha] 1251.5

Ordnance Survey Sheet 1:50,000: 134

1:10,000: TG 40 NE, SE TG 5

Date Notified [Under 1949 Act]: -

Date of Last Revision: -

Date Notified [Under 1981 Act]: 1987

Date of Last Revision: -

Other Information:

A new site; the majority has been established as a Local Nature Reserve since 1968.

#### Reasons for Notification:

Breydon Water is an inland tidal estuary at the mouth of the River Yare and its confluence with the rivers Bure and Waveney. Extensive areas of mud are exposed at low tide and they form the only intertidal flats occurring on the east coast of Norfolk. Large numbers of wildfowl and waders are attracted to an abundant food supply when on passage and during the winter months. Several wintering wildfowl reach nationally important population levels and the estuary occupies a key position on the east coast for these species and for migrating birds. Rare species are regularly recorded. There is also considerable botanical interest with small areas of saltmarsh, reedbeds and brackish water communities in the surrounding borrow dykes. Invertebrate fauna is rich and includes one scarce species of snail.

The mudflats are characterised by growths of green algae [*Enteromorpha* sp. and *Ulva*] and two uncommon species of Eel-grass [*Zostera marina* and *Z. noltii*]. These plants, together with an abundant invertebrate fauna, attract large numbers of ducks and waders to feed in the estuary at the appropriate seasons. There are nationally important wintering flocks of Wigeon [winter maximum 4,500 birds] and Shelduck [1,000] and an internationally important flock of Bewick's Swans [120]. Other notable wintering wildfowl include Golden Plover, Red-breasted Merganser, Pintail, White-fronted Goose and Pink-footed Goose. Large flocks of waders are also present with a total winter maximum of 3-6,000 birds. The most numerous species are Knot, Dunlin, Redshank and Ringed Plover. Several uncommon species are recorded with some regularity, the most noteworthy being Spoonbill, Avocet and Mediterranean Coot. Breeding species include Little Grebe, Shelduck, Common Tern and Bearded Tit.

Small areas of saltmarsh occur at the lower end of the estuary. Glasswort [*Salicornia*] is dominant on the lower marsh and this zone grades into midmarsh where typical species include Sea Lavender [*Limonium vulgare*], Sea Aster [*Aster tripolium*], Sea Purslane [*Halimolobos portulacoides*], Sea Plantain [*Plantago maritima*] and Sea Poa [*Puccinellia maritima*]. At the upper end of the estuary saltmarsh is replaced by brackish reedswamp and there are extensive stands of Common Reed [*Phragmites australis*].

A flood-bank surrounds the estuary and behind this is a borrow dyke which contains distinct brackish water communities of plants and invertebrates. Marginal plants include Sea Clubmoss [*Scirpus maritimus*] and Mud Rush [*Juncus gerardi*] while the dominant water plant is Spirogyra [*Myriophyllum spicatum*]. The maritime grassland on the edge of the estuary includes the rare Bulbous Fox-tail [*Alopecurus bulbosus*].

The uncommon mollusc, *Assiminea gravana* has been recorded from the upper estuary.

