NRA

WATER QUALITY REPORT 1992

National Rivers Authority
Anglian Region

SUMMARY

The National Rivers Authority (NRA) is a public body, charged with the duty of improving the Water Environment. The NRA operates through a Board and National Head Office. Anglian Region is one of eight Regional Units.

We report trends over the past 8 years in the chemical quality of rivers. We demonstrate an upgrade of 5.6% since last year.

This is matched by an improvement in the biological quality of rivers. The biological quality is the best we have recorded.

We provide evidence that the improvements in river quality are due to a combination of better effluent quality and increased river flows since the end of the drought.

Despite these improvements, the number of Pollution Incidents increased by 12% from 1991 to 1992. This resulted from more effective monitoring on our part and growing public awareness.

A few sites failed criteria for the Dangerous Substances Directive.

As in 1991, recreation was disrupted at some lakes and reservoirs by Blue-green Algae.

We report trends in the quality of Bathing Waters since 1987. In 1992, two Waters failed of the 33 Identified under the Bathing Waters Directive. This is the best result we have seen.

We give trends for the performance of discharges since 1982. 98.4% of the sewage treatment works operated by Anglian Water Services complied with their Consents. This is the highest ever recorded and an improvement of 2% since 1991. Other types of discharges also show the best compliance ever recorded.

The number of enquiries of the Water Act Register has increased steadily since it opened in 1985. There were over 640 in 1992, an increase of 32% since 1991.

In 1992, the number of samples analysed for routine audit purposes increased to 39,000.

We used River Quality Indices and the Laboratory Information Management System to ensure efficient use of our monitoring resources.

We continued to plan the measures needed to achieve future Water Quality Objectives. To this end we have completed further mathematical models of rivers, estuaries and coastal waters.

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Part 1. INTRODUCTION

1.1 National Aims

Our duties for the quality of the Water Environment extend to all Controlled Waters. Controlled Waters include rivers, lakes, groundwaters, estuaries and coastal waters. We aim to:

- achieve a continuing improvement in the quality of Controlled Waters, through the control of pollution;
- maintain and improve the quality of environmental waters for all those who use them;
- ensure that dischargers pay the costs of the consequences of their discharges; and,
- as far a possible, recover the costs of improving the Water Environment from those who benefit.

1.2 Duties

Under the Water Resources Act 1991, we have duties:

- to achieve Water Quality Objectives;
- to monitor the extent of pollution;
- to conserve and enhance the amenity of inland and coastal waters, and of land associated with such waters;
- to determine and issue Consents for discharge of wastes;
- to maintain Public Registers of Water Quality Objectives, Consents, and water qulaity data;
- to keep maps of Controlled Waters for public inspection;
- to advise and assist the Department of the Environment; and,
- to exchange information with Water Undertakers on pollution matters.

We operate openly in discharging our duties and aim to balance the interests of all who benefit from and make use of Controlled Waters.

1.3 The Environmental Protection Act

The Environmental Protection Act 1990 introduced the concept of Integrated Pollution Control for processes which manufacture or use particular substances. (See Part 4.8). These are authorised by Her Majesty's Inspectorate of Pollution (HMIP). The NRA is a statutory consultee, and HMIP must accept our recommendations for Authorisations, where water quality is affected.

1.4 Water Quality 2000

Our national strategy for water quality, **Water Quality 2000**, addresses how we shall set about achieving our future goals:

- introduce Statutory Water Quality Objectives;
- implement a system of catchment planning;
- determine the impact of all the causes of poor water quality;
- set up systems for controlling these causes; and,
- develop economic incentives as a basis for pollution control.

1.5 Catchment Management Plans

This involves the NRA and others in work which will:

- identify the features and the current and potential uses of the catchment;
- set targets;
- compare targets with the current state of the catchment;
- identify the issues and the options for addressing them;
- consult on the uses, targets, issues and options;
- prepare a plan to address the issues; and,
- implement the plan, and monitor and review.

In 1992, plans were issued for the River Cam and the coastal catchment surrounding Louth in Lincolnshire. Draft plans were also produced for the combined Gipping and Stour catchments and the Ely Ouse. The process was also started for the Lower Nene and Yare (see 2.13).

After the draft plans have been commented on and revised, the plans will be published and will form the basis for our decisions. The plans look forward at least 10 years and will be reviewed at five yearly intervals.

1.6 Tasks

To achieve our aims for water quality, we must excel in four areas:

- manage the resources available for monitoring;
- ensure that dischargers invest enough in the disposal of their wastes;
- ensure that changes in land use and other developments cause no damage to the water environment; and,
- minimise the risk of damage from accidents and pollution incidents.

During 1992, we developed further our systems for managing our monitoring programme.

We have continued the development of tools for assessing measures needed to improve water quality.

We have also developed further our systems for the audit of performance against water quality standards.

2.1 Chemical Monitoring

Much of our work depends on good data on river chemistry.

2.1.1 Routine Sampling of Surface Waters

Our 1992 programme for chemical monitoring is shown in Table 2.1:

TABLE 2.1

Numbers of Sites and the Frequency of Sampling

Samples per year	Reservoirs	Rivers	Canals	Lakes etc	Total by frequency
< =4	1	132	0	19	152
5 - 12	4	933	7	11	955
13 - 24	14	44	0	20	78
25 - 48	6	18	0	0	24
> 48	0	2	0	0	2
Totals	25	1129	7	50	1211

This monitoring allows us to characterise 4,669 km of freshwaters. The total number of samples was 14,507, from 1,187 sites (see also Table 8.1).

Samples of river sediments were collected at 70 sites, mainly for the Dangerous Substances Directive. The frequencies ranged from one to four per year.

Our programme for groundwater included 700 sites and involved the collection of 2,500 samples. Sampling frequencies ranged from fortnightly to one per year, depending on the type of survey and the variability of water quality at the site (see Part 2.11).

2.1.2 Continuous Monitoring

We maintain a network of 27 Automatic Monitoring Stations. These provides continuous measurements of river water quality. Most stations are placed below major discharges of effluent, directly above abstractions by Water Companies, or at places where water is pumped from one river to another.

Results are telemetred to operational staff. If any of the measurements exceed pre-set limits, the stations notify our Regional Communication Centre. Staff here will then instigate an investigation.

2.2 River Quality Classification

The reporting of river water quality has been based on the River Classes introduced by the National Water Council (NWC).

The Class for a particular stretch is determined mainly by the concentrations of Dissolved Oxygen, Biochemical Oxygen Demand (BOD) and Ammonia found from routine monitoring. The following table gives the river quality standards for these determinands and the associated classes. The concentrations are 95-percentiles - they must be met for 95 percent of the time.

TABLE 2.2

Class	River Quality Criteria		
	Dissolved Oxygen (% saturation)	Biochemical Oxygen Demand (mg/l)	Ammonia (mg/l)
1A Good	80	3	0.3
1B Good	60	5	0.7
2 Fair	40	9	-
3 Poor	10	17	-
4 Bad	Inferior to Class 3, anaerobic at times		

The classification of rivers for the year is shown in a map, enclosed with this report. There have been some changes since 1991. About 9% of river lengths were upgraded, while 3% were downgraded. Overall, 94% of rivers fall into the classes defined as Good to Fair quality.

These statistics indicate that 500 km of rivers have changed Class since 1991. Changes occurred across all Classes although most were between Classes 2 and 1B, and Classes 3 and 2. **There was a net upgrade of 262 km since 1991.**

We estimate that over 40% of the river length which was upgraded improved because of increased flows in the rivers following the end of the drought. Among these, about 21 km of the River Witham, 22 km of the River Brant, and 17 km of Alconbury Brook were re-classified to 1B.

Much of the remaining improvement was due to improved effluent qualities from many sewage treatment works. This included around 16 km of the River Yare and 16 km Soham Lode. These were upgraded, from Class 3 to 2, and 3 to 1B respectively.

Better river quality also resulted from more effective management of septic tanks and the better storage of agricultural waste. The most notable of these was 17 km of Bury Brook which was upgraded from Class 2 to 1B.

About 25% of river length which deteriorated did so because of poor-quality effluent discharges. This included 10 km of Chickering Beck, 4.8 km of Willow Brook

(Northern Stream), and 4.5 km of the River Wid. The reason for over 29 km of the Old Bedford River slipping from Class 2 to 3 is not yet understood.

There were no changes in the classification of canals.

2.3 River Quality Objectives

River Classes provide an absolute measure of river water quality. A river in a good Class will generally be a good fishery and suitable for other uses like the supply of drinking water, but this cannot be guaranteed because a use can be affected by pollutants which are not in the classification system.

Therefore, in addition to the NWC system, we have established River Quality Objectives (RQOs), for our major rivers. The RQOs are defined for the following Uses:

- Abstraction for Public Water Supply;
- Salmonid Fishery;
- Cyprinid Fishery;
- Amenity and Conservation;
- Abstraction for Industrial Water Supply;
- Spray Irrigation of Field Crops; and,
- Livestock Watering.

RQOs have been established in the Region since 1979. They ensure that river quality is checked more directly against all the quality standards needed to support those uses. Improvements to river quality, for example by expenditure on effluent treatment, would then be targeted to ensure that RQOs were met and maintained.

Following full public consultation in 1979, the Anglian Water Authority assigned RQOs to 1,350 individual stretches of river, totalling 7,843 km. Each river stretch has a group of Uses, and the amalgamation of the standards for all these Uses gives a set of water quality standards for that part of the river.

In some rivers where the current river quality is very good the achievement of River Quality Objectives could, in theory, permit a deterioration in river water quality. To prevent this, a policy of No Deterioration is superimposed on the River Quality Objectives.

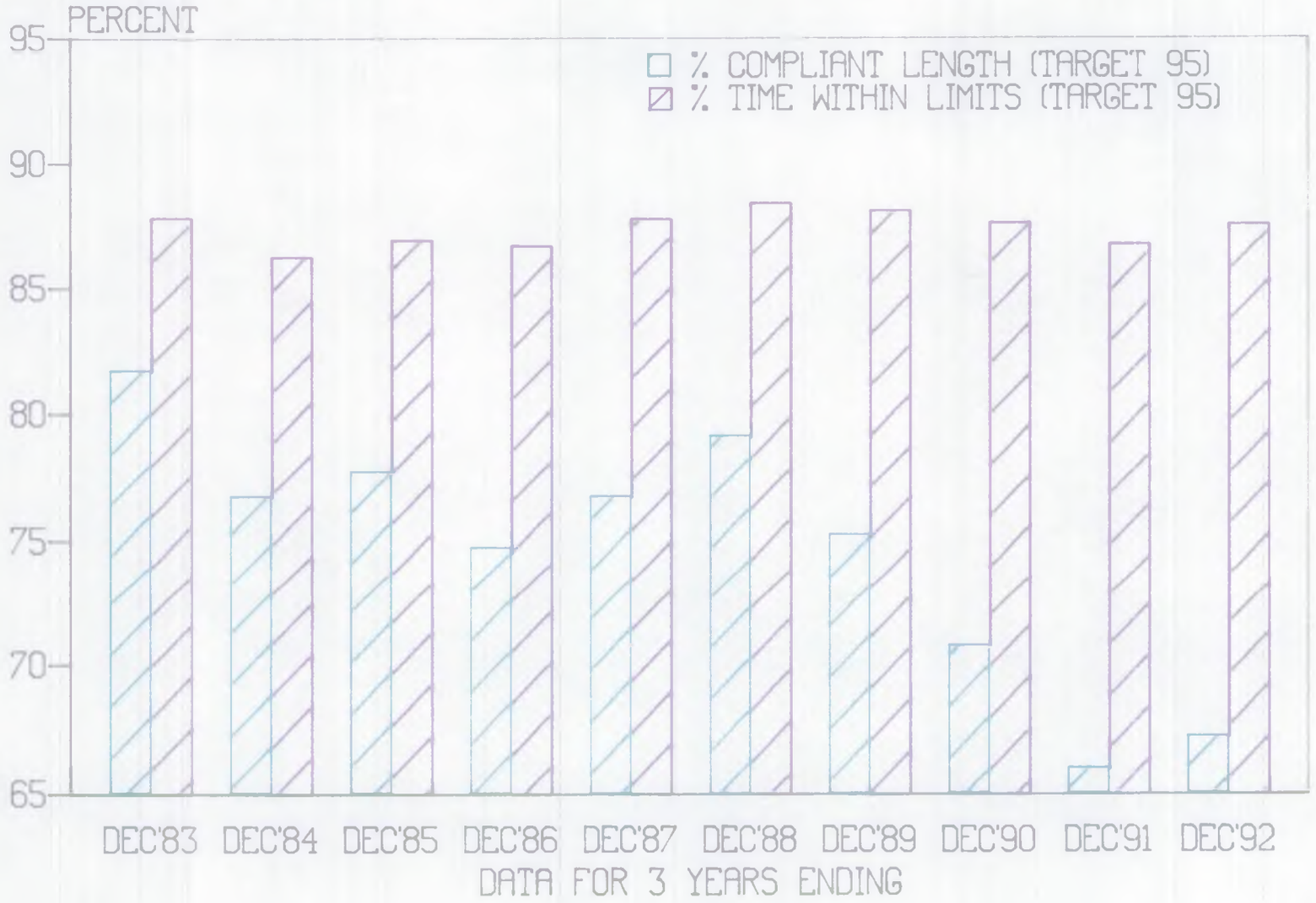
2.3.1 Compliance

The determinands most often involved in decision-making are Dissolved Oxygen, Biochemical Oxygen Demand, and Ammonia. The impact of other substances, for example metals and pesticides, is also assessed against the standards set down in the River Quality Objectives. These substances are also prominant in several of the Directives issued by the European Community.

River quality is highly variable and our spot-sampling means that there is always a risk that we report wrongly that water quality has changed, or failed or passed a standard. We control this risk, which is largest at low sampling rates, using statistically-sound methods of assessing compliance and change.

FIGURE 2.1

PERFORMANCE OF RIVERS AGAINST RIVER QUALITY STANDARDS



In order to smooth out these effects, and to increase our ability to detect small changes in quality, we use data from three-year periods to report performance.

Every three months, we audit and report the chemical quality of 4,500 km of our rivers against the River Quality Objectives, using results from 890 sampling points. Much of the remaining 3,300 km is monitored biologically (see Part 2.7).

The trends in water quality compliance for Dissolved Oxygen, Biochemical Oxygen Demand and Ammonia are given in Figure 2.1. This shows results for the average percent of time for which rivers complied and the percent of total river length which met standards. These statistics, particularly the former, are stable and efficient measures which can be used to suggest trend.

For the three-year period ending in December 1992, the percent of time spent within the required limits was 87.5%, compared to 86.7% for the three-years ending in December, 1991. Over the same period, 67.2% (3,050 km) of river lengths were of the required quality. This compares with 65.9% (2,995 km) for the three years ending in December, 1991.

In our Region, the growth of algae is encouraged by the nutrient-rich, slow-moving nature of many of the rivers. This leads to algal activity in the laboratory test for BOD, and to spurious, elevated results. Consequently, the performance figures for river quality are pessimistic because they are distorted by the effect of algae on the measurement of this test.

If we ignore the effects of algae on the measurement of the BOD, the total length complying would increase from 78.1%, in 1989/91, to 81.3% in 1990/92.

So, a net upgrade in Classified river length, plus improved RQO compliance indicate that river quality was better in 1992 than in 1989.

2.3.2 Chemical quality - the impact of effluents, and the drought

We can investigate this by looking at median values of concentrations of water quality parameters. Median values are those which fall exactly in the middle of the range of values. They will not be affected by extreme outlying results. Any shifts in median values can be expected to reflect real overall shifts in qualities.

Results from median values are shown in Table 2.3.

TABLE 2.3

Median Values For Each Determinand

Determinand	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
BOD mg/l	2.2	2.4	2.3	2.5	2.5	2.5	2.4	2.4	2.1	2.1	2.1	2.1
Total Ammonia mg/l	0.09	0.14	0.15	0.14	0.16	0.16	0.16	0.15	0.13	0.1	0.08	0.07
D.O mg/l	10.0	10.2	10.2	10.1	10.1	10.1	9.8	9.8	9.5	9.4	9.4	9.7
D.O % Saturation	94.8	94.8	93.4	95.8	94.3	92.2	90.5	89.4	87.8	88.7	86.4	91.4

Since the mid-1980's an improvement can be seen in the statistics for BOD and Ammonia. These are the principal parameters to be affected if effluents deteriorate, yet they have improved.

Conversely values for Dissolved Oxygen had deteriorated until 1990/91, although they have improved in 1992. Concentrations of Dissolved Oxygen in the rivers, have been depressed by the drought and low flows, particularly in the upper reaches.

The values in Table 2.3 suggest that the apparent decline in compliance with River Quality Objectives up to 1991 was not caused directly by sewage treatment works (see also Part 4.2.5). The improved concentrations of Dissolved Oxygen, in 1992, are at least partly attributable to increased rainfall, higher freshwater flows and lower temperatures. This appears to be the one reason for the improvement in compliance. The continued reduction for Ammonia indicates that another reason is the improvements in the quality of discharges.

The changes for Dissolved Oxygen are illustrated in Figure 2.2. This shows the change at a site on the River Can, in Essex. For the three years up to 1992, the mean value for Dissolved Oxygen was 72%. The corresponding value since the beginning of 1992 has increased to 93%.

2.4 Statutory Water Quality Objectives

As described above we seek to protect and improve river quality using targets known as River Quality Objectives. The Water Act extended and strengthened this approach. National targets can be derived and underwritten by the Secretaries of State for the Environment and for Wales. When issued in this way the targets will be called Statutory Water Quality Objectives (SWQOs).

The Act sets out the two steps by which SWQOs will be introduced:

- first, the Secretaries of State set up ways of grading or classifying Controlled Waters according to water quality; and then,
- they use these Classes to define SWQOs for individual segments of Controlled Waters.

Our role in the NRA is to make recommendations on both these points and to use our powers and resources to achieve the targets. After wide-ranging consultation through most of 1991, the NRA submitted advice on Classification. The Government used this as the basis for its own scheme, which was issued, for consultation, in 1993.

The scheme applies initially to rivers and is based on the use of rivers as water supplies, fisheries, sites of recreation, and as environmental assets.

The Government foresees separate schemes of Classification for each of these Uses, concentrating, initially, on safeguarding the ecology of rivers, particularly fish. Each Use is given quality targets within a system of six Fisheries Ecosystem Classes. The best quality, Class 1 defines a water quality which should support high-class game and coarse fisheries.

FIGURE 2.2

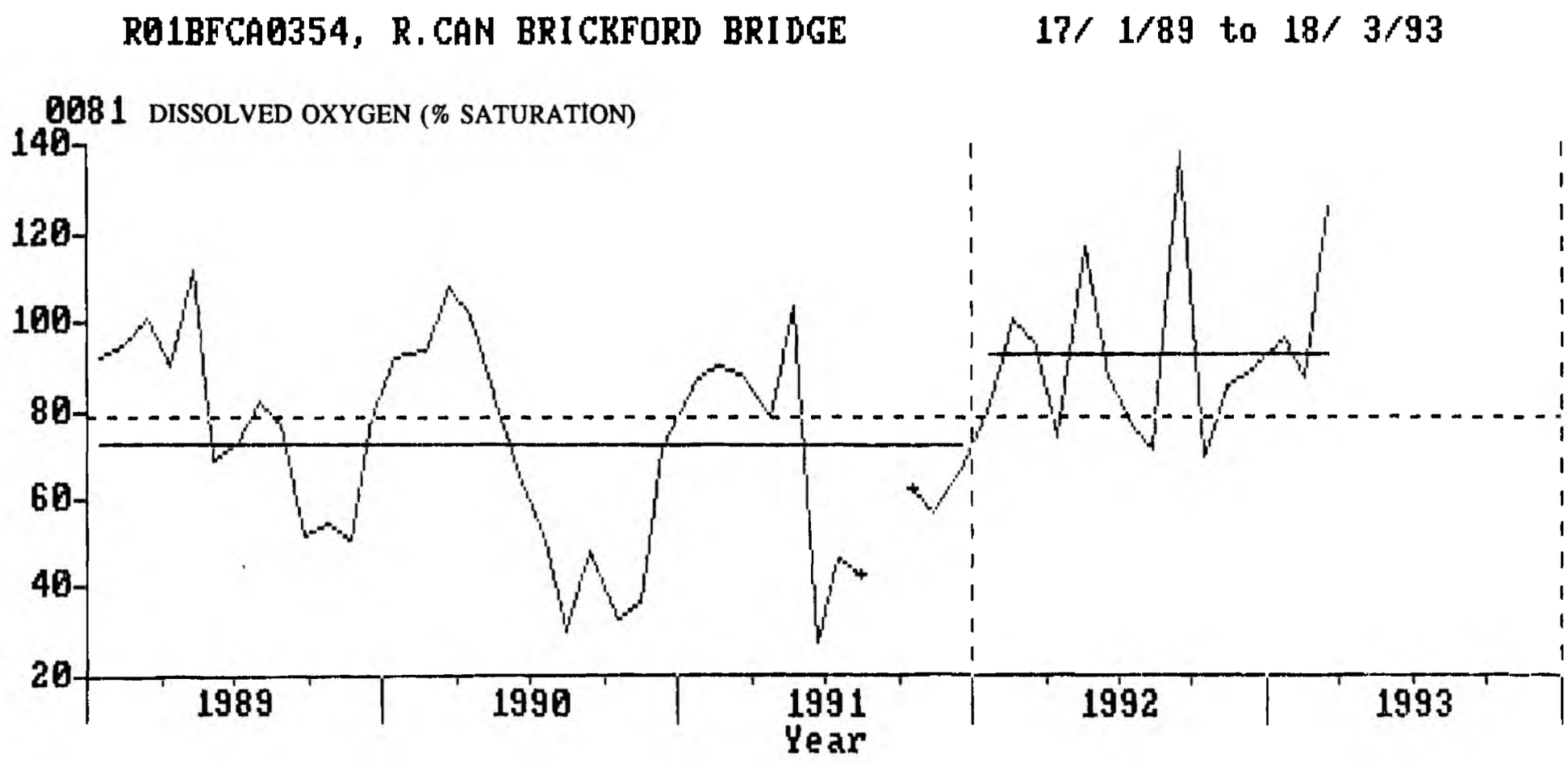
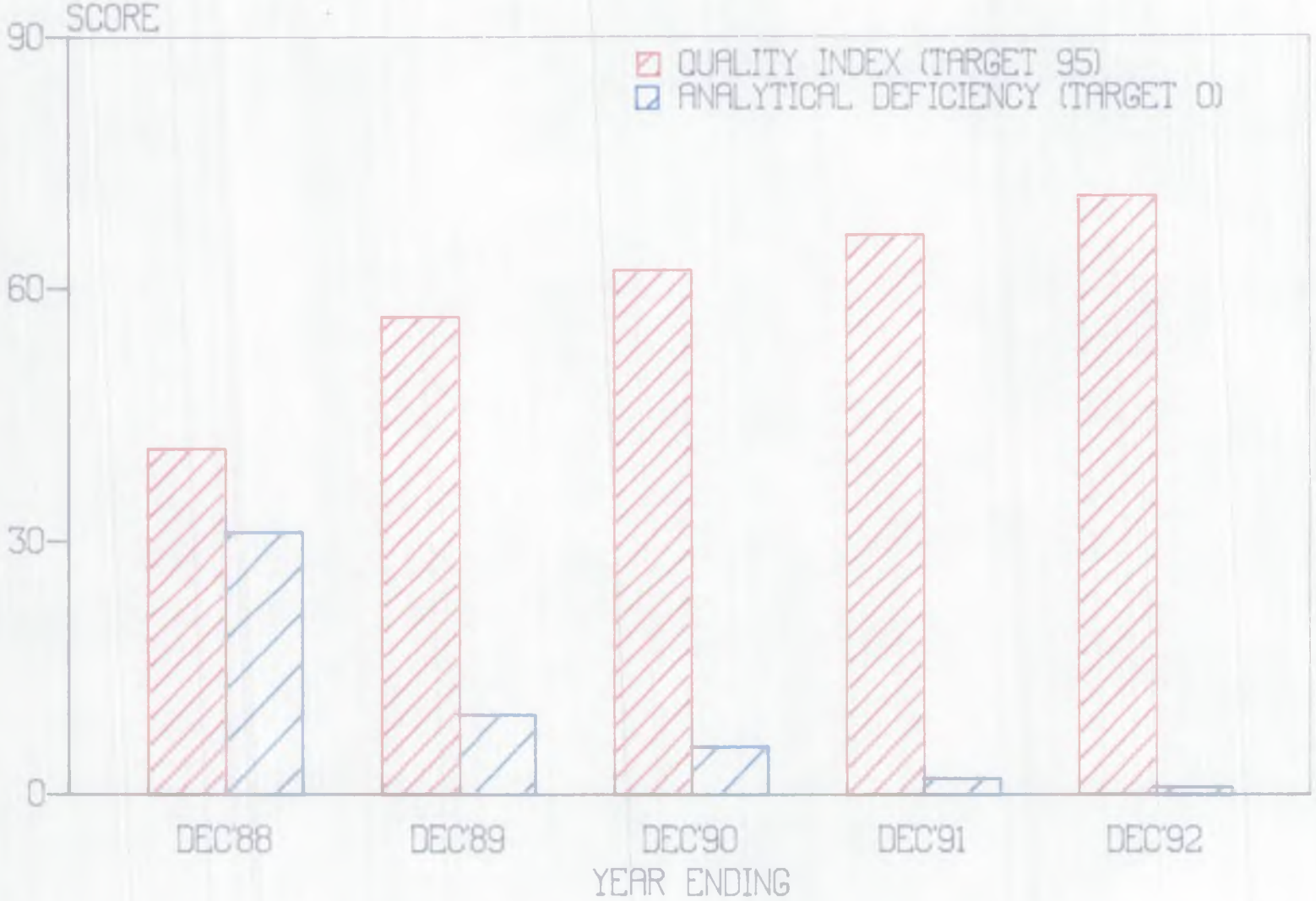

R01BFCA0354, R.CAN BRICKFORD BRIDGE
17/ 1/89 to 18/ 3/93
0081 DISSOLVED OXYGEN (% SATURATION)
140
120
100
80
60
40
20
1989
1990
1991
1992
1993
Year

FIGURE 2.3

REGIONAL RIVER QUALITY INDEX



Because formal targets for water quality have not been set in this way before in England and Wales, the NRA decided in consultation with the Government to commence the introduction of SWQOs in a series of "pilot" catchments. From Anglian Region, the Cam and the Gipping/Stour have been included on a list of candidates from which the Secretary of State will select the first batch. We have drafted proposed SWQOs for Fisheries Ecosystem for these catchments (see Part 1.5).

SWQOs for the other Uses described in the Government's consultation paper will follow the Government's timetable. Plans for water quality will be based on non-statutory standards in the meantime.

2.5 River Quality Indices

At many sites we need to assess compliance with the standards for over 70 different determinands (see Part 8). The management of this large and complex workload is aided by a system of River Quality Indices (RQIs).

The Index summarises water quality and measures performance in managing resources for environmental monitoring. Data are compressed into a simple number which discriminates between good and bad quality, thus reducing the effort needed to:

- maintain an awareness of water quality;
- set targets;
- identify areas of poor quality;
- direct resources to areas of poor quality; and,
- audit sampling and analytical resources

The Indices allow us to summarise information at a site, within a District or an Area, or over the whole Region. They are used by managers to direct resources to areas of concern and to ensure that the Sampling Programme covers all our obligations.

Figure 2.3 shows changes in the Regional RQI over the five years since December 1988. No allowance has been made for algal-BOD in these values (see Part 2.3).

A perfect result is a score of 100 for each river, District, Area and the Region. The target for the Region is to see the Index rise progressively towards 100. Figure 2.3 also shows improvements in our ability to achieve our sampling programme (in the reduction of scores for Analytical Deficiency).

2.6 Biological Monitoring

To provide a more complete picture of the health of rivers and to help measure the impact of any pollution not covered by the our measurements of chemical quality, we assess the biological quality. The assessment is based mainly on the monitoring of small animals which live on the bed of the river - the **benthic macroinvertebrates.** (Though we also assess the plant life).

These animals live in continuous contact with river water. If the water is polluted, even for only a few minutes, some or all may die. It may be several months before the community is restored fully. This means that biological data provide evidence of pollution which may have been missed by the routine spot-checks which form the

basis of most chemical monitoring.

Because some animals respond differently to different chemicals, the biological data may give a clue about the types of pollution to look for. A list of samples collected is given in Appendix I.

Because of a reduction from 3 to 2 samples collected per site for the National Biological Quality Survey (see Part 2.6.5), fewer invertebrate samples were taken in 1992 than in 1991 (Table 2.4).

TABLE 2.4

The Number of Biological Samples Taken

Year	1988	1989	1990	1991	1992
Number	1684	3400	7474	8899	7911

However, there was an increase of 20% in the number of samples taken for pollution incidents, and twice as many samples were taken for special surveys in 1992 compared with 1991.

2.6.1 Biological Quality

The biological quality of each sample is assessed using the scoring system devised by the Biological Monitoring Working Party. Families which are sensitive to pollution score more highly than those which tolerate pollution, and total scores range from 0 to over 150 as shown in Table 2.5:

TABLE 2.5

The BMWP Score System

BMWP Score	Quality
> 150	Excellent
101 - 150	Very Good
51 - 100	Good
26 - 50	Moderate
0 - 25	Poor

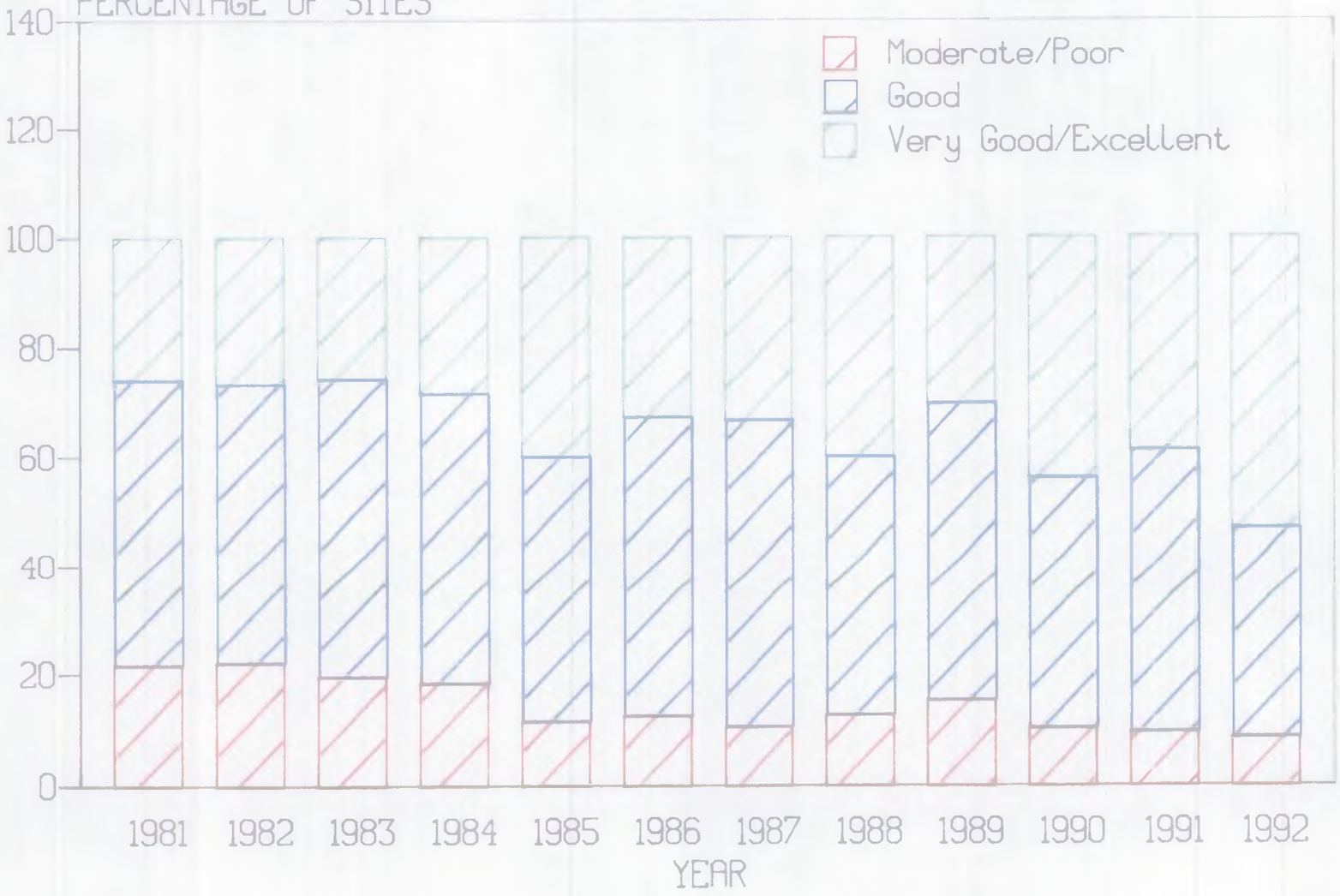
2.6.2 National Reporting Sites

Using the BMWP system, we have assessed biological quality for the past 13 years at approximately 240 sites. The results, given in Figure 2.4, show trends in biological quality.

These data indicate an improvement in quality since 1991. No sites fall into the lowest category, and the number in the top class is greater than in any previous year. This continues the general improvement since 1981.

FIGURE 2.4

BIOLOGICAL QUALITY OF RIVERS (BMWP SCORE)



2.6.3 RIVPACS

Rivers vary greatly in natural characteristics like size and water-flow and in the background climate, topography and geology. This means that the life found in rivers varies from river to river even when pollution is absent. This suggests that it is best to describe the biology in terms of a shortfall from that expected under conditions of natural water quality. Damage to the biota could be assessed by comparing the actual biology with the biology predicted for natural conditions of water quality.

The Department of the Environment funded the development of this idea using a mathematical model to predict the **biota** which should be found in a clean river. The model is called **RIVPACS**, an acronym for River Invertebrate Prediction and Classification System. RIVPACS was developed by the Institute of Freshwater Ecology.

The result was a method which could be used to predict the types of invertebrates which should be found under conditions of natural water quality. If the BMWP **predicted** by RIVPACS is higher than the **observed** value, the result suggest that some form of pollution has occurred.

2.6.4 National Biological Classification System

RIVPACS has been used to develop a national classification. For each site, the biological quality is placed in one of four Grades, A to D. Details are gived in a forthcoming national report.

2.6.5 Biological River Quality Survey

The results are shown in the map enclosed with this report. They are also summarised in Table 2.7, which shows that over 50% of the river length is in Band A, the best quality.

TABLE 2.7

The 1992 Biological Survey

	1990 Survey		1991 Survey		1992 Survey	
	km	%	km	%	km	%
Band A	2,983	51.6	3,212	52.8	3,049	50.5
Band B	1,917	33.2	1,954	32.1	1,960	32.5
Band C	696	12.1	782	12.8	841	13.9
Band D	178	3.1	139	2.3	189	3.1
Total	5,774		6,087		6,039	

Of 888 sites which were classified in both 1991 and 1992, 17 changed by 2 or more bands. This is considered to indicate an appreciable change in biological quality.

What caused these changes to occur?

Of the 10 sites which decreased in quality, some can be attributed to specific events. Part of the River Lark was re-classified from A to C because of liquid fertiliser pollution (see Part 2.9) and a stretch of the King's Beck dropped from A to C, due to dredging operations.

Of the 7 sites showing improvements, New Inn Brook and Haughley Watercourse were re-classified from D to B and from C to A, respectively, because of better water quality, following campaigns to reduce the risk of pollution from farms (see also Part 2.8).

At several other sites, deteriorations and recent improvements have been directly related to the drought and subsequent increased rainfall (see below).

2.6.6 Biological Quality and the Drought

Using the criterion of 2 or more changes in Band, results were assessed for quality changes, following increased rainfall in 1992. Data were examined from sites which had been sampled both during the spring or summer, and in the autumn (Figure 2.5). Quality generally improved, since the proportion of sites in bands A and B increased later in the year, while the percentage of sites in bands C and D decreased.

At many sites, poor biological quality was attributed simply to low flows which were restored after the heavy rain. This occurred on the Rivers Wensum, Mun and tributaries of the Rivers Ouse and Ouzel. Increased flow also diluted effluent inputs with a resulting improvement in biological quality, as seen on the River Bain, and in Abbotsley and Birchwood Brooks. Other sites in the Region, for example on the Rivers Nene and Welland, have improved because flood water flushed away silt and vegetation which had built up and clogged the channel.

During the drought, saline intrusion of the lower reaches of some watercourses resulted in communities becoming dominated by estuarine taxa. Increased freshwater flows diluted the saltwater, or pushed it downstream, resulting in improvements to the biological quality in a number of rivers, including Greyfleet Drain and North Level Main Drain.

2.7 Directives

The management of river water quality is affected by several Directives issued by the European Community Directives. They impose requirements to monitor and report. They also affect the Consenting of discharges and other measures for the control of water quality (see Part 4).

Some Directives have been in force for many years, the most important being:

- Dangerous Substances in Surface Waters;
- Dangerous Substances in Groundwater;
- Surface Water Abstracted for Drinking Water; and,
- Freshwater Fisheries.

FIGURE 2.5
PERCENT OF SITES IN EACH BAND

During the last few years, new Directives have been adopted and their requirements will come into force progressively:

- Urban Waste Water Treatment;
- Pollution of Waters by Nitrates from Agriculture; and,
- Freedom of Access to Information.

Several Directives apply both to fresh **and** to saline waters. For convenience, the detail on these Directives is described in this section. Directives which apply only to saline waters are described in Part 3.

Throughout the year, we check compliance with water quality and sampling requirements.

2.7.1 Dangerous Substances in Surface Waters

The Dangerous Substances Directive contains two lists of pollutants. List I includes materials which are particularly toxic, persistent, and which accumulate in the environment. List II covers pollutants with potentially less serious effects. The Directive's primary aim is to eliminate pollution from List I substances and to reduce pollution from List II substances.

2.7.1.1 List I Substances

Water quality standards have been set for mercury, cadmium, lindane, carbon tetrachloride, pentachlorophenol, DDT, the drins (dieldrin, aldrin, endrin and isodrin), hexachlorobenzene, hexachlorobutadiene, chloroform, trichloroethylene, trichlorobenzene, tetrachloroethylene, and 1,2 dichloroethane.

The Directive applies to discharges to both fresh and saline surface waters. We have to provide lists of important discharges, monitor the receiving waters, and report annually to the DoE (which then reports to the Commission). We have also to control all major discharges of Listed Substances, through the issue and review of Consents.

In addition to monitoring for List I substances at sites which may be affected by specific discharges (known as discharge-related sites), the DoE requires us to perform background monitoring at a set of National Network sites for all List I Substances. This is undertaken mainly at the tidal limits of major rivers.

At the discharge-related receiving water sites in 1992:

[a] There were no failures to meet the quality criteria in any of the 9 freshwater sites designated under the Mercury Directive, nor the 30 sites for the Cadmium Directive.

[b] One of the three freshwater sites monitored under the Lindane Directive failed the quality standard. The failed site is downstream of the premises of Calders and Grandidge, near Boston, which suffers from historic contamination by timber treatment chemicals.

We maintain close contact with the company, which is committing capital investment to tackle the problem. One boundary of the site has now been sealed. A treatment plant is being installed during 1993 to treat the collected

site drainage and greatly reduce concentrations entering the river. The company has applied for a consent to discharge effluent from the treatment plant. No problems have been detected downstream, in the Witham Haven.

[c] The single freshwater site designated for Carbon Tetrachloride passed the standard.

[d] There are no freshwater sites in this region designated for Pentachlorophenol or DDT.

[e] Under the Drins Directive, three freshwater discharge-related sites were monitored. One of these exceeded the criteria for Dieldrin, and for Total Drins. This site is located in the watercourse downstream of Calders and Grandidge where problems are being addressed as described in [b] above. There were no problems at sampling sites further downstream.

[f] The remaining substances in the Drins Directive are Hexachlorobenzene (HCB), Hexachlorobutadiene (HCBD) and Chloroform. No freshwater, discharge-related, sites were monitored for HCB, HCBD or Chloroform in 1992.

Environmental standards for the chlorinated solvents (trichloroethylene, trichlorobenzene, tetrachloroethylene, and 1,2 dichloroethane) came into force on 1st January 1993. The Commission will require the first monitoring data in 1994.

During 1992, the DoE issued the Surface Waters (Dangerous Substances) (Classification) Regulations. These incorporate into UK Law the Directive standards for the chlorinated solvents. The DoE issued a Direction to the NRA to monitor for these substances in inland and coastal waters.

We undertook monitoring during 1992 to identify whether there were any discharges of chlorinated solvent in our Region. No significant discharges were identified, apart from two already Consented for these substances. However, low concentrations of one, or more, of the chlorinated solvents were detected at some sites. We are continuing to monitor these discharges in 1993 to assess whether they need to be controlled for these substances.

2.7.1.2 List II Substances

During 1992 there were around 100 continuous discharges to freshwaters which contained appreciable quantities of List II substances, in Anglian. Monitoring of the receiving waters was undertaken as required and the following sites exceeded (or nearly exceeded) their national quality standards:

[a] The Willow Brook at Corby failed for zinc. A work programme has been agreed with the industrialist responsible for the discharge. A new treatment plant will be fully operational during 1993, and a new Consent will be issued upon completion of the control measures. Recent improvements have already been noted. Once the treatment plant is operational we shall monitor to establish whether there is also a problem of contaminated land at the site.

[b] The Whaddon Brook failed its standard for copper. It receives the discharge from Royston STW. Improvement in the Brook will rely on improvement of

the discharge. We are discussing measures to control trade effluents with Anglian Water Services, to reduce copper concentrations entering the works.

[c] The Hog Dyke was a borderline pass for copper. The river receives effluent from the sewage treatment works for Raunds. The source of the copper is being investigated with the help of Anglian Water's trade effluent inspectors. The Consent (see Part 4.2) for the works is being reviewed and it is likely that copper limit will be included.

2.7.2 Groundwater

This Directive protects groundwater against pollution caused by certain Dangerous Substances. It effectively prohibits the discharge of List I Substances to groundwaters and limits the discharge of List II Substances. The lists of Substances differ to some extent from those for discharges to surface waters. No annual reports have yet been requested by DoE for this Directive (but see Part 2.7.7).

During 1992, the NRA received a Direction from the DoE requiring that we classify substances into either List I or List II depending on their toxicity, persistence and bioaccumulation. The NRA has set up a national committee to review data on Substances and to place them on List I or List II. A national database of Substances and their classification will be set up, and made available for public examination.

At Community level, groundwater protection is moving up the agenda. The Council of Ministers issued a Resolution during 1992, asking the Commission to draw up an action programme by mid-1993, and to progress an amendment of the Groundwater Directive to incorporate it within a general policy for the management and protection of freshwaters.

These proposals would considerably extend Community legislation in this field, but the end result of this initiative will depend very much on how the principal of subsidiarity is interpreted by the Commission and Member States.

2.7.3 Surface Water

Under this Directive, surface water abstracted for public water supply has to comply with water quality standards which depend upon the type of water treatment provided. So far, the DoE has not asked us to report on this Directive (but see Part 2.7.7).

During 1992, we contributed to a national exercise to provide the DoE with information on abstraction points. This information will contribute to the designation of points for SWQOs under the Directive (see also Part 2.4).

2.7.4 Freshwater Fisheries

Water quality standards for the protection of game and coarse fisheries are specified under this Directive. In Anglian Region, 400 km of game fishery and 950 km coarse fishery have been designated.

We reported the results of the 1992 monitoring for this Directive to the DoE. A total of 348 km of game fishery and 803 km of coarse fishery complied with the Directive quality standards. There were a few exceedences of the standards, mainly for Dissolved Oxygen and pH. Failures for these two parameters can be attributed to low

river flows. Two stretches failed the standard for Total Ammonia. These failures were probably caused by effluent discharges.

2.7.5 Urban Waste Water Treatment

This Directive imposes requirements on sewerage systems and sewage treatment. It requires that specified standards are achieved for the effluents. The stringency of the requirements depends on the population served, and also on the type receiving waters. The Directive covers discharges to fresh and saline waters.

Nutrient removal will be required in cases where discharges are considered to contribute to eutrophication, or to elevated levels of nitrate in waters abstracted for drinking.

During 1992, we worked to progress the implementation of this Directive, although some interpretation and development is still needed.

2.7.5.1 Eutrophic Sensitive Areas

The DoE published a Consultation paper in 1992 setting out proposed criteria for deciding whether a water body should be designated as a Eutrophic Sensitive Area. The criteria are a mix of chemical parameters, such as Phosphate and Dissolved Oxygen, and biological parameters, such as the abundance and diversity of aquatic plants and invertebrates.

Using these we proposed a number of Candidate Sensitive Areas for possible designation by the Government. Following discussions, the DoE must identify and designate areas by the end of 1993.

2.7.5.2 Sensitive Areas for Nitrate

This applies to surface waters used for water supply. It is being implemented in tandem with the provisions of the Nitrate Directive (see Part 2.7.6).

2.7.5.3 Trade Discharges to Controlled Waters

Annex III allows for some discharges, generally associated with strong, organic effluents from the food and drinks industries, to be subject to some of the Directive's provisions. Our studies suggest that 20 discharges in Anglian Region will be affected.

2.7.6 Pollution of Waters by Nitrates from Agriculture

This Directive aims to protect surface and groundwaters from pollution by nitrates from agriculture. The requirements come into force over the next few years.

Member States must identify Polluted Waters. These can be surface waters with elevated nitrate which are abstracted for drinking water, or groundwaters with high nitrate, or waters which are eutrophic because of nitrate.

During 1992, the NRA undertook the monitoring required for this procedure in accordance with a Direction from the Secretary of State. Monitoring will be required to allow a review of the affected waters every four years.

Once the Polluted Waters have been identified, Vulnerable Zones will be designated. These are areas of land draining to the affected waters. During 1992 we carried out studies of surface waters to determine the size of Polluted Waters upstream of points of abstractions which have high nitrate. The are being used by the DoE to decide the final method for sizing Polluted Waters.

In addition, we have carried out work to identify groundwaters which have high nitrate and the catchments (Vulnerable Zones) draining to them. In the UK, groundwater Vulnerable Zones are likely to be based around boreholes which are used for Public Water Supply. We have used of data from Water Companies. This aspect of the Directive is being linked to the implementation of the Groundwater Protection Policy (see Part 2.11.2).

Action programmes, including mandatory restrictions on agriculture, must be established and implemented within six years of designating the Vulnerable Zones. A voluntary Code of Good Agricultural Practice is being introduced with the aim of achieving a general level of protection from nitrate pollution.

2.7.8 Freedom of Access to Information

The aim is to ensure freedom of access to information on all environmental matters, held by public bodies. It sets out the basic terms and conditions on which such information should be made available.

The Government introduced the Environmental Information Regulations (1992), which incorporate the provisions of the Directive into UK law. These Regulations, and the accompanying DoE Guidance Note, give instructions and advice on who is affected by the Directive, the scope of information that has to be made available, instances when requests for information may be refused, and the right of appeal against this.

This right of access to information will be much used by the Public, Pressure Groups and businesses. The Directive and Regulations effectively codify current practice of the NRA which has always sought to make available as much information as possible available.

2.7.9 Proposed Directives

The following are proposed:

- Ecological Quality of Surface Water;
- Landfill of Waste;
- Hazardous Waste;

There is also a proposed Directive which will amend the Pesticides Authorization Directive, which would establish uniform principles for Member States when considering whether or not to authorise a pesticide product. It is likely that this new Directive (the "Uniform Principles" Directive) will include provisions designed to ensure that significant quantities of an authorised pesticide do not appear in the aquatic environment.

Progress on these Directives will depend mainly upon the political will of the Member State holding the presidency of the Commission, and how the principle of subsidiarity is interpreted by the Commission and Member States.

2.8 Pollution Prevention

During 1992, the Region made important progress in the field of pollution prevention, largely associated with the identification of staff responsibilities specific to this role.

We have initiated special site visits for the purposes of pollution prevention. These cover industrial and agricultural premises and aim to identify any illegal discharges. They also assess the risk of potential sources of pollution. Site owners are required to rectify illegal discharges. They are also advised of the measures which can be taken to reduce the potential to cause pollution, both from everyday activities and in emergencies.

Staff have carried out site visits associated with the Farm and Conservation Grant Scheme. This allows farmers to reclaim up to 50% of the cost of improving dirty water systems provided that the NRA approves their actions. Evidence of the effectiveness of this work comes from a decrease of 50% in some Districts in the incidence of pollutions from farms.

Information gathered during site visits is entered to a database. This helps us check how remedial measures are being progressed and shows the high risk sites which exist in a particular areas. The database is being developed nationally.

A further example of improvements through pollution prevention, comes from the Padholme Drain near Peterborough. This had been affected by a number of discharges for many years. Contaminated sediments have been removed and restoration of the watercourse has been carried out. Conservation sites at the Padholme Reservoir and the Flag Fen Bronze Age site have been improved. Pollution prevention equipment has been installed at key sites to reduce risks and contaminated land has been removed. This project, which is funded by industry, highlights the need for environmental regulators, conservation groups and industrialists to work together.

In conjunction with other Regions, another key aspect of pollution prevention work, the production of a series of NRA Pollution Prevention Guidelines, was initiated in 1992. The series covers such topics as Avoidance of Pollution from Oil Storage Facilities and Sewage Disposal in Areas without Mains Drainage. It provides a valuable source of information to help people prevent pollution.

The NRA is a statutory consultee in the process leading to the granting of waste disposal site licences. The NRA must ensure that the quality of Controlled Waters is protected when licences are granted. The Groundwater Protection Policy provides guidance to developers and the operators of landfill sites on the precautions which should be taken to avoid pollution. Operators of landfill sites will be required by the NRA to monitor their activity to demonstrate that their site causes no pollution.

2.9 Pollution Incidents

Formal records of reported pollution incidents began in 1974 and, since 1991, they have been held on a computer-based system called **POLLEASE**. This enables field staff to enter details onto computers as they carry out their investigations. At regular intervals details are copied to a Regional Headquarters database to enable regional statistics to be compiled.

FIGURE 2.6

NUMBERS OF POLLUTION INCIDENTS

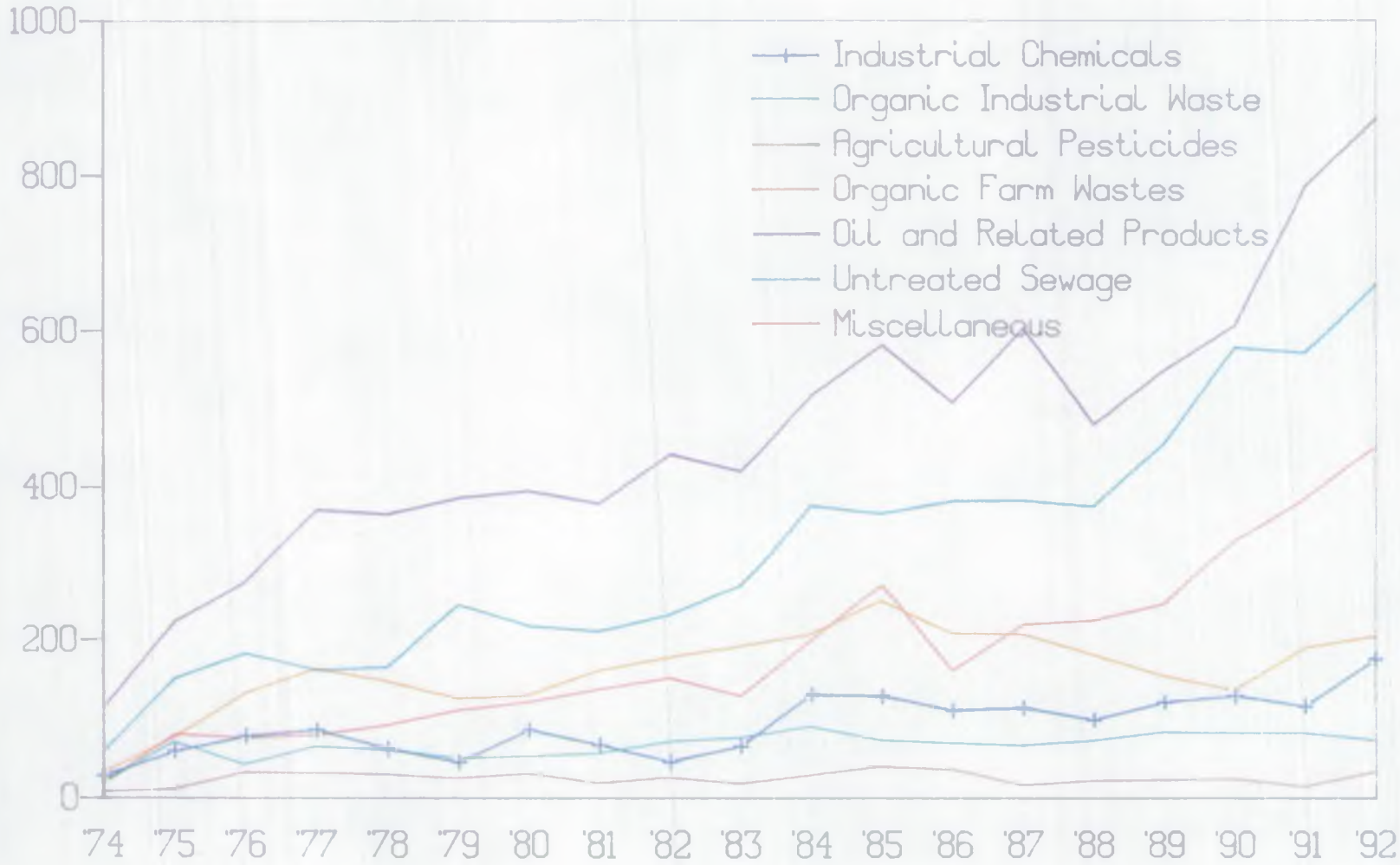
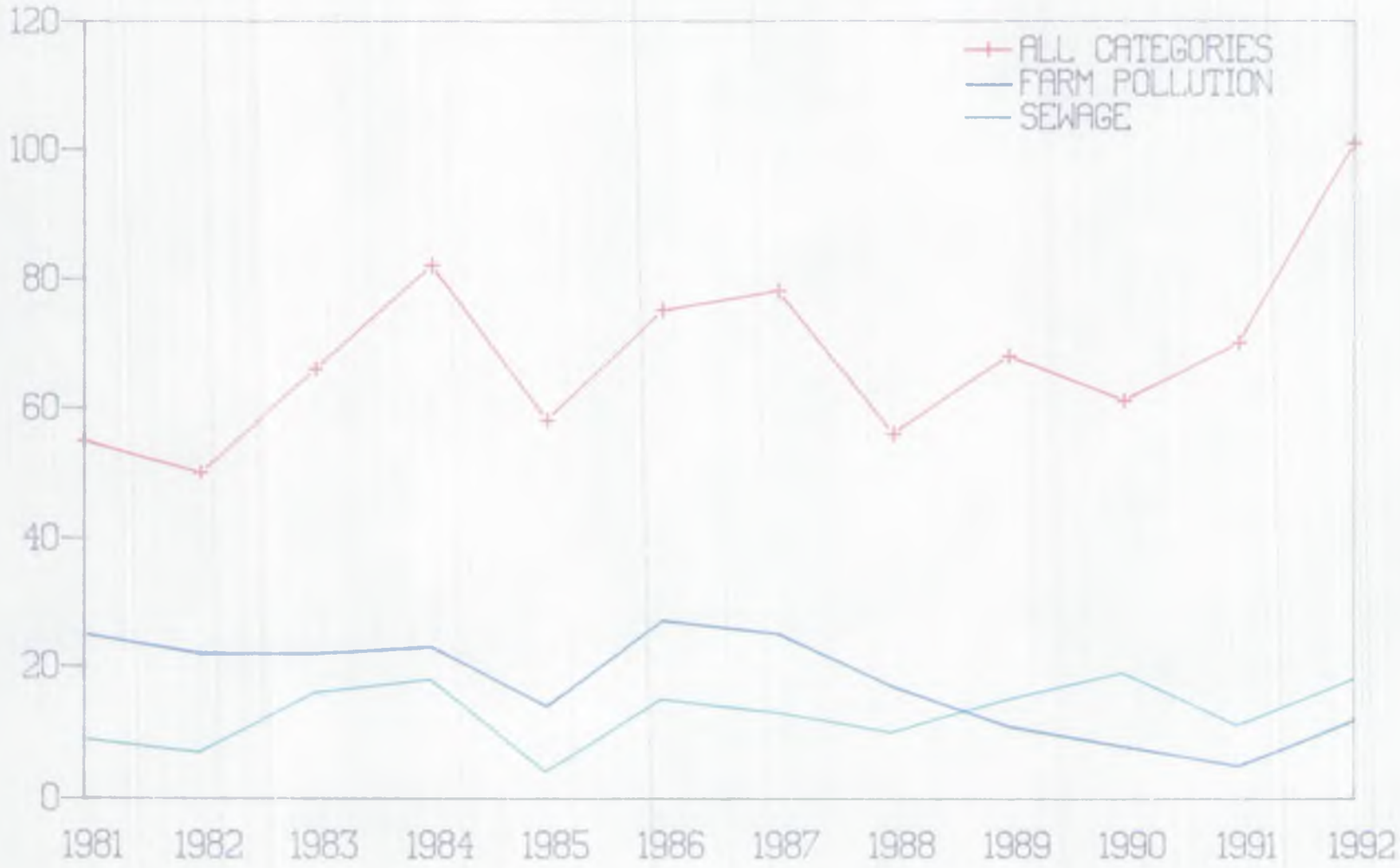


FIGURE 2.7

NUMBER OF POLLUTION INCIDENTS RESULTING IN FISH MORTALITIES



Upon investigation, a proportion of the reported incidents turn out to be due to factors other than pollution (temperature-induced changes in river conditions, for example). Therefore, incidents are categorised into "substantiated" and "no pollution". Substantiated incidents are split further into 3 groups according to their severity: Category 1 (major), Category 2 (significant) and Category 3 (minor).

During 1992, our staff dealt with 3,369 pollution incidents. This is an increase of 12% over 1991.

The number substantiated was 2,462 (73%). (All subsequent reference to incidents, in this Section, refer to **substantiated incidents**). Figure 2.6 shows the number of pollutions reported annually since 1974. Overall, only 18 (0.7%) were classified as Category 1 (see Table 2.8), compared to 11 in 1991.

Table 2.8

Category One Pollution Incidents in 1992

Industrial Chemicals	5
Agricultural pesticides and fertilizers	2
Organic farm waste	1
Oil and related products	3
Untreated sewage	1
Miscellaneous	6
Total	18

Most incidents, were due to releases or spillages of oil and related products (35%), an increase of 11% compared with 1991. These were principally Category 2 incidents.

The only decrease to report was in pollutions due to releases of organic industrial waste, falling from 82 in 1991, to 72 in 1992.

Some of the most important pollution incidents during the year are described here:

- During March, liquid fertiliser contaminated the River Lark at Hawstead. Over 5,000 fish were killed and damming, pumping and liming were necessary in order to contain the pollutant. Prosecution was not instituted as vandalism was claimed. A civil claim is being considered.

- Chemicals were washed into the Colne Tributary at Ridgewell, in April. They affected 1/2 mile of the watercourse downstream. The watercourse had to be dammed and the water pumped out. Following a successful prosecution, a fine of £4,500 was imposed, with £814.35 costs.

- Also in April, effluent from a cattle yard contaminated Salmonby Beck and the River Lymn resulting in high ammonia concentrations and sewage fungus growth which severely affected invertebrate life. Soil was used to seal off the point of contamination. Following a successful prosecution, a fine of £7,500

was imposed, with £894.32 costs.

- Starting in late June, a major fish mortality occurred in the Tidal Nene as a result of poor water quality, over 80,000 eels were lost. The issue of improving water quality in the tidal Nene will be addressed as part of the Lower Nene Catchment Management Plan. Many improvement programmes have already commenced.

- In November, 10,000 fish died after a toxic discharge from a surface water sewer at Thrapston to a tributary of the Nene. The source and nature of the pollutant could not be determined, although chlorine was suspected. As a result no prosecution was possible.

- About 40 tons of liquid nitrogen fertilizer were lost from a farm bulk storage tank, to tributary of Wissey at Bardenham, during November. A water treatment works intake was closed, and dams, lime-dosing and aeration were used to treat the spillage. About 1,000 fish were rescued, but 500 were killed. A prosecution is being considered.

- Following a fire at a chemical factory in December, the Essex Water Company closed their intake at Stanway on the Roman River because the resultant run-off contained an industrial chemical (polymer resin) which polluted the watercourse. The contaminated water was pumped over adjacent land. Prosecution was not appropriate as blame could not be apportioned.

Figure 2.7 gives a breakdown of incidents resulting in fish mortalities. The total number has increased compared with 1991. This increase is due to pollutants such as industrial wastes, solid wastes and industrial chemicals. Farm or sewage pollutions have not contributed to the rise.

Better legislative powers and our growing effectiveness at pollution prevention will reduce the number and impact of incidents. However, any decrease in the number of incidents will continue to be offset as public awareness continues to grow. We may therefore see greater numbers of less serious incidents being reported.

The drought affected incidents in a number of ways. Low flows meant that less river water was available to dilute and disperse pollutants. Also, sudden heavy rain following long dry periods, flushed out stagnant drainage systems, initially reducing the quality of receiving waters. Conversely, heavy autumn rainfall flushed out those rivers that had suffered from saline ingress, in particular the South Forty Foot and Hobhole Drains where significant fish mortalities had occurred earlier in the year.

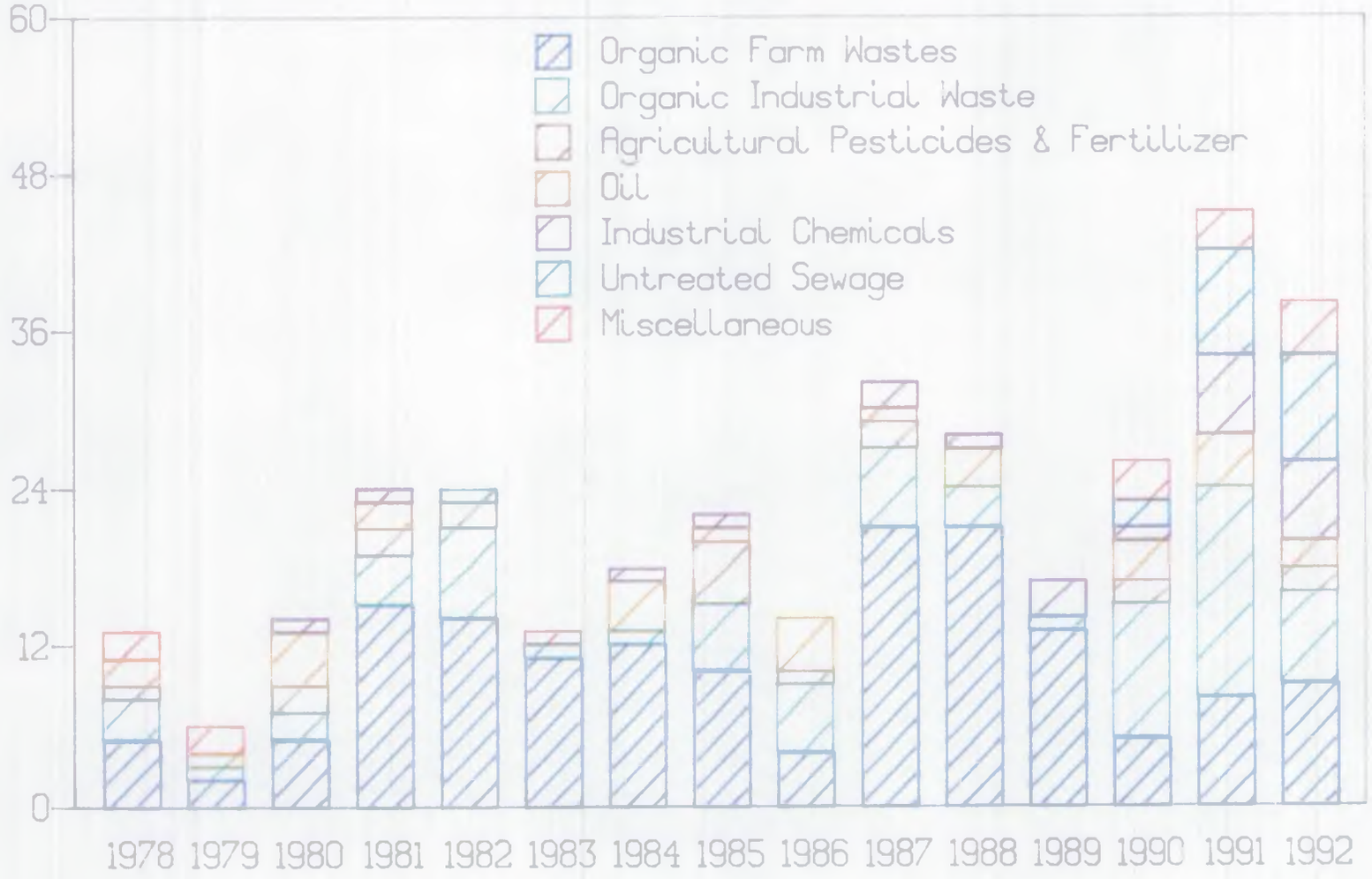
2.10 Prosecutions for Pollution

It is an offence to "cause or knowingly permit any poisonous, noxious or polluting matter or any solid waste matter to enter any controlled waters". Prosecutions are normally brought only where serious pollution has occurred, or some negligence or deliberate act was involved, and where sufficient evidence can be accumulated to mount a successful case.

This means that the number of prosecutions is a small fraction of the total number of pollution incidents, and some prosecutions are not brought to court until the following

FIGURE 2.8

NUMBERS OF PROSECUTIONS FOR POLLUTION INCIDENTS



year. The cases brought to court in 1992 are listed at Appendix II and trends in the prosecutions over the last 15 years are shown in Figure 2.8. In 1992 37 prosecutions were undertaken, 8 fewer than in 1991.

In addition to prosecutions, the NRA is able to issue Formal Cautions, which are issued for pollution incidents where it is inappropriate to prosecute but it is clear that an offence has been committed. Such a caution, whilst not leading to court action, does require the alleged offender to acknowledge guilt. The NRA has adopted guidelines followed by the Crown Prosecution Service and we are now more actively pursuing the use of Formal Cautions. This is reflected in the number of prosecutions undertaken and the increase in Formal Cautions from 3 in 1991 to 18 in 1992 (see Appendix III).

Biological data were used to support a number of cases.

2.11 Groundwater

Half of the public supply of drinking water in the region is taken from groundwaters. These are generally of high quality, and in most cases require treatment only by disinfection. In addition to the larger Public Supply boreholes, there are thousands of groundwater abstractions for agricultural and industrial water supplies and many wells are used for private supplies of drinking water.

2.11.1 Monitoring

Currently, we routinely monitor 700 points. Analytical suites range from simple tests, to complex lists including metals, pesticides and microbes (see Part 8). Many of the major boreholes in the Region are owned by Water Companies, and we regularly obtain their data, to supplement our own.

National guidelines have been drawn up for monitoring groundwaters. The Region is developing a strategy based on the national guidelines which when formulated will be used to define the NRA Monitoring Network.

During 1992 we began to develop a computer system to improve how we assess compliance with standards.

2.11.2 Protection

Protecting the quality of groundwaters is important because groundwater pollution is very difficult to remedy once it has occurred. By launching the 'Policy and Practice for the Protection of Groundwater' in December 1992, the NRA established a technical framework protecting groundwater quality and quantity. This framework is used for our duties under the Water Resources Act 1991 and to influence others, for example, in response to consultations in local authority planning processes.

We have written a Regional Appendix to this Policy. This gives a Regional perspective of the importance of groundwaters, geological classification of strata, NRA contacts, and an explanation of how the transition from the old Anglian Region Aquifer Protection Policy to the new national Policy is being carried out.

Our strategy for groundwater protection is based on 2 approaches:

i) **Resource Protection**. This is for potential or future abstractions. It uses Groundwater Vulnerability Maps which classify strata into Major, Minor, and Non-Aquifer. Major Aquifers are further classified as high, intermediate, or low vulnerability;

ii) **Source Protection** around boreholes, wells and springs currently used for water supply. Three Source Protection Zones, Zone I (Inner), Zone II (Outer), and Zone III (Source Catchment), may be defined around sources.

Activities which pose a threat to groundwaters are grouped together, forming eight policy statements on:

A. Control of abstractions;
B. Physical disturbance of aquifers and groundwater flow;
C. Waste disposal to land;
D. Contaminated land;
E. Disposal of liquid effluents, sludges and slurries to land;
F. Discharges to underground strata;
G. Diffuse pollution of groundwater;
H. Additional activities which pose a threat to groundwater quality.

The acceptability of these activities to the NRA is governed by the location of the activity and any appropriate Source Protection Zones.

Through the Waste Disposal site licensing Authorities (County Councils), we continue to increase the pressure on site operators to prevent leachate reaching Controlled Waters. Containment and extraction systems for managing leachate at new and proposed landfill sites are being stipulated by NRA.

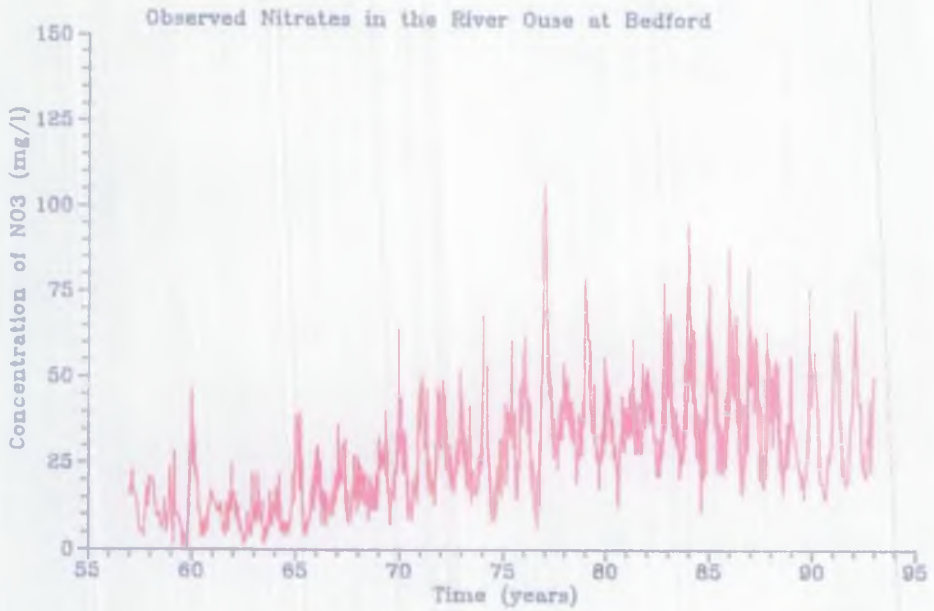
Our staff are working closely with County Councils to investigate and improve the situations around a number of contaminated sources. We are investigating a number of boreholes, at Mildenhall, Honington, Baldock, Bury St Edmunds, Letchworth, Thetford, and Cambridge for example.

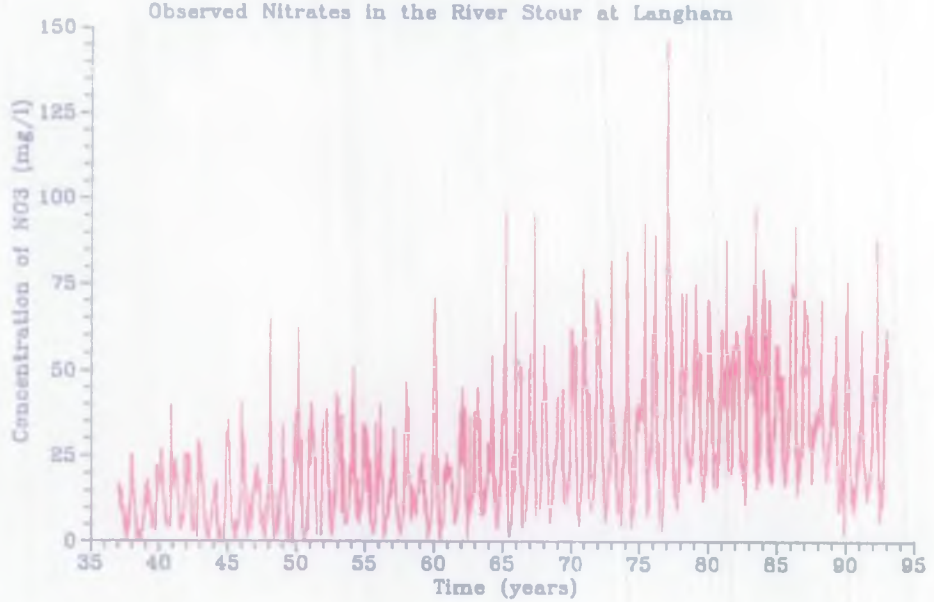
We are also liaising with Glanford Borough Council who are conducting a scheme to reclaim contaminated land on the former Britag site in Barton on Humber. When the reclamation scheme has been completed it is anticipated that potential for the underlying chalk aquifer and the adjacent River Humber to become polluted will be substantially reduced.

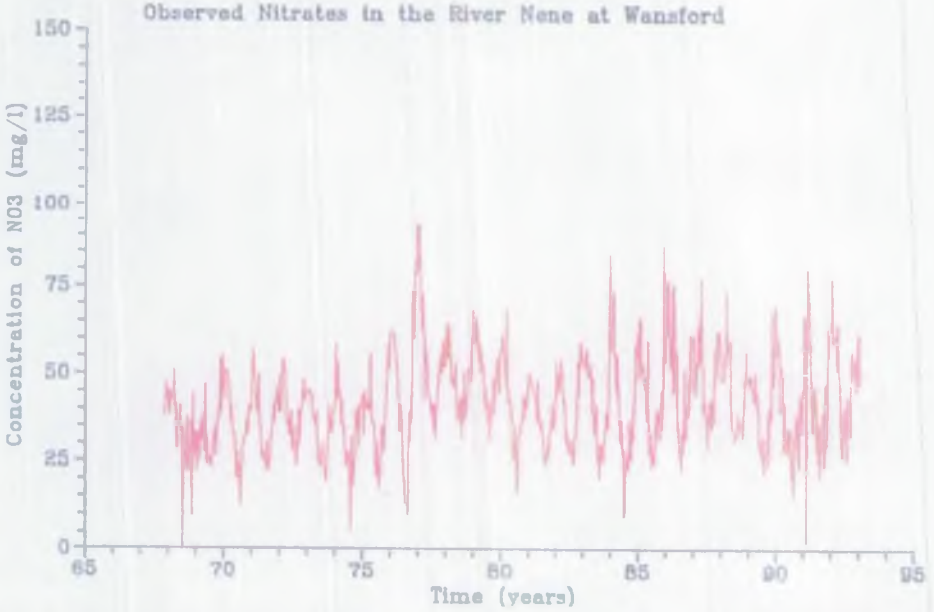
Further investigations of polluted groundwater around a public water supply borehole at Etton, near Peterborough have been carried out. A herbicide has been traced back to a series of landfill sites which lie to the south-west of the borehole. Although the pollutant is adequately removed from the groundwater at the site of the borehole using Granular Activated Carbon, we are evaluating the feasibility of options to prevent further pollution occurring, and to clean up the existing contamination.

Work is continuing on the pollution of groundwater at Sawston by chlorinated solvents. Cambridge Water Company's appeal against losing their civil action against those responsible was upheld. The party responsible for the pollution have appealed against this. The case is to be considered at the House of Lords.

FIGURE 2.9


Observed Nitrates in the River Ouse at Bedford
Concentration of NO3 (mg/l)
Time (years)


Observed Nitrates in the River Stour at Langham
Concentration of NO3 (mg/l)
Time (years)


Observed Nitrates in the River Nene at Wansford
Concentration of NO3 (mg/l)
Time (years)

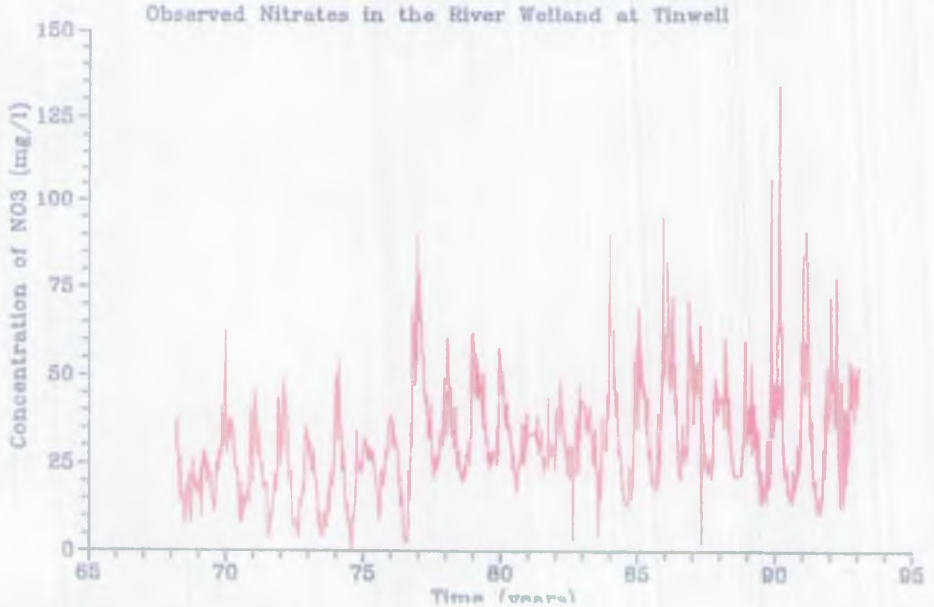
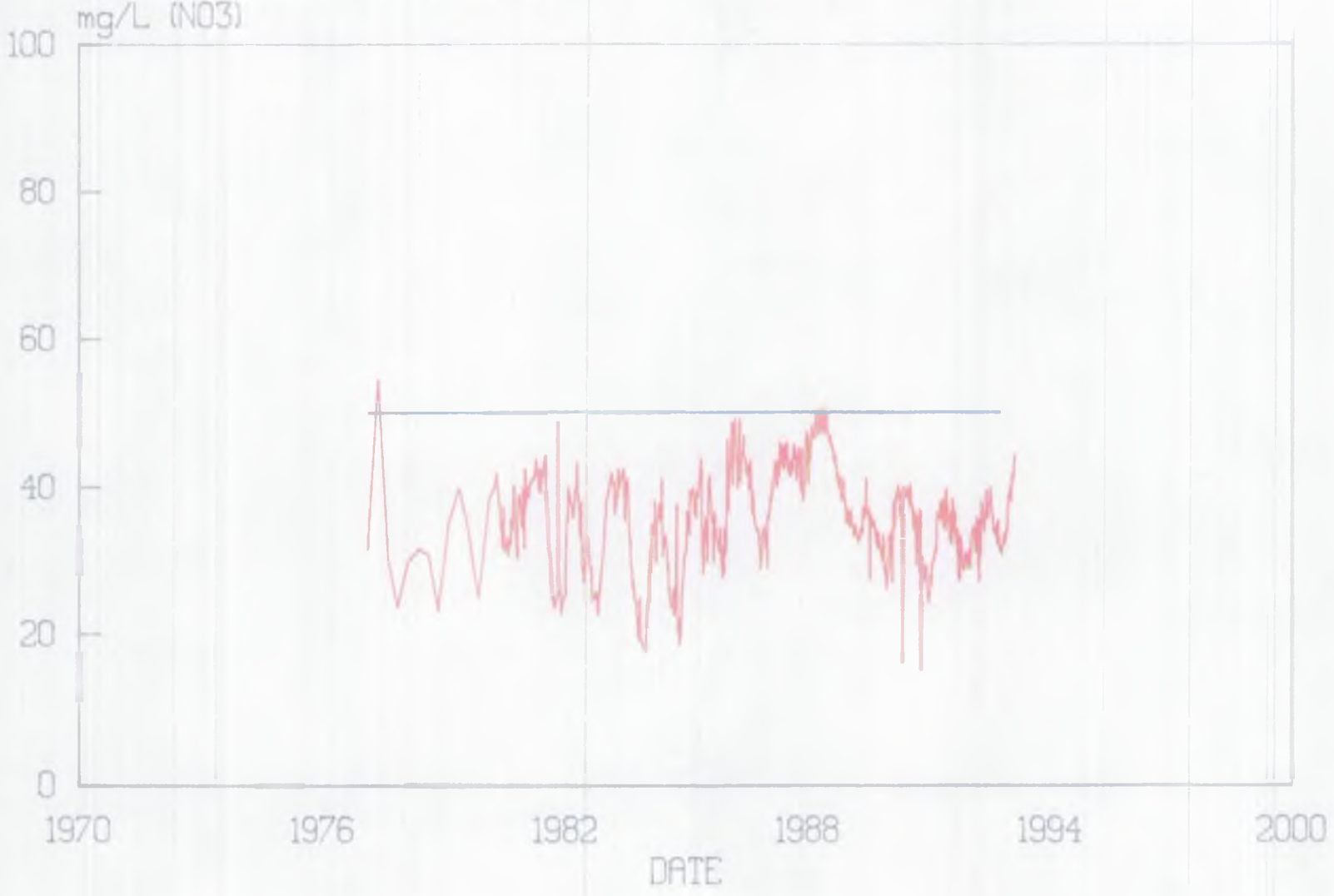

Observed Nitrates in the River Welland at Tinwell
Concentration of NO3 (mg/l)

FIGURE 2.10
BRANSTON BOOTHS - NITRATE CONCENTRATION



2.12 Nitrate

2.12.1 Nitrate in Rivers

Figure 2.9 illustrates the variability of nitrates with site and season, showing trends at four major surface water abstraction sites in the region. It suggests that since 1976, the upward trend appears to have levelled off.

2.12.2 Nitrate Sensitive Areas

The Water Resources Act allows for the designation of Nitrate Sensitive Areas (NSAs) in which it is desirable to reduce the leaching of nitrate to ground and surface waters. In 1990, following notification by the NRA of Candidate Areas and following consultations with farmers, the Ministry of Agriculture, Fisheries and Food (MAFF) established 10 NSAs of which 2 are in Anglian Region. These are at Sleaford and Branston Booths, near Lincoln. Nine further areas were identified as Nitrate Advisory Areas (NAAs), of which 5 are in the Anglian Region.

The scheme aims to reduce nitrate leaching by encouraging changes to farming practise. It is voluntary and runs for five years from 1990. Farmers are given small compensatory payments for the relatively modest land-use changes in the "basic scheme". Larger payments are given for major changes, in the "premium scheme". Virtually 100% of land in the Branston and Sleaford NSAs is included in the "basic scheme". In addition, 13% and 33% respectively is also in the "premium scheme".

In conjunction with the Water Companies (whose boreholes are being protected by the NSAs and NAAs), we are monitoring nitrate concentrations within the NSAs and at the abstraction boreholes. Results of this monitoring are sent to DoE and, through MAFF, to the farmers involved. An example is given in Figure 2.10. This also shows the limit in nitrate defined in the Drinking Water Directive.

The reduction in nitrate since 1988 is believed to be due to the effects of the drought with very dry winters in 1990 and 1991 causing less nitrate to be leached from the soil. Heavy rain in the late summer and autumn of 1992 has resulted in the first "normal" year of the NSA pilot scheme with high rates of autumn leaching of nitrate. Preliminary results, given in Figure 2.10, indicate that nitrate concentrations are still peaking at pre-NSA levels. The situation is extremely complex, however, and it is too early to say if the NSA measures will have a detectable effect.

2.13 Blue-Green Algae and Eutrophication

Since the problems experienced at Rutland Water in 1989, Blue-green Algae have continued to be an issue across the Region. The Toxic Algae Task Group, based in Anglian Region, was set up in 1989 to assess the incidence of toxic blue-green algae and to make recommendations for monitoring and control measures. The Task Group recommended a change from "routine" to "reactive" monitoring for 1991 and beyond.

Under the "reactive" sampling strategy, waters that were not sampled, or did not contain significant populations of blue-green algae, during the "routine" monitoring programmes of 1989 and 1990, were sampled as a result of public enquiries. This reduced the repetitiveness of the previous extensive routine monitoring programmes and allowed resources to be diverted into developing methods and recommendations

for resolving problems. The 1991 sampling programme was effective and so the Task Group decided to adopt it on an annual basis.

In the Anglian Region 43 waters were sampled for the first time on a reactive basis during 1992. Of these 43 waters, 21 (49%) contained populations of potentially toxic species at levels sufficiently high to warn owners that blooms of blue-green algae could occur (the "warning" level), and 24 (56%) contained blue-green algal blooms and/or scums. In addition, a number of waters which were sampled in previous years were also sampled on a reactive basis in 1992. Twenty such waters were sampled, with 11 (55%) exceeding the "warning" level and 14 (70%) containing blooms and/or scums.

There is now a greater public awareness of the issue and it is becoming accepted as a natural phenomenon which has the potential to occur each year. The weather conditions did not give rise to as many incidents worthy of media attention as in previous years. However, detailed records of the occurrence of blue-green algal problems and the events of toxicity are maintained.

The Task Group is currently coordinating work on the development and implementation of Action Plans. There is no universal solution, and action plans aim to provide the best option for control in an individual water body. The first stage is to identify and prioritise the waters which have a problem. A computer package called "PacGap" (Prediction of Algal Community Growth and Production) is then used to identify the options available for control (see also 7.1). The options are assessed in relation to their effectiveness, the practicality of implementation, their cost and their environmental impact. The most appropriate option can then be selected and, following consultation, implemented.

Anglian Water Services has continued, directly and indirectly, to dose a number of reservoirs with ferric sulphate. This reduces phosphorus and we have monitored the effects at Covenham Reservoir, Grafham Water, Pitsford Reservoir and Rutland Water.

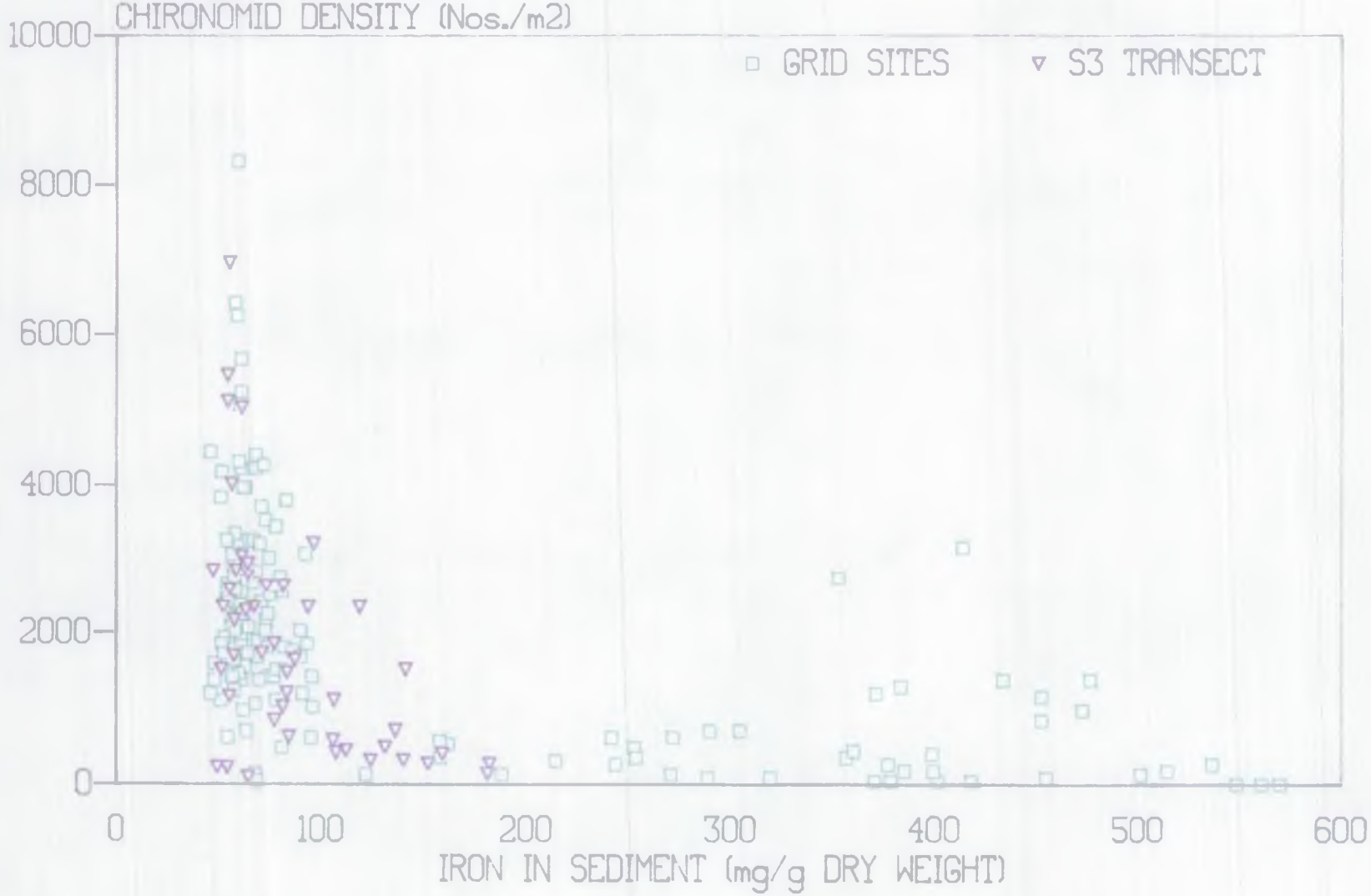
The results have indicated that dosing has damaged the invertebrate communities near the discharge point in some reservoirs. The damage is probably due to a combination toxicity, as well as a physical blanketing of the sediments. Observations shown in Figure 2.11 demonstrate that above approximately 90 to 100 mg Iron per gramme dry weight there was a lowered density of chironomid numbers. From these results, we have derived a suggested sediment standard of 100 mg iron per gramme dry weight of sediment. This forms part of the proposed national guidelines for controlling ferric dosing.

In addition to these studies, we are continuing with several research projects on eutrophication control, including water quality aspects related to eutrophication at Rutland Water, and a eutrophication control study to quantify the changes to the biology, fisheries and water quality, of the River Nar, a riverine SSSI.

Another project involves the identification and extent of rivers containing moderately low levels of nutrients. Such **mesotrophic** rivers are uncommon in the Region. The study will help to identify animals and plants that are typical of such systems, and facilitate the development of protocols for monitoring eutrophication control.

FIGURE 2.11
RUTLAND WATER - IRON IN SEDIMENTS vs CHIRONOMID DENSITY

DECEMBER 1991 TO SEPTEMBER 1992



2.14 The Norfolk Broads

The Broads are one of the most eutrophic freshwater areas in the UK. This means that they suffer from algal blooms and contain an impoverished invertebrate and fish fauna because of the loss of aquatic plants. Since its inception in 1989, the NRA has investigated ways to aid the improvement of this internationally important wetland. We have demonstrated the need for an integrated strategy linking water quality, water quantity and fisheries into a combined programme of restoration.

Essential to this work is the reduction of phosphorus input to the system. This is now underway with the introduction of phosphorus limits on 7 sewage treatment works which discharge to the Broads' catchment. Limits have been set to reflect the lowest loads that each works can achieve with existing plant, and negotiations are underway to set a timescale for achieving tighter limits that will enable the implementation of other restoration measures.

Throughout our work on the Broads, we have worked closely with other agencies, particularly the Broads Authority, to enable laboratory and pilot field experiments to be developed into full scale trials. The success of this work has resulted in the award of a 50% EC grant, jointly to the NRA and the Broads Authority, under the LIFE programme, to continue to develop and explore innovative techniques in lake restoration.

This is a 3-year programme, funded by NRA R&D, English Nature, the Broads Authority and the Soap & Detergent Industry. It will investigate three main issues:

- the control of the input of phosphorus from the lake sediment by mud pumping or the use of very low iron salt dosing direct to the sediment;
- the use of biomanipulation to create clear water, by encouraging grazing zooplankton (water fleas), to overcome the inherent stability of these shallow lakes following the control of phosphorus input from the catchment; and,
- the re-establishment of aquatic vegetation and an appropriate fish community.

The development of a restoration strategy for the Broads is a major aim for both the NRA and the Broads Authority, and the results from this and previous work will provide a model for the restoration of shallow eutrophic lakes elsewhere in the UK. A guide to lake managers will be one of the outputs from the research.

In addition, the knowledge gained will help formulate the Broads Authority's draft plan for the Broads, 'No Easy Answers'. This contains policy statements prepared jointlt with NRA, and these will be reflected in our Catchment Management Plan for the Yare.

2.15 Pesticides

Pesticides are used to control a great range of micro-organisms, weeds and insects. Because of this, and the increasingly-accurate analytical techniques available, many pesticides are now being detected, widely, in low concentrations in surface and groundwaters. Although such quantities are not known to be harmful to humans or aquatic life, every effort must be made to prevent further contamination.

During 1992 we analysed samples for 92 different pesticides and over 16,000 results were obtained.

We are producing an NRA strategy for pesticides which will include a number of recommendations to help minimise the risk from pesticides. Our main approach is to maintain an ongoing commitment to promoting the correct way of storing, using and disposing of pesticides (Best Practice), through discussions with industry, government and at agricultural shows. We are continuing to ensure farmers and other users are aware that it only takes a very small quantity of pesticide to contaminate watercourses, and that by implementing Best Practice many small scale pollutions can be prevented.

During the year no major pollution incidents resulted from pesticides. We hope that this is a sign that the message of "Best Practice" is getting across to pesticide users..

We have provided data to MAFF for pesticide reviews. These are carried out when further information is needed on an already approved pesticide, either to upgrade data or to investigate any adverse effects which may be associated with the pesticide. The result of one review was that non-agricultural use of the herbicides Atrazine and Simazine was banned from August 1993, following increasing detection of their presence in surface and groundwaters. Alternative pesticides will be used by Local Authorities and others, and we will closely monitor the outcome.

Water Companies have reported a small number of instances when pesticides in potable water have been detected above the standards set down in the Drinking Water Directive. These have primarily been from the herbicides Atrazine, Simazine, Isoproturon, Diuron, 2,4 D, Dicamba and Mecoprop. The occurrence of Atrazine and Simazine should decline following their withdrawal from use and we are currently investigating the origin of the others so that action can be taken.

2.16 Mathematical Modelling

SIMCAT, our river water quality model, describes the quality of river water throughout a catchment. SIMCAT is used to help to plan the measures needed to improve water quality. SIMCAT has special features which enable it to produce results quickly whilst controlling the effect on decision-making of the statistical uncertainties associated with water quality data.

Data files have been produced for the following rivers:

Blackwater, Cam, Chelmer, Gipping, Great Ouse, Ivel, Little Ouse, Mardyke, Nene, Stour, Thet, Waveney, Welland, Wensum, Wid and Witham.

The model is routinely used to assist us in setting conditions for Consents to Discharge (see Part 4.1). In addition, we are now applying it to examine the effect on the rivers Great Ouse and Nene, of removing phosphorus from the effluent from sewage treatment works. Figure 2.12 shows predictions for the River Nene.

FIGURE 2.12
Phosphorus Profile in the River Nene

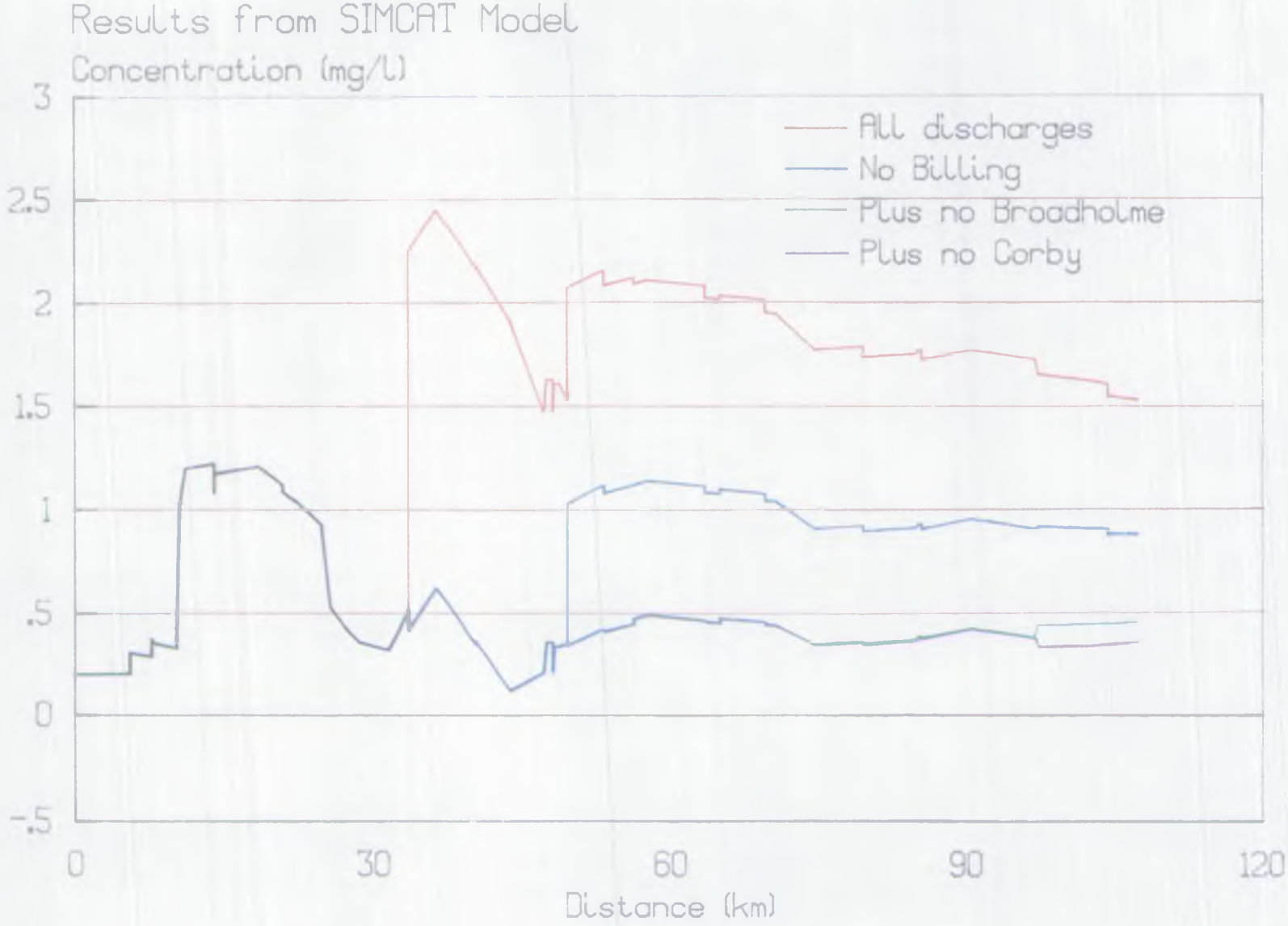
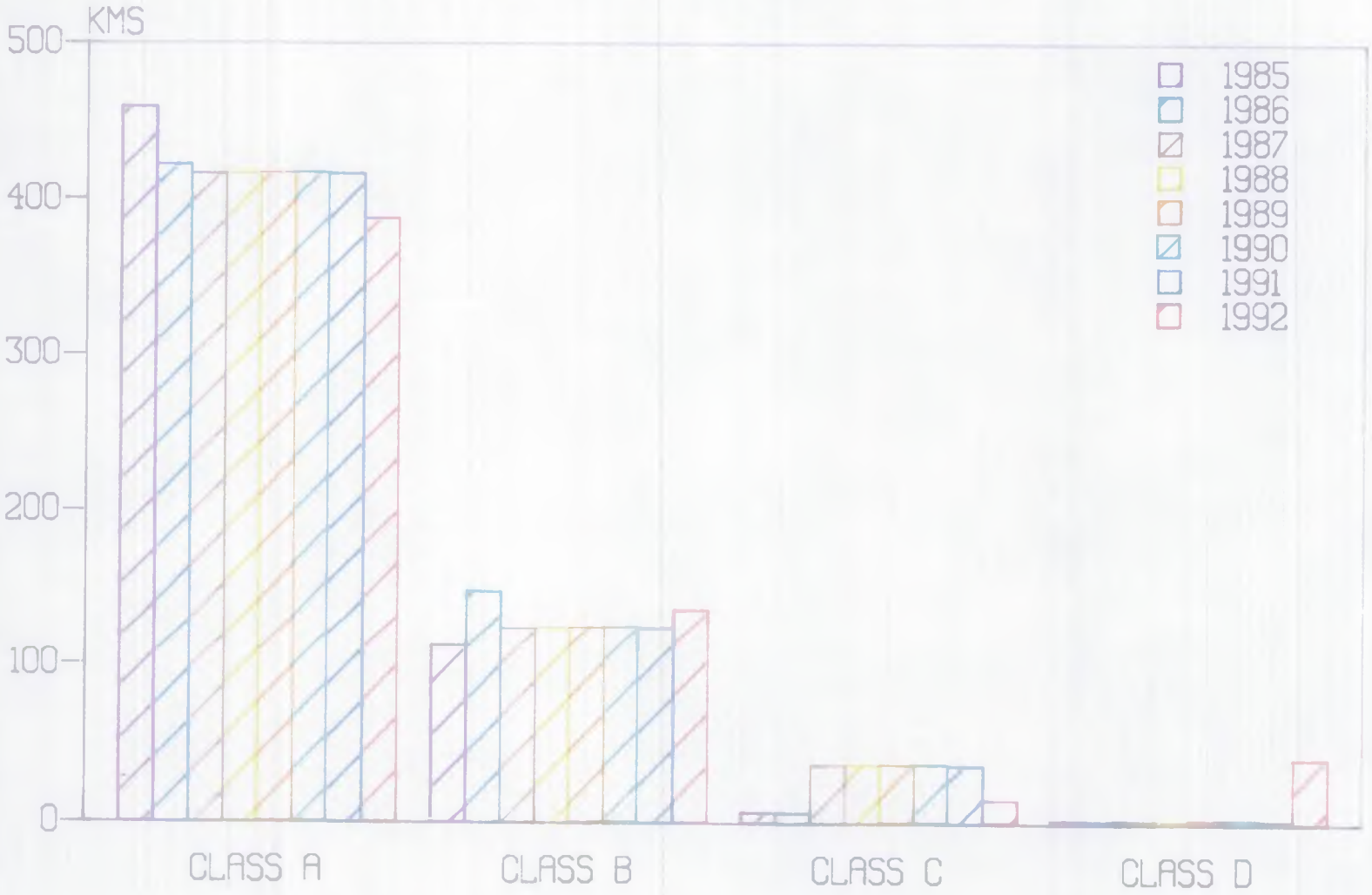


FIGURE 3.1

ESTUARIAL WATER QUALITY



Part 3: ESTUARIES & COASTAL WATERS

3.1 Monitoring

During 1992, we continued to expand our monitoring of tidal waters. We worked on 22 estuaries and most of our coastal waters.

Routine sampling was performed at 570 sites, including the 33 Bathing Waters. Additionally, 240 sites were sampled for special surveys. Frequencies ranged from annually to weekly. The total number of samples collected exceeded 5,700.

A sampling programme was set up to obtain information on nutrients, chlorophyll and algal populations in our estuaries. The results have been used as background information for the Directives on Urban Waste Water Treatment and Nitrate.

Sediments were collected for investigations of discharges containing Dangerous Substances, and as part of the monitoring programme for the Humbe. Frequencies ranged from one to four per year.

Samples of shellfish were collected from several sites in the Wash to monitor the bacteriological impact of sewage effluents on the fishery and to gather information for the Shellfish Hygiene Directive.

Biological monitoring was performed on all of our major estuaries and at several sites on the coastline. The numbers of samples are given in Appendix I.

Our expanded marine monitoring has been due largely to the commissioning of our coastal survey vessel, the "Sea Vigil" (see Part 3.5.1)

3.2 Classification

We use the CEWP System to assess the qualities of over 580 km of our estuaries, including the whole 65 km of the Humber.

There have been some changes in estuary water quality since 1991. Most lengths of estuary are of good quality although there are localised areas of pollution around some outfalls.

A summary of the results for 1992 is given in Figure 3.1 with data for previous years for comparison. Most of our estuaries (61%), are in Class A, with 28% in Class B, 3% in Class C, and 8% in Class D. The most significant change since 1991 is the re-classification of the Nene as Class D. This reflects the poor water quality which resulted from low freshwater flows and subsequent lack of dilution for effluents, during the drought (see parts 2.6.6 and 3.7.1).

Our coastal waters have some of the strongest tides in the whole of the North Sea. In some areas the tidal range can be as much as 7 metres. In general, these tides ensure that effluents and riverine discharges are rapidly diluted and dispersed.

3.3 Marine Biology

In all, 3,200 samples of biota were collected in 1992 (Appendix I). They were collected for a variety of reasons including our own routine monitoring and as part of the NRA's National Marine Monitoring Programme (NMMP)

Surveys of benthic invertebrates have also been carried out to assess the impact of sewage discharges, of outfalls in the Humber (see 3.5.3), of a gas terminal outfall, and an acidic discharge. We have also conducted such surveys for statutory monitoring under the Titanium Dioxide Directives, and to establish the background quality of our estuaries.

A project was carried out to determine the current biological and chemical quality at sites which may be affected by the relocation of the outfall from Ciba Geigy Ltd. This survey will be used to determine the environmental impact of the change.

In liaison with local Environmental Health laboratories, shellfish have been examined for bacterial content as part of the EC Shellfish Health Directive (see 3.5.6).

3.3.1 Marine Algae

Nutrient inputs to coastal waters can cause eutrophication and may lead to excessive growths of marine algae, forming blooms. These often result in aesthetic nuisance when accumulations of decaying algal material form scums and are washed inshore. The material is often confused with sewage and leads to public complaints. Of greater importance are the toxins produced by certain species, which are of concern when concentrated by filter-feeding bivalves, of commercial interest.

In 1991, the NRA established a monitoring programme for algal blooms at 50 bathing beaches. In Anglian Region, algal material was collected for analysis when blooms were visible during routine water quality monitoring.

This programme was repeated in 1992. In addition we report on "significant blooms" which caused accumulations of algal material on beaches and which could lead to public complaints. More than 20 beaches were reported to have been affected by such blooms. The presence of algae resulted in press reports.

3.4 Directives

The Directives affecting Freshwaters are described in Part 2. The principal, long-standing Directives affecting saline waters are those for:

- Dangerous Substances in Surface Waters;
- Shellfish Waters;
- Titanium Dioxide; and,
- Bathing Waters.

During the last few years, the following new Directives have been adopted and their requirements will come into force progressively:

- Urban Waste Water Treatment;
- Shellfish Health;

- Pollution of waters by nitrates from agriculture;
- Freedom of access to information on the environment (2.7.8).

3.4.1 Dangerous Substances

The scope and objectives of this Directive are outlined in 2.7.1.

We are required to monitor marine sites affected by discharges. All sites passed the required List I quality standards for mercury, cadmium, lindane, pentachlorophenol, the Drins (Aldrin, Dieldrin, Endrin, and Isodrin) and chloroform. We also undertook background monitoring for List I substances, as required by the DoE.

Downstream monitoring of saline waters for 32 discharges containing List II substances was undertaken. Six sites exceeded the national quality standards, these being:

- The Blackwater estuary at Fullbridge for zinc and copper;
- The Orwell estuary at Woolverstone Marina for zinc;
- The Humber Estuary at South Killingholme for copper;
- Fenn Creek (R. Crouch estuary) south of Eyotts Farm for copper;
- The River Crouch at Battlesbridge for copper; and,
- The Blackwater estuary at Herons Point for copper.

No obvious cause for the zinc exceedences has been identified. The copper failures in the Humber resulted from inputs to the river system which are upstream of Anglian Region. Work by the Water Research Centre has shown that this copper is bound up with organic matter and has low toxicity. Concentrations of copper in excess of the quality standard, are permitted in such cases.

No specific cause for the failure in Fenn Creek has been identified. The upstream sewage treatment works (Woodham Ferrers and Wickford) are being investigated as possible sources. Likewise, the failure in the Crouch at Battlesbridge may be linked to the significant proportion of flow in the river from the sewage treatment works at Wickford.

The Blackwater at both Fullbridge and Herons Point is affected by the combined discharge of treated sewage effluent from Chelmsford and Witham. Monitoring of the effluent for Copper has been instigated, and the situation will be reviewed.

3.4.2 Shellfish Waters

In contrast to the Shellfish Health Directive (see 3.4.6), this is not a direct public health measure. It lays down quality standards for waters designated as shellfisheries. It also aims to ensure a suitable environment for shellfish growth. There are six designated Shellfish Waters in our region.

Although there was no formal requirement to report the results to the DoE and the Commission, the waters are monitored every year, as required under the Directive. There were few exceedences of the Mandatory Standards. Individual results for Dissolved Oxygen of less than the minimum standard were experienced, and a single pH result of less than the minimum standard was recorded. However, these are not considered to have harmed the shellfish.

Exceedences of the DoE guideline standard for zinc were recorded at 5 sites:

- Butley River Oysterage;
- Pyefleet Channel at North Farm Hard;
- River Blackwater off Marconi Sailing Club, Stansgate;
- Hamford Water, The Twizzle off Titchmarsh; and,
- River Roach, East End, Paglesham.

No obvious cause for the zinc exceedences has been identified.

There were copper failures at two sites:

- River Blackwater off Marconi Sailing Club, Stansgate; and,
- Hamford Water, The Twizzle off Titchmarsh.

One of the failures may have been due to an industrial discharge. This discharge has recently had a consent issued which includes a copper limit. Another possible cause is the increasing use for boats of anti-fouling paints containing copper.

3.4.3 Titanium Dioxide

Waste from the Titanium Dioxide industry is harmful to the environment, mainly because of its iron content and high acidity.

The Directives on Titanium Dioxide require that factories discharging such waste should reduce the pollution caused by their discharges, within a specified timescale. There are three factories in the UK. The two largest, Tioxide UK and SCM, are on the south bank of the Humber and their effluent is discharged to the estuary.

In 1988, the outfalls from both factories were relocated to deeper water where dilution and dispersion would be much greater. A survey in 1989 confirmed that the new outfalls had produced a substantial reduction in the area affected by pollution.

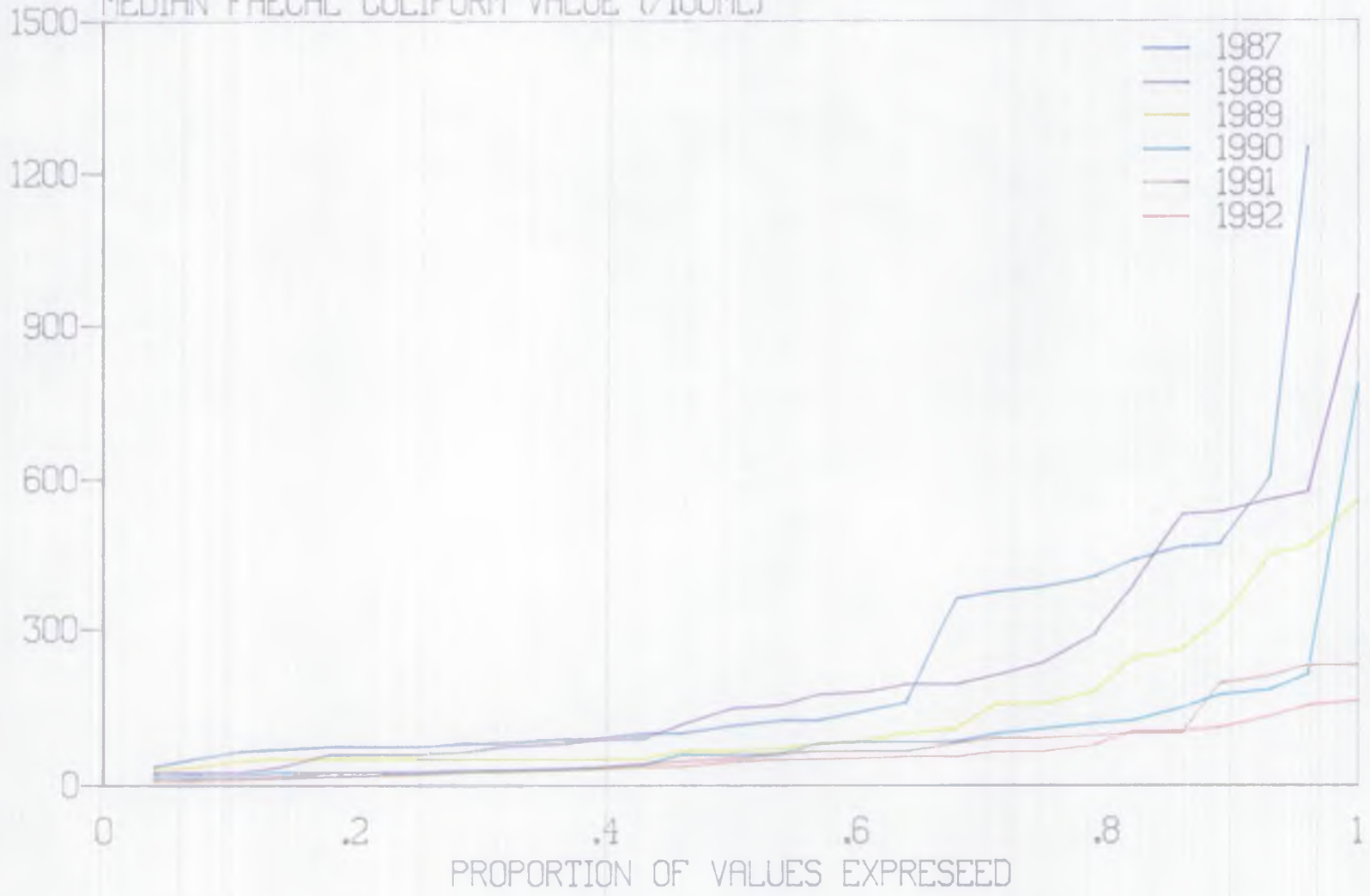
Chemical and biological monitoring of the receiving waters in 1992 was carried out as required by the Directives and the results were reported to the DoE.

Reductions in iron concentrations in the receiving waters, evident since the relocation of the two outfalls, has been maintained at SCM. Water around the Tioxide outfall did, however, exhibit higher iron concentrations than in 1991. The results of biological monitoring indicate that there has been some deterioration around the Tioxide outfall since 1988. It seems likely that this decline is caused by the discharge, although further investigations are in hand which will clarify the situation. Data from around the SCM outfall suggest that there has been a recovery in the fauna.

During 1991, one of the Titanium Dioxide Directives was annulled following an action by the Commission over the legal basis of the legislation. This Directive laid down timescales for the reduction and elimination of pollution from the discharges. The Directive was subsequently redrafted by the Commission and was adopted by the Council of Ministers in December 1992. The DoE is drafting Directions to the NRA under the Water Resources Act 1991, which will enshrine the new Directive within UK law. Discussions are now underway with the companies to ensure that their plans to reduce pollution meet the timetable imposed by the Directive.

FIGURE 3.2

BATHING WATER QUALITY



3.4.4 Bathing Waters

The purpose of the Directive is to reduce pollution of Bathing Waters, to prevent further deterioration, and thereby protect Public Health and the Environment.

The 1992 season was the first in which samples were analysed using methods which confirm the numbers of coliform bacteria, the primary indicators of sewage pollution. This has led to greater accuracy and is in line with the requirements of the Directive.

1992 was also the first season in which we analysed all Bathing Water samples for Faecal Streptococci, secondary indicators of sewage pollution. This was in response to the addition of the Directive's Guideline Standard for Faecal Streptococci to the requirements of the 1993 European Blue Flag Scheme and the 'Premier' Seaside Award scheme set up by the Tidy Britain Group.

Of the 33 identified Waters in Anglian Region, 31 passed the water quality standards in 1992 as assessed by the DoE criteria. This compares with 29 out of 33 in 1991 (See Table 3.1). The two sites which failed the Directive, Cleethorpes and Great Yarmouth South, also failed in 1990 and 1991. Capital schemes planned by AWS will improve the bathing water quality at both of the above sites over the next few years.

The method of assessing compliance with the Directive is volatile and leads to results whereby, in statistical terms, some Bathing Waters may be classed wrongly to have passed or failed. It is therefore useful to look at the trend from a different viewpoint, using the Median values of water quality for each bathing water (see also Part 2.3.2).

By ranking the median values of all Bathing Waters for each of several years and plotting them graphically, we get a better estimate of the trend. Figure 3.2 plots the median quality for each Bathing Water over six years against the proportion of beaches with a median less than that particular value. Essentially the further the graphical plot is to the right for a particular year, then the better the quality for that year.

There has been a steady improvement since 1987. 89% of Bathing Waters had a median of less than 500 Faecal Coliforms per 100 ml in 1987. In 1991, and again in 1992, this figure had improved to 100%. (In 1992 then, stable estimate of trend supports the more volatile estimate provided by the number of failed Bathing Waters).

This improvement had been attributed to a combination of capital expenditure by the Water Companies, together with dry, suuny summers from 1989 to 1991 which caused caused increased die-off of bacteria and less discharge of storm-water. Although 1992 was a wetter, cooler summer than the previous three, the improvement in quality was sustained and advanced. This suggests that improvement schemes are the main cause of the improvement.

During 1991, Regulations under the Water Act were issued by the DoE. These put the requirements of the Bathing Water Directive into UK law and established a classification system for bathing waters based on the mandatory values in the EC Directive. During 1992, Statutory Water Quality Objectives were issued (see also Part 2.4), which applied the classification to all Identified bathing waters by means of a Direction and Notices to the NRA under the Water Resources Act (1991). The NRA

has a duty to achieve compliance with the Objectives within a specified timescale and to monitor to enable the assessment of compliance.

TABLE 3.1

BATHING WATER DIRECTIVE

Compliance with Standards for Total and Faecal Coliforms

Bathing Water	1987	1988	1989	1990	1991	1992
Cleethorpes	Fail	Fail	Fail	Fail	Fail	Fail
Mablethorpe	Fail	Pass*	Fail	Pass*	Pass	Pass*
Sutton on Sea	Fail	Fail	Pass	Pass*	Pass	Pass*
Moggs Eye	Pass	Pass	Pass*	Pass	Pass	Pass
Anderby	Pass*	Pass	Pass*	Pass	Pass	Pass
Chapel St. Leonards	Fail	Pass	Pass	Pass*	Pass	Pass
Ingoldmells	Fail	Pass.	Pass*	Pass*	Pass	Pass
Skegness	Pass	Pass	Pass*	Pass*	Pass	Pass*
Heacham	Pass	Fail	Pass	Pass*	Pass*	Pass
Hunstanton	Pass	Fail	Pass	Pass	Pass	Pass
Wells	Fail	Pass*	Pass*	Pass*	Pass	Pass
Sheringham	Fail	Fail	Fail	Pass	Pass	Pass
Cromer	Fail	Fail	Fail	Pass	Pass*	Pass*
Mundesley	Pass	Pass*	Pass	Pass	Pass	Pass
Hemsby	--	--	--	--	Pass	Pass*
Gorleston Beach	--	--	--	--	Fail	Pass*
G.Yarmouth North	Fail	Pass	Pass	Pass	Pass	Pass
G.Yarmouth Pier	Fail	Fail	Pass*	Pass*	Pass*	Pass
G.Yarmouth South	Fail	Fail	Fail	Fail	Fail	Fail
Caister Point	--	--	--	--	Pass	Pass
Lowestoft North	Pass	Pass	Pass	Pass*	Pass*	Pass
Lowestoft South	Pass	Pass	Pass	Pass	Pass	Pass
Southwold The Denes	--	--	--	Pass	Pass	Pass
Felixstowe North	Pass	Pass	Pass	Pass	Pass	Pass
Felixstowe South	Pass	Pass	Pass	Pass	Pass*	Pass
Dovercourt	Fail	Fail	Pass*	Pass*	Pass	Pass
Walton	Fail	Pass	Pass*	Pass	Pass	Pass*
Frinton	Pass	Pass*	Pass	Pass	Pass	Pass
Holland	Fail	Pass	Pass	Pass	Pass	Pass
Clacton	Fail	Pass*	Pass	Pass	Pass	Pass
Jaywick	Pass	Pass	Pass	Pass*	Pass*	Pass*
Brightlingsea	Fail	Pass*	Pass*	Pass*	Pass	Pass
West Mersea	--	--	--	--	Fail	Pass*

* These sites have had at least one failing sample.

3.4.5 Urban Waste Water Treatment

Discharges to saline waters will be particularly affected by this Directive (see 2.7.5). It requires secondary sewage treatment at many locations, unless the discharge is to a Less Sensitive Area. This differs from the past practice of limited treatment and discharge via a long sea outfall.

In many instances, the standards required by the Directive, **are tighter than those which we would have required to meet the needs of the receiving waters.**

3.4.5.1 Less Sensitive Areas

Member States can apply treatment less stringent than secondary to discharges to Less Sensitive Areas (re-named High Natural Dispersion Areas in 1993). They apply only to estuarine or coastal waters.

For less stringent treatment to be allowed it must be demonstrated that the discharge does not adversely affect the environment in the proposed area, or adjacent areas. A number of factors will be considered when deciding on the suitability of proposed Less Sensitive Areas. These include the presence of good water exchange, the absence of eutrophication, and no oxygen depletion. Before any discharge to a Less Sensitive Area is allowed, a comprehensive study of its environmental impact will be carried out by the discharger.

3.4.6 Shellfish Health Directive

Previously known as the Shellfish Hygiene Directive, this was formally adopted in 1991. During 1992, three sets of Regulations under the Food Safety Act 1990 were issued, to incorporate the Directive (and the related Fish Health Directive) into UK law. They stated conditions for the production and marketing of live bivalve molluscs intended for immediate human consumption, or for further processing before consumption.

The key points for dischargers and regulators in the Water Industry are the requirements for the harvesting areas and for the monitoring of those areas. Shellfish harvesting areas are classified into three categories, principally on the basis of the bacterial content of the shellfish flesh. Shellfish may be marketed only if they are taken from waters falling into these groups and, for two of the categories, only after relaying or purification. A fourth category exists, from which harvesting is prohibited. This Directive applies to all the main commercial shellfisheries and not just to those designated under the Shellfish Waters Directive.

The classification of harvesting areas was based upon sampling undertaken by Local Authorities and Port Health Authorities, with help from the NRA, during 1991/92. To date 76 Harvesting Areas have been identified nationally, with 17 of these being within Anglian Region.

The NRA monitors **waters** designated under the Shellfish Waters Directive; Local Authorities monitor **shellfish quality**, for the Shellfish Health Directive.

Many of the commercial shellfisheries have fallen into categories which will require the relaying or purification of the molluscs prior to marketing. As a result of this there is likely to be pressure to initiate further designations of waters under the

Shellfish Waters Directive and to bring about improvements in the water quality (and thus the classification) of shellfisheries. However, the DoE has indicated that it intends to make no further designations under the Shellfish Waters Directive in the immediate future, and that higher classifications will come about only through water quality improvements under Regulations from other Directives.

There is likely to be pressure on the NRA to establish the impact of discharges on shellfish quality. In anticipation of this, we ascertained, for each harvesting area, which discharges are likely to affect the water quality (see also Part 3.11).

3.4.7 Pollution of Waters by Nitrates from Agriculture

The scope of this Directive is outlined in Part 2.7.6. It applies also to eutrophic tidal waters. Vulnerable Zones will need to be designated by the end of 1993.

3.5 The North Sea

The Government participates in the international North Sea Conferences. Nutrients, eutrophication and toxic and persistent pollutants are topics of particular concern to the Conference, especially in the vulnerable southern part of the North Sea where the Anglian coastline lies. To address this concern we have increased our coastal monitoring and we participate in a number of national and international studies.

3.5.1 Coastal Survey Vessel

Our marine monitoring has greatly increased with the commissioning of our coastal survey vessel, the "Sea Vigil". Its first full operational year was 1992, during which it met its target working hours. Details are shown in Figure 3.3.

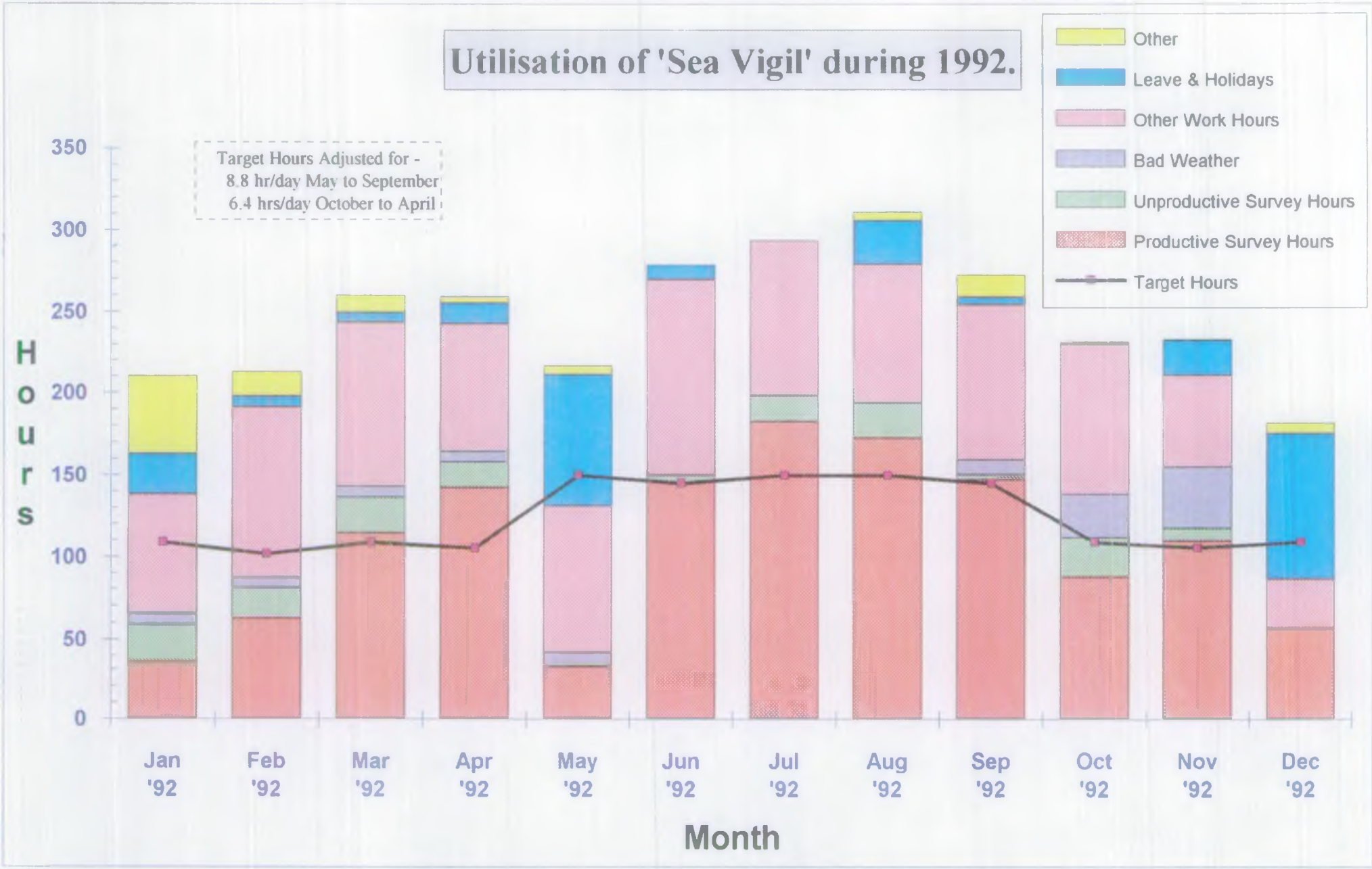
Much of the boat's time is spent collecting nutrient data and some of these results are given in Figure 3.4. They were taken during a summer survey, between the Wash and the Thames, and they illustrate that greater quantities of nutrients are found along the Suffolk and Essex coast where there a number of estuaries which drain agricultural catchments, and where there are inputs from large coastal resorts.

In addition to work carried out for projects such as NaCoMS and JoNuS (see 3.5.2 and 3.5.3), nutrient work was also undertaken to look at the impact of the four tributary estuaries (Witham, Welland, Nene and Great Ouse) of the Wash. Figure 3.5 shows results from some of this work. The Great Ouse receives substantial inputs of treated sewage effluent and drains an intensively farmed area. The distance that the effect extends out into the Wash will be further investigated.

3.5.2 National Coastal Monitoring Study (NaCoMS)

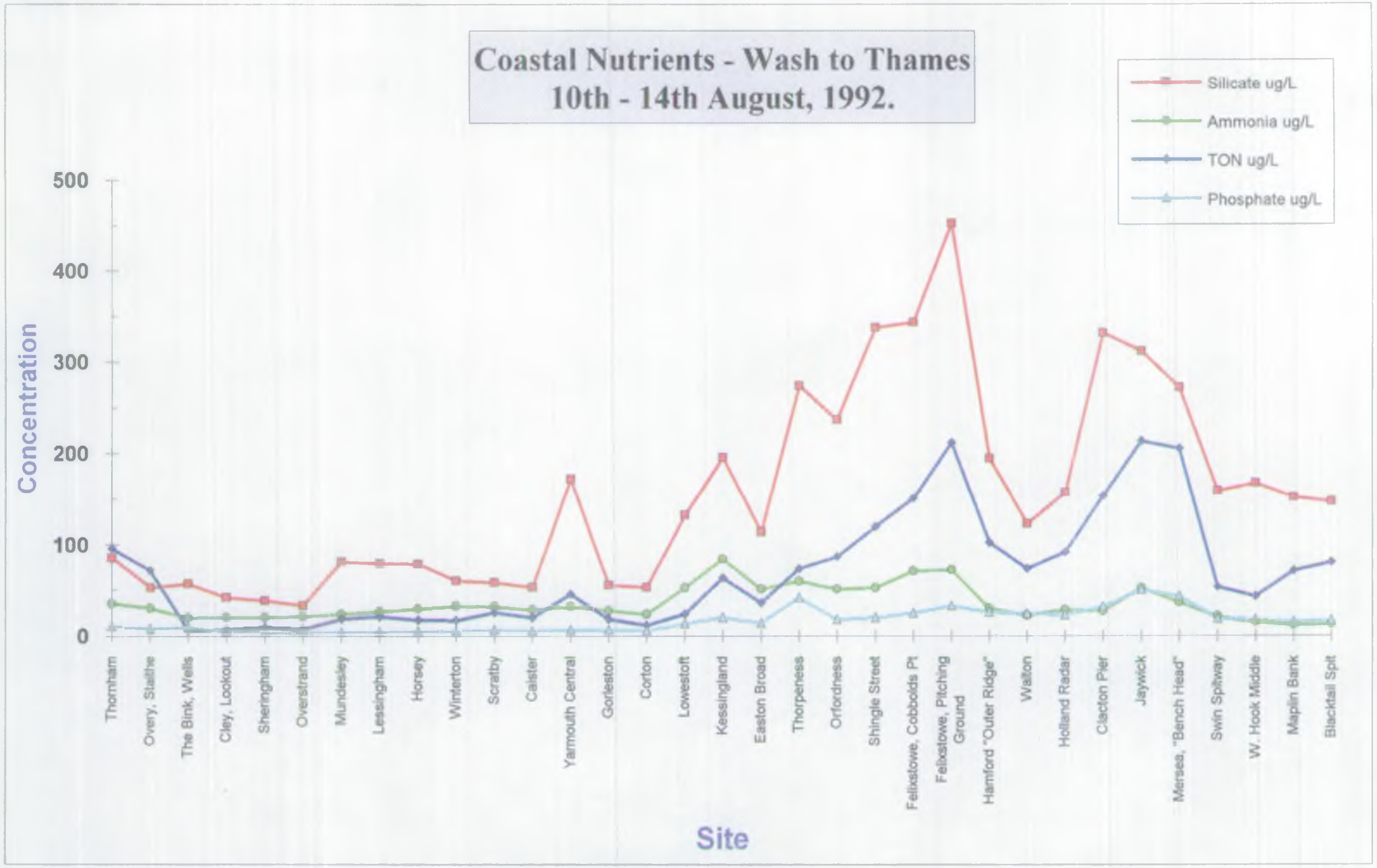
Anglian Region also contributes to the NRA's National Coastal Monitoring Study. In this, water quality data are recorded around the whole coast of England and Wales. Survey vessels collect information along a line 4 to 5 km offshore while, at the same time, an aircraft carrying a remote sensing scanner (see Glossary), flies overhead. Images collected by the aircraft are mapped on data collected by the vessels. In this way, it is possible to determine water quality anywhere within the area of sea surface covered. The first of such joint survey took place in November 1992.

Figure 3.3



Operations - January to December, 1992.

Figure 3.4



Analysis on-board 'Sea Vigil'.

Figure 3.5: WASH Survey, August 1992 – Nitrate (ug/L–N).

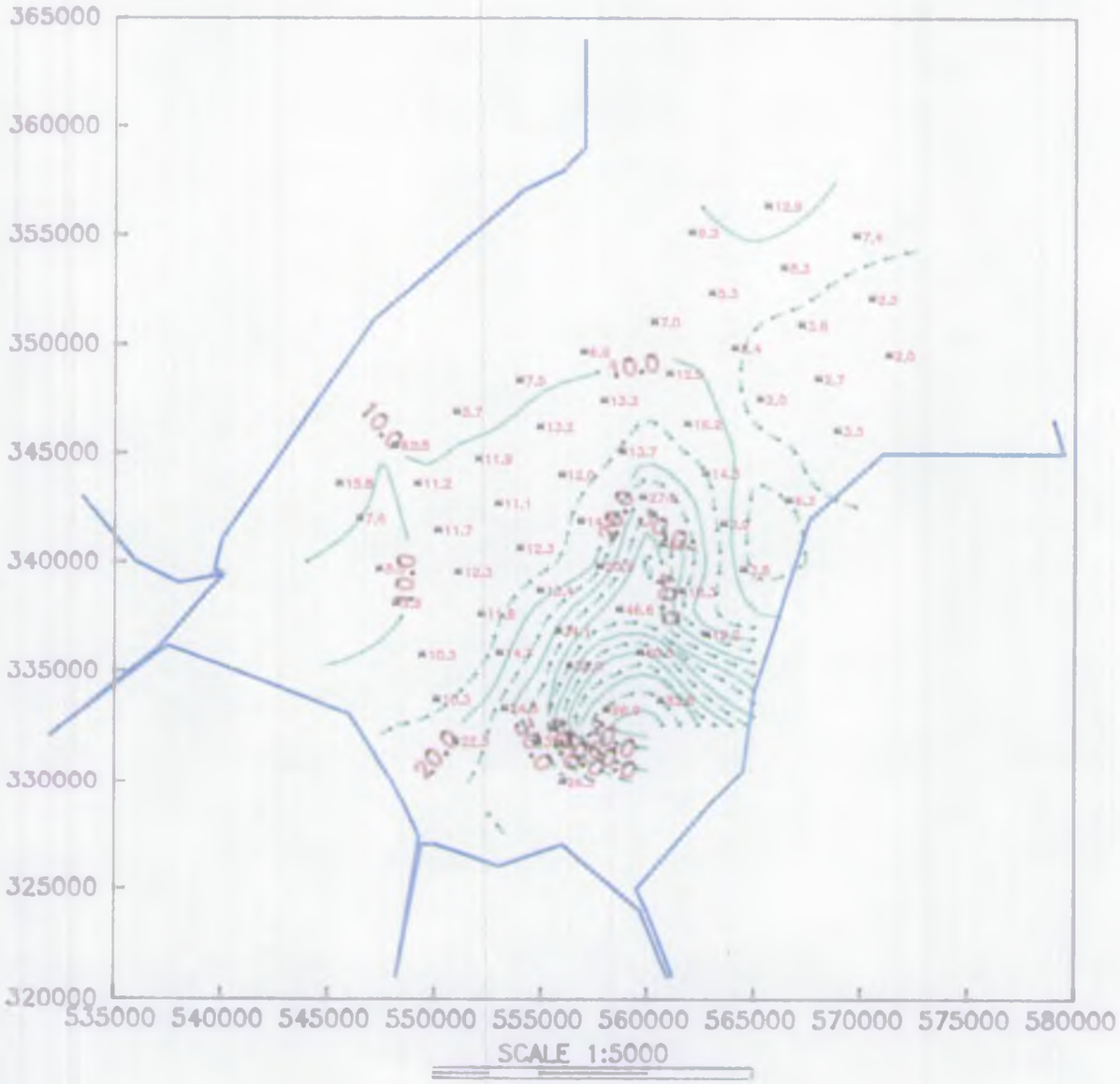
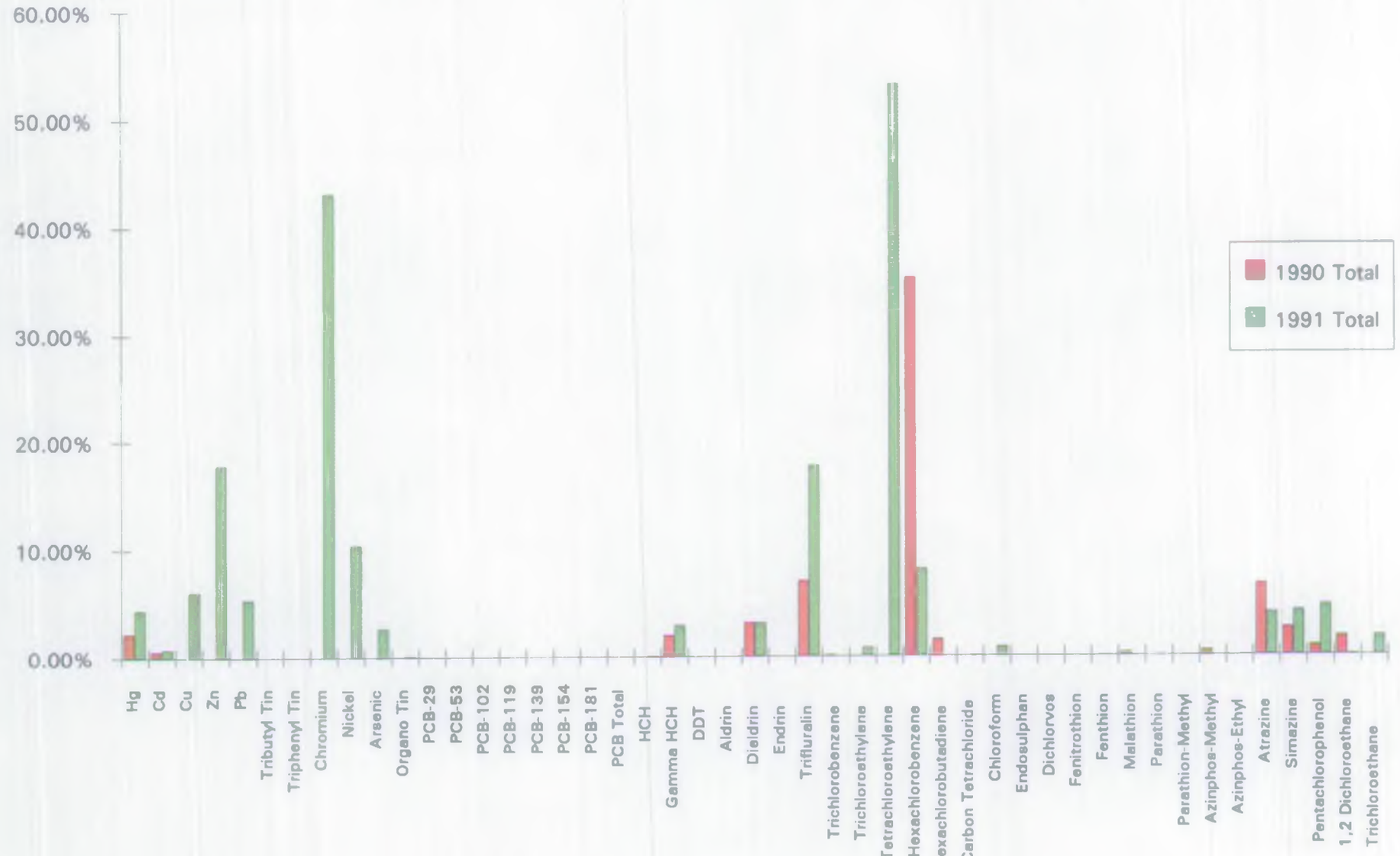


Figure 3.6

Anglian Region's Contribution to the National Totals of Red List (1990) and Annex 1A (1991) substances



3.5.3 The Joint Nutrient Study (JoNuS)

The national JoNuS study is gathering information on the transport of nutrient loads through estuaries to coastal waters. MAFF, funded by DoE, is concentrating on the coastal and offshore zones between the Humber and the Thames. The NRA contributes to the project by providing nutrient data from the Wash and the associated estuaries. We also support a research project at the University of East Anglia on phosphate recycling.

Results from the programme during 1992 indicated that even in turbid estuaries such as the Great Ouse, algal activity leads to significant reductions in the amount of nutrient which flows into the sea.

3.5.4 Red List/Annex 1A

In 1987, Government representatives to the second North Sea Conference agreed to a 50% reduction by 1995 in the loads of certain Dangerous Substances discharged to the North Sea. The Government identified a list of 23 such Substances: the Red List. The third North Sea Conference (held in 1990) identified a list of 36 Substances, including all of the Red List except PCBs. This is known as Annex 1A.

In England and Wales, the NRA has the responsibility for ensuring that this reduction is met.

Since 1990, we have been collecting data on all significant inputs of Red List/Annex 1A substances to estuaries and coastal waters. All of the data for England & Wales are processed in Anglian Region. Action to achieve load reductions, is dealt with by individual Regions.

Figure 3.6 shows the proportion of the national loads discharged to the North Sea from our Region during 1990 and 1991. Anglian contributes a comparatively small proportion of the total for most substances. This reflects the relative lack of heavy industry and large freshwater rivers. Four substances stand out. Zinc, chromium and tetrachloroethylene are industrial in origin and are associated with South Humber Bank industries.

Discussions have started with the industrialists about ways of reducing their input. During 1992 two of the factories brought new effluent treatment plants into use at a cost approaching £50M; other treatment plants are planned. Once these plants are all fully operational, input loads will decrease.

The fourth Substance, Trifluralin, is an agricultural herbicide and its presence reflects the extent to which farming is a major occupation in the Anglian region.

Agricultural herbicides find their way into rivers and the North Sea mainly from the land and hence are diffuse in origin. Such diffuse inputs cannot be controlled as easily as point source inputs. Restrictions on marketing and use are the most likely ways by which inputs could be reduced.

3.6 Paris Commission

In 1978 the Convention for Marine Pollution from Land-based Sources set up the Paris Commission. Since then, monitoring has been carried more or less continuously. In 1988, the Paris Commission implemented an annual survey, specifically to identify the sources of 90% of the load of selected pollutants, to Convention Waters.

We monitor discharges from 17 rivers, 14 STWs and 8 industrial sites. Rivers are monitored close to their tidal limits. Major industrial and sewage effluents below these tidal limits are also monitored. Figure 3.7 shows the proportions contributed by these sources, in 1990 and 1991.

3.7 Mathematical Modelling

The aim of modelling work is to provide a suite of consistent techniques for calculating the measures needed to achieve our objectives for water quality.

3.7.1 Estuaries

Mathematical models constructed by the Water Research Centre have been extended to calculate effluent standards as 95-percentiles. This feature, and the inclusion of the option to model microbes and nutrients, illustrates the way in which we adapt the models to meet new demands.

The Colne Estuary Model has been used to determine future quality criteria for discharges to the estuary so that water quality can be improved. A typical set of water quality profiles is shown in Figure 3.8.

We have used the Nene Estuary Model to determine the improvements required in the quality of effluents discharging to the estuary. Improvement schemes are now in progress at Haywoods Foods, McCains Foods, Potato Marketing Board and Wisbech Sewage Treatment Works. The diversion of a number of effluents to the public foul sewer has also reduced the pollutant load discharged to the River Nene.

A model of the Stour/Orwell/Harwich Harbour system has been completed by the Water Research Centre. This model is unusual because it integrates 1-dimensional estuary components with a 2-dimensional coastal model. This allows us to predict the behaviour of pollutants both along the length and across the width of this system.

3.7.2 Coastal Waters

In 1987, the Water Research Centre completed mathematical models describing coastal waters in the area of Heacham and Hunstanton in the Wash. These models were used to assess the impact on the bacterial quality of recreational waters and fisheries of discharges from existing and proposed outfalls. Following the success of this study, models were developed to cover all of our Bathing Waters.

The work was set in motion by Anglian Water and is mainly funded now by Anglian Water Services. Details of the studies are managed by a Steering Group comprised of representatives from Anglian Water Services, the Water Research Centre, and our

Figure 3.7

Anglian Region's Contribution to the National Totals of PARCOM (1990) and PARCOM (1991)

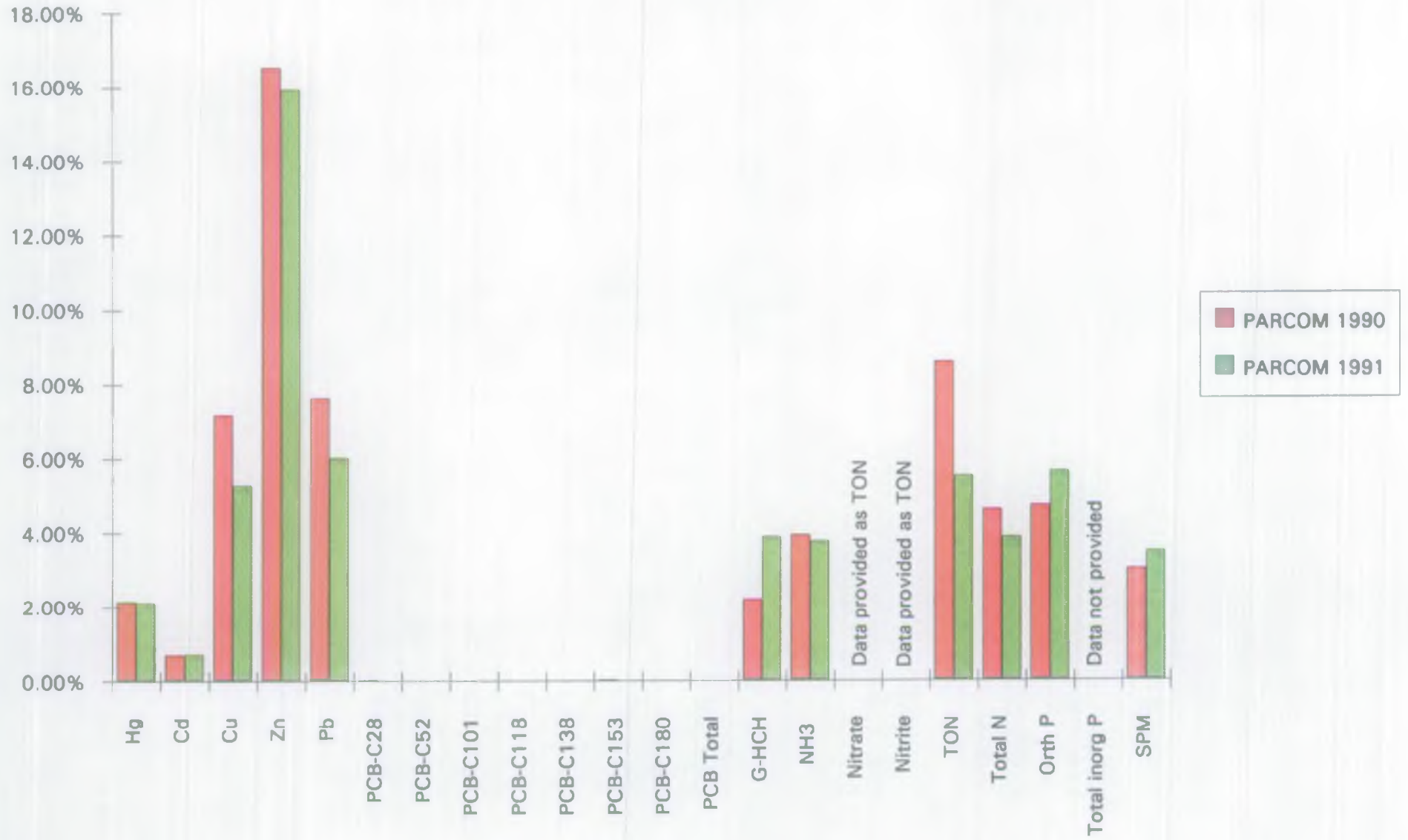
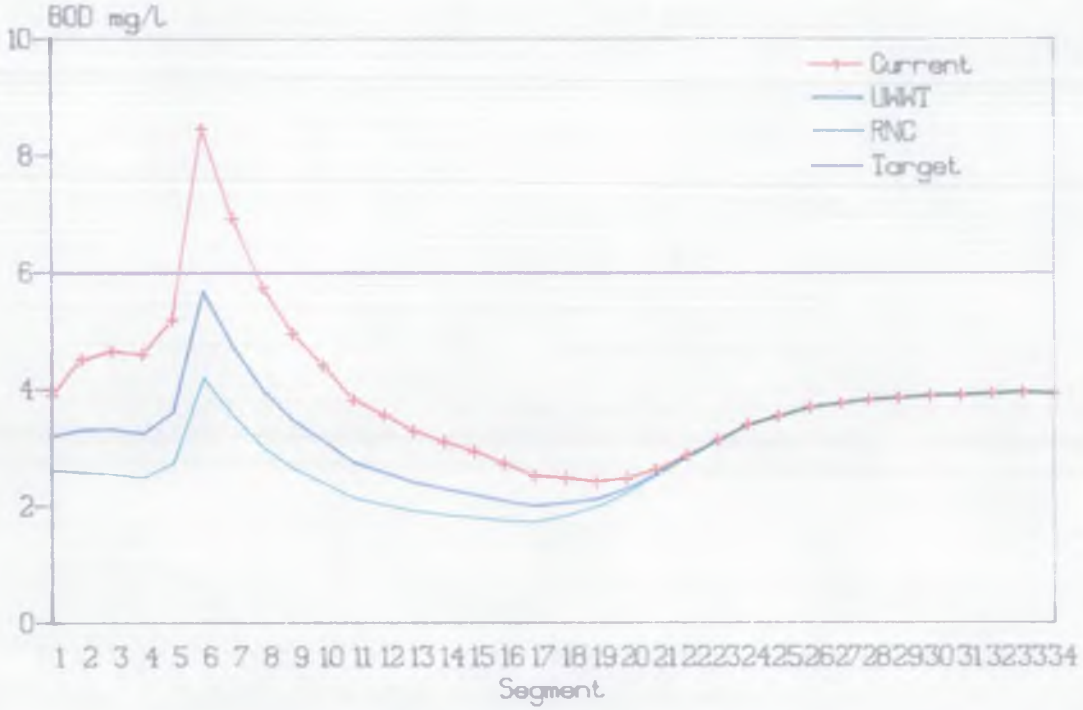


FIGURE 3.8
Colne Estuary Model
Predicted BOD Concentration



Colne Estuary Model
Predicted Ammonia Concentrations

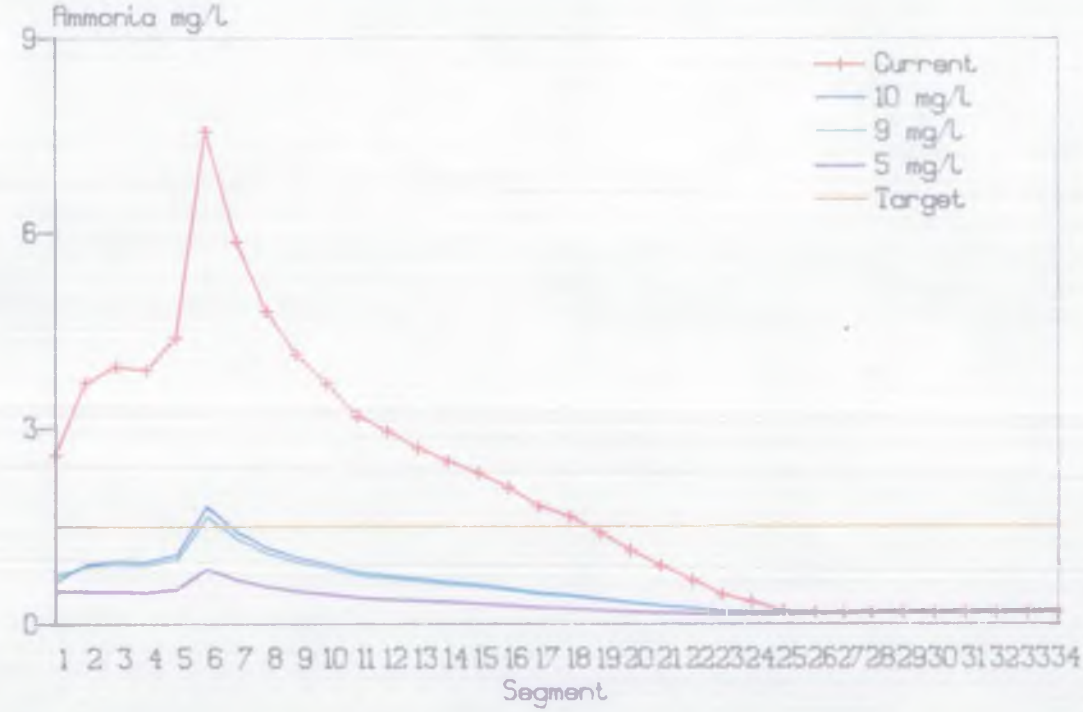
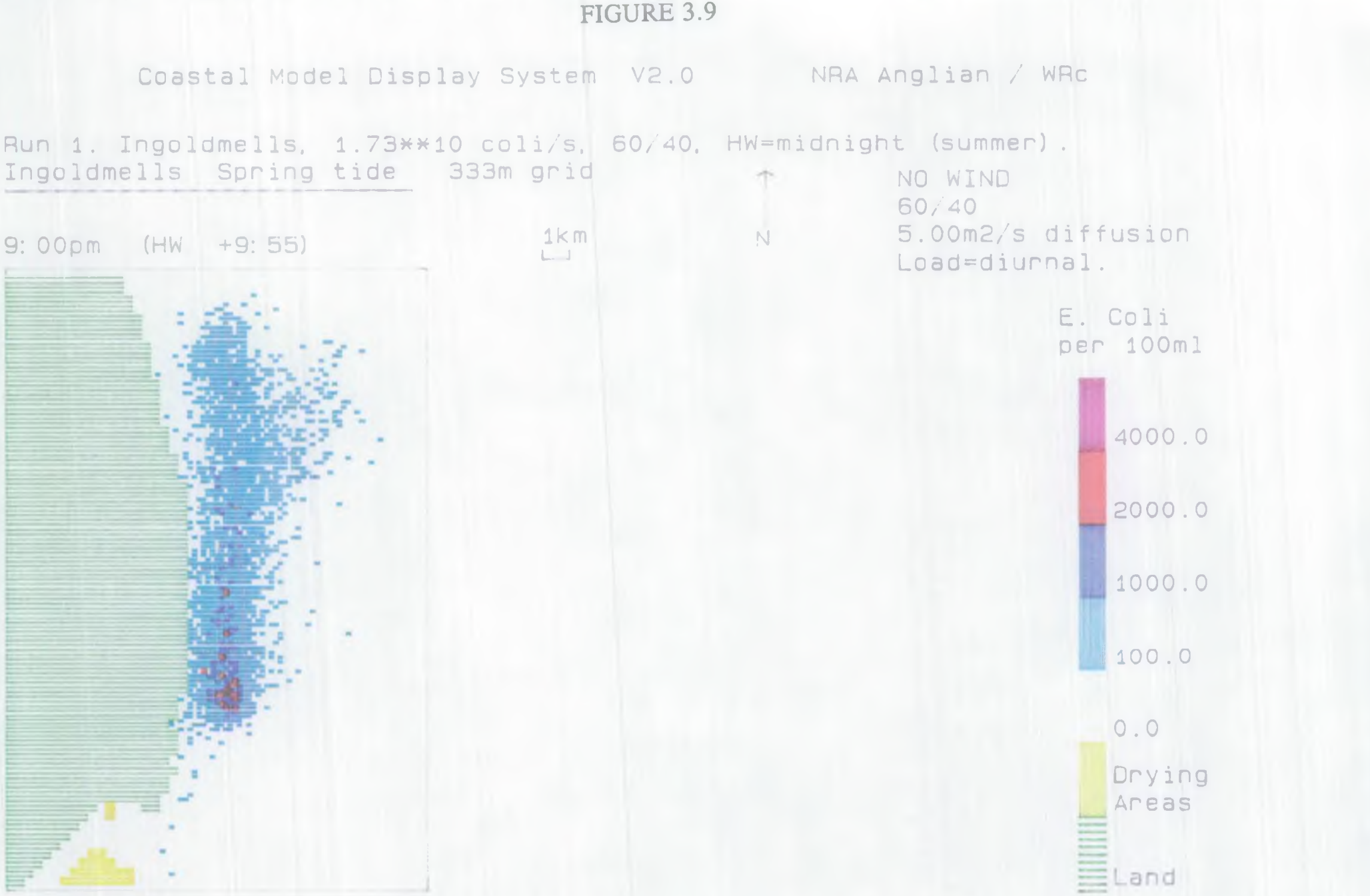


FIGURE 3.9


Coastal Model Display System V2.0
NRA Anglian / WRc
Run 1. Ingoldmells, 1.73**10 coli/s, 60/40, HW=midnight (summer).
Ingoldmells Spring tide 333m grid
9:00pm (HW +9:55)
1km
N
NO WIND
60/40
5.00m2/s diffusion
Load=diurnal.
E. Coli
per 100ml
4000.0
2000.0
1000.0
100.0
0.0
Drying
Areas
Land

Region of the NRA.

We have copies of all completed models and they are maintained on our own computer. We have made enhancements to the output, so that animated displays can be shown on any Personal Computer (PC).

Figure 3.9 shows an example of the model output which predicts the concentration and dispersion of bacterial pollution from an outfall at Ingoldmells. This output is produced for different degrees of effluent treatment to build up a picture of bacterial pollution and how it might affect, for example, Bathing Waters or shellfish beds. We can also use the model to check the consent limits requested by dischargers.

4.1 Consents

The discharge of wastewaters is controlled by granting a Consent, which is the legal permission to discharge an effluent to a Controlled Water.

4.1.1 Policy on Setting Consents

We need to calculate revised standards for discharges for a number of reasons. These include the growth in loads, changes in environmental standards and altered locations.

The policy of the NRA is that all new or revised Consents will aim to maintain the present quality of Controlled Waters (No Deterioration) and, wherever possible, they will ensure that Water Quality Objectives for Controlled Waters are met.

Small discharges (5 cubic metres per day or less) of sewage effluent to land do not need a Consent (provided that any underlying aquifer is not put at risk (see Part 2.10.2), and that soil conditions are suitable for a soakaway). Pending the introduction of a National Policy on these discharges, applicants have been told the conditions to which the treatment system should be constructed. This controls the installation of the soakaway and also exempts the discharger from paying the Application Fee (see Part 4.7).

Since September 1989, all Consents have been issued by the NRA. Because they are covered by different types of Consent, we distinguish between discharges owned by the main Utility (Anglian Water Services, or AWS) and those owned by other bodies, private individuals and other traders. These are called Non-Utility discharges.

4.2 Utility Discharges

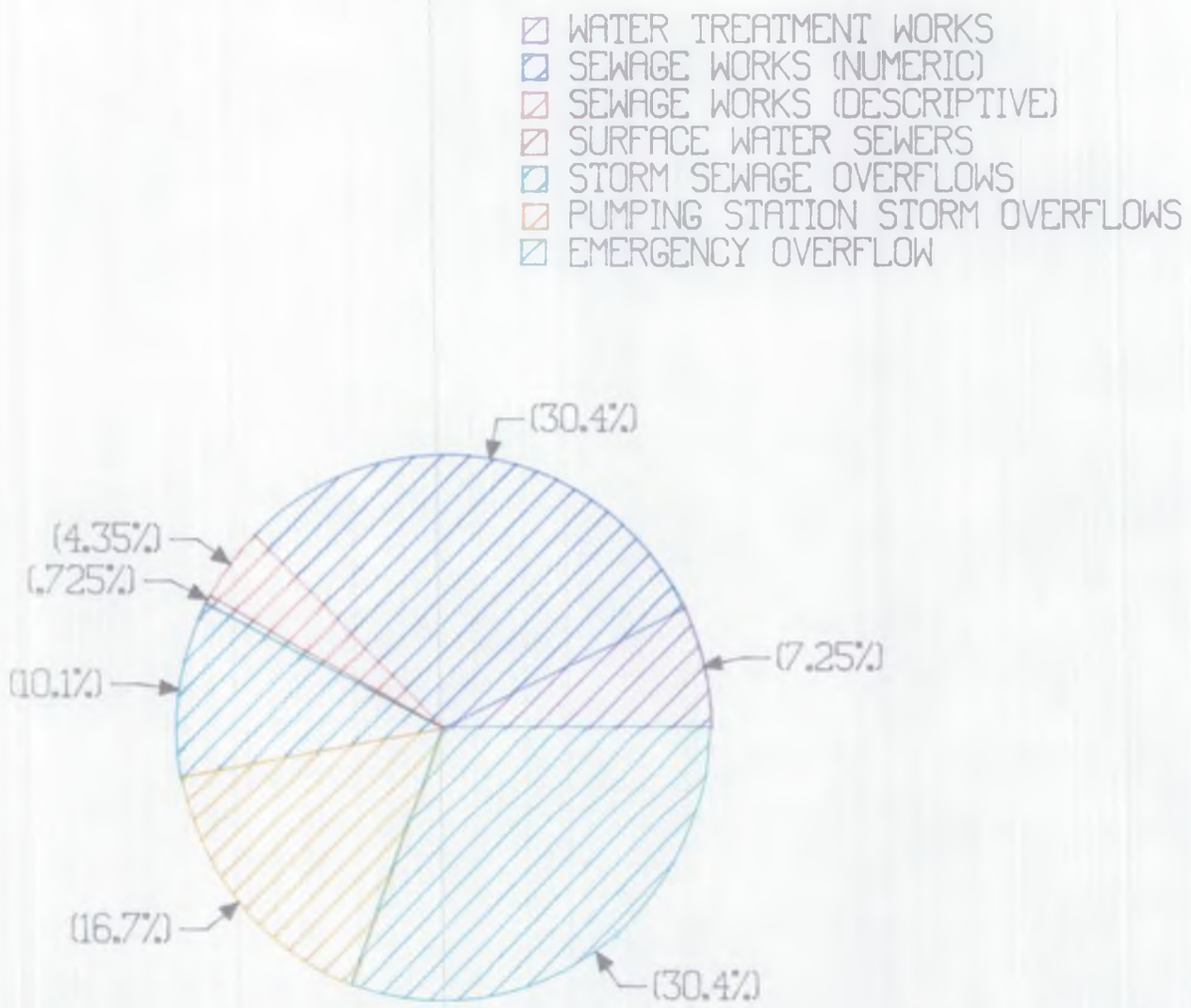
4.2.1 Types of Consent

The **Legal Consent** is the term used to mean the consent now in force. It may be a **Numeric Consent**, containing limits on the quality and quantity of the effluent or, for a small works, the Legal Consent may be a statement of the type of treatment which must be provided. This is known as a **Descriptive Consent**.

The **River Needs Consent** (or RNC), is a working estimate of the Consent which may be needed in the future to achieve the Quality Objectives for Controlled Waters (see part 1.2). In itself, it has no legal force but a growing number of Legal Consents (now about 36%), are set to achieve the necessary Quality Objectives.

In the run-up to privatisation, the Water Authorities were given a chance to reduce their risk of prosecution. In our Region, **Time-limited Consents** were granted for 220 discharges from sewage works which were failing their Legal Consents. These relaxations were conditional. The Company has had to bring these works into compliance, by an agreed date, with the stricter of either the old Legal Consent or a Consent based on maintaining the 1984 effluent load. We press the Utility to achieve the River Needs Consent for discharges where the additional cost is less than

FIGURE 4.1
UTILITY : APPLICATIONS RECEIVED



10% of the total.

The net effect of all this activity is that sewage treatment works in this Region have, on average, the tightest standards in the United Kingdom.

Of the Utility's STWs, 685 had Legal Consents which included numeric limits on the quality of the effluent. Descriptive consents applied to 354 small works and a few large coastal outfalls.

4.2.2 Processing of Applications

Under the Water Resources Act 1991 Section 91(2), the person who applied for the consent may appeal to the Secretary of State against the conditions of the consent. The Utility started to appeal against some of the conditions included in their Consents early in 1991. As yet, no appeals have been fully resolved by the Secretary of State.

We had decided not to process a large number of Applications until these conditions had been resolved. At the beginning of 1992 therefore, around 400 Applications were lodged with us. During 1992, we received a further 140 Consent Applications from the Utility. The proportions of applications in different categories are shown in Figure 4.1.

Because no Appeals had been resolved, and to prevent a further increase in the backlog, we issued over 300 Consents in 1992, including 58 for sewage treatment works.

4.2.3 Discharges

At the end of 1992, Anglian Water Services was responsible for the 4034 discharges:

Sewage Treatment Works	1,039
Storm Sewage Overflows	1,505
Emergency Overflows	940
Surface Water Sewers	371
from Water Treatment Works	179

4.2.4 Monitoring

The minimum frequency at which a discharge is sampled is governed mainly by its size. This is a key factor governing the potential impact of the effluent on the environment. The degree of treatment provided at the works, is also used to determine the sampling rate, as is the sensitivity of the receiving water.

Maximum frequencies ranged from weekly, for works serving in excess of 100,000 people, to quarterly for those serving fewer than 1,000 people.

Some Legal Consents contain criteria for Dangerous Substances. We monitor effluents for these at least monthly.

We aimed to inspect works with Descriptive Consents quarterly. Descriptive Consents include the need to refer to the state of the receiving water, so monitoring is co-ordinated with the inspections of these waters.

During 1992, the planned number of samples was 11,200. Because some works discharge effluents from more than one outfall, and because separate samples are required for extended suites of analysis, the actual number collected was 11,460.

4.2.5 Compliance with Standards

Two summary statistics are used to compare performance of effluent qualities with their Consents. The first, the Percent of Compliant Works, is a simple statement of the number of discharges which meet their Consent. This can be volatile and does not necessarily reflect the impact of effluents on the receiving water.

In managing the quality of receiving waters, large works are more important than small ones so we also report the percent of the total flow from all works which complies with the Consent Limits. This statistic, the Percent of Compliant Flow, is less volatile than the Percent of Compliant Works and gives a better measure of the damage which can be done by non-compliance.

The pollutants commonly associated with sewage treatment are Suspended Solids, BOD and Ammonia. These are called Sanitary Determinands. The Consent Limits for the Sanitary Determinands are 95-percentile limits. The 95-percentile is a concentration which must be met for 95% of the time. Hence a summary target which covers all discharges is a Percent of Compliant Flow which exceeds 95%.

The definition of compliance allows a certain number of sample results to exceed the limit. If the number of exceedences is more than the permitted number, then we are 95% certain that the failure is not due to chance. We then report the discharge as having failed its Consent. The numbers of permitted failures is laid down in a Look-up Table, which is referred to in the Legal Consent.

Figure 4.2 shows the performance of works against the percentile limits in their Legal Consents. The results cover all discharges which have numeric limits on the discharge quality.

Table 4.1 summarises the proportions of discharges to Non-Tidal and Tidal waters and shows the improvements seen over the last year. Although only 5% of STWs discharge to tidal waters, they account for around 20% of all flows because they generally serve larger populations.

TABLE 4.1

Sanitary Criteria

Receiving Water	Number of Discharges	Percent Compliant			
		Works		Flow	
		1991	1992	1991	1992
Non-tidal	657	94.2	99.8	91.8	93.6
Tidal	36	94.4	94.4	91.3	93.3
Total	693	94.2	98.4	91.7	93.5

FIGURE 4.2

COMPLIANCE WITH LEGAL NUMERIC CONSENTS

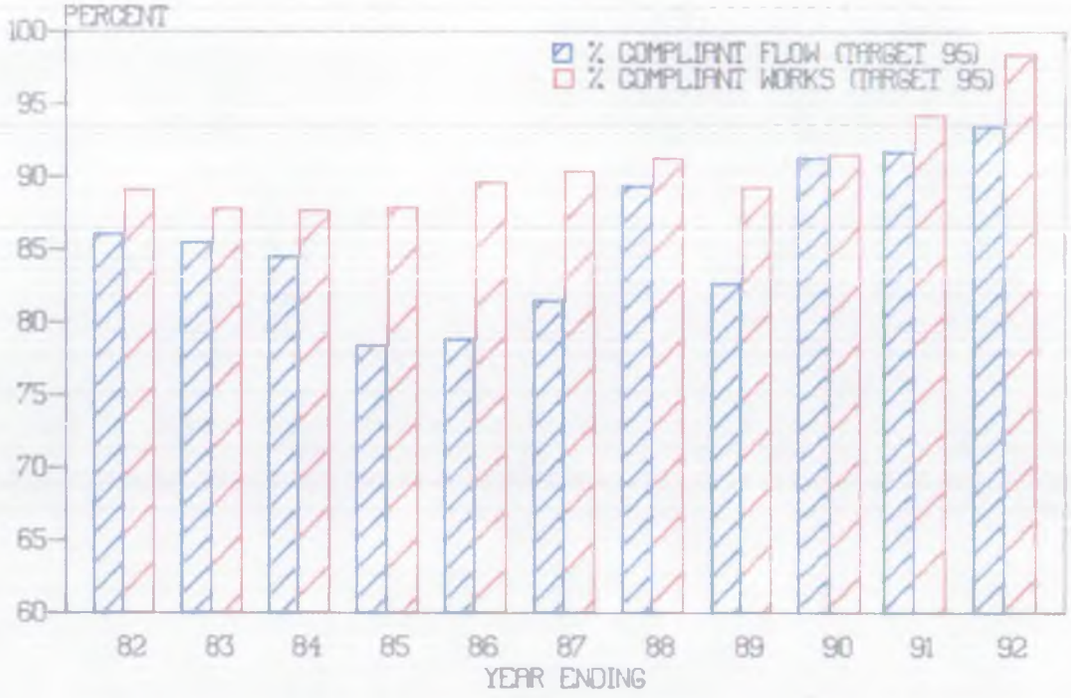


FIGURE 4.3

COMPLIANCE WITH LEGAL DESCRIPTIVE CONSENTS

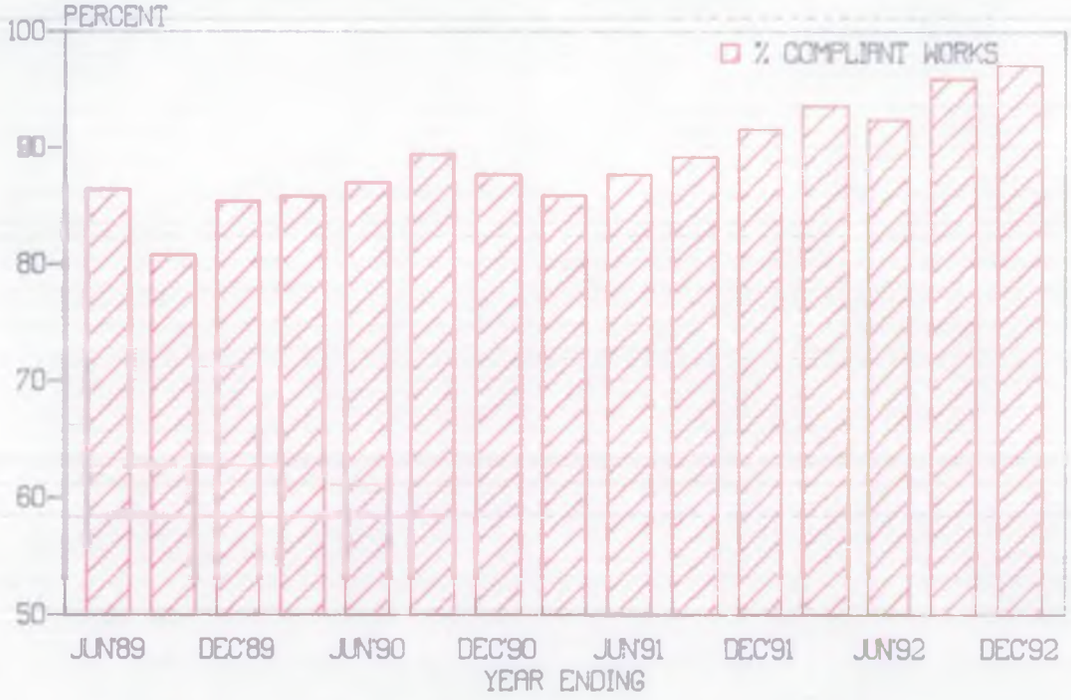