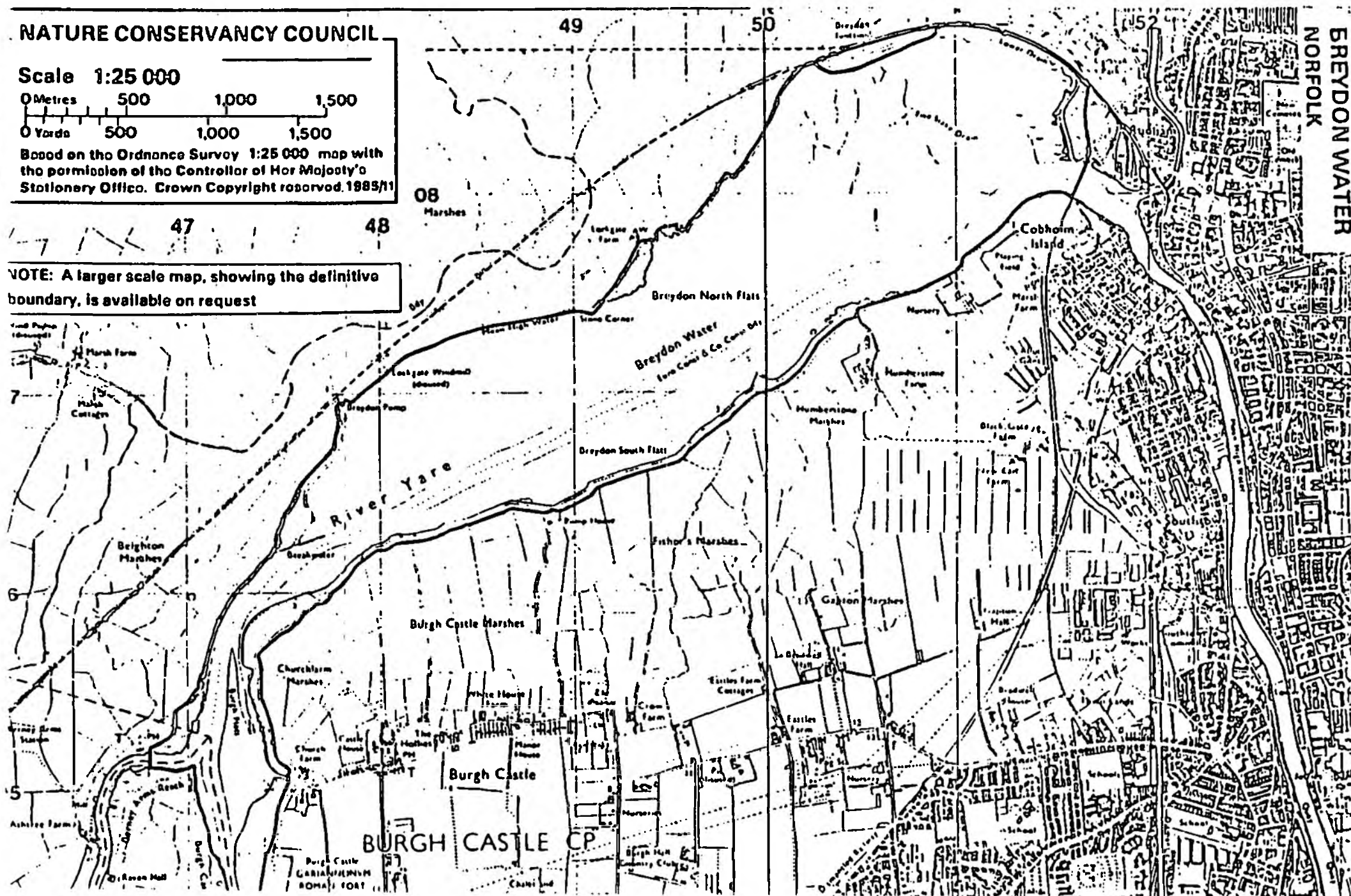
# NATURE CONSERVANCY COUNCIL

Scale 1:25 000

0 Metres 500 1,000 1,500  
0 Yards 500 1,000 1,500

Based on the Ordnance Survey 1:25 000 map with the permission of the Controller of Her Majesty's Stationery Office. Crown Copyright reserved 1985/11

NOTE: A larger scale map, showing the definitive boundary, is available on request



BREYDON WATER  
NORFOLK

DATE NOTIFIED: 23 JUNE 1981

## OPERATIONS LIKELY TO DAMAGE THE SPECIAL INTEREST

Site name: BREYDON WATER, NORFOLK

<u>Ref No</u>	<u>Type of Operation</u>
1.	Cultivation, including ploughing, rotovating, harrowing, and re-seeding.
2.	The introduction of or changes in the grazing regime [including type of stock or intensity or seasonal pattern of grazing and cessation of grazing].
3.	The introduction of or changes in stock feeding practice [including changes in the number of animals stocked].
4.	The introduction of or changes in the mowing or cutting regime [including hay making to silage and cessation].
5.	Application of manure, fertilisers and lime.
6.	Application of pesticides, including herbicides [weedkillers].
7.	Dumping, spreading or discharge of any materials.
8.	Burning.
9.	The release into the site of any wild, feral or domestic animal*, plant or seed.
10.	The killing or removal of any wild animal*, including pest control.
11.	The destruction, displacement, removal or cutting of any plant or plant remains, including herb, and turf.
12.	The introduction of or changes in tree and/or woodland management+.
13a.	Drainage [including the use of mole, tile, tunnel or other artificial drains].
13b.	Modification of the structure of watercourses [eg. rivers, ditches, dykes, drains], including their banks and beds, as by re-alignment, re-grading and dredging.
13c.	Management of aquatic and bank vegetation for drainage purposes [see also 11].
14.	The changing of water levels and tables and water utilisation [including irrigation, storage and abstraction from existing water bodies and through boreholes].
15.	Infilling of ditches, dykes, drains, ponds, pools, marshes or pits.
16a.	The introduction of or changes in freshwater fishery production and/or management**.
16b.	Changes in coastal fishing practice or fisheries management and seafood or marine life collection+*.
17.	Reclamation of land from sea, estuary or marsh.
18.	Bait digging in intertidal areas.

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\* 'animal' includes any mammal, reptile, amphibian, bird, fish or invertebrate.

+ including afforestation, planting, clear and selective felling, thinning, coppicing, modification of the stand of underwood, changes in species composition, cessation of management.

\*\* including sporting fishing and angling.

+\* including the use of traps or fish cages.

Continued...  
19, 20, 21, 22, 2  
26, 27 & 28



Dreydon Water Continued....

<u>Ref No</u>	<u>Type of Operation</u>
19.	Erection of sea defences or coast protection works.
20.	Extraction of minerals, including shingle, sand and gravel, topsoil, subsoil, and spoil.
21.	Construction, removal or destruction of roads, tracks, walls, fences, hardstands, banks, ditches or other earthworks, or the laying, maintenance or removal of pipelines and cables, above or below ground.
22.	Storage of materials.
23.	Erection of permanent or temporary structures, or the undertaking of engineering works, including drilling.
26.	Use of vehicles or craft likely to damage or disturb features of interest.
27.	Recreational or other activities likely to disturb wildfowl and waders.
28.	Introduction of or changes in game and waterfowl management and hunting practice.

NATIONAL RIVERS AUTHORITY

ANGLIAN REGION

ASSESSMENT OF ENVIRONMENTAL EFFECTS REGULATIONS 1988

STATUTORY INSTRUMENT NUMBER 1217

HALVERGATE MARSH EROSION SCHEME CONTRACT NUMBER 7

Notice is given that the National Rivers Authority (Anglian Region) propose to undertake strengthening and erosion protection Works to the north flood embankment of the River Yare at Breydon Water between Breydon Pump and the Berney Arms Public House (National Grid Reference TG 478069 to 471053) a length of some 1.7km.

The Works will include open concrete revetment blockwork on the river face of the embankment and the widening of the embankment to provide a 3.0 metre wide crest width. It is planned that these Works will be undertaken over an 18 month period, commencing in the Autumn of 1992.

Any person who wishes to inspect the drawings of the proposed works and the Environmental Statement for the Halvergate Triangle may do so by calling at the Authority's offices at 79 Thorpe Road, Norwich, between 09.00 and 16.30 hours Monday to Friday.

Any person who wishes to make representations in relation to likely environmental effects should do so in writing to the address below not later than the Monday 17 August 1992.

Mr P Foster  
Regional Manager (Flood Defence and Operations)  
National Rivers Authority  
(Anglian Region)  
Kingfisher House  
Goldhay Way  
Orton Goldhay  
Peterborough  
PE2 0ZR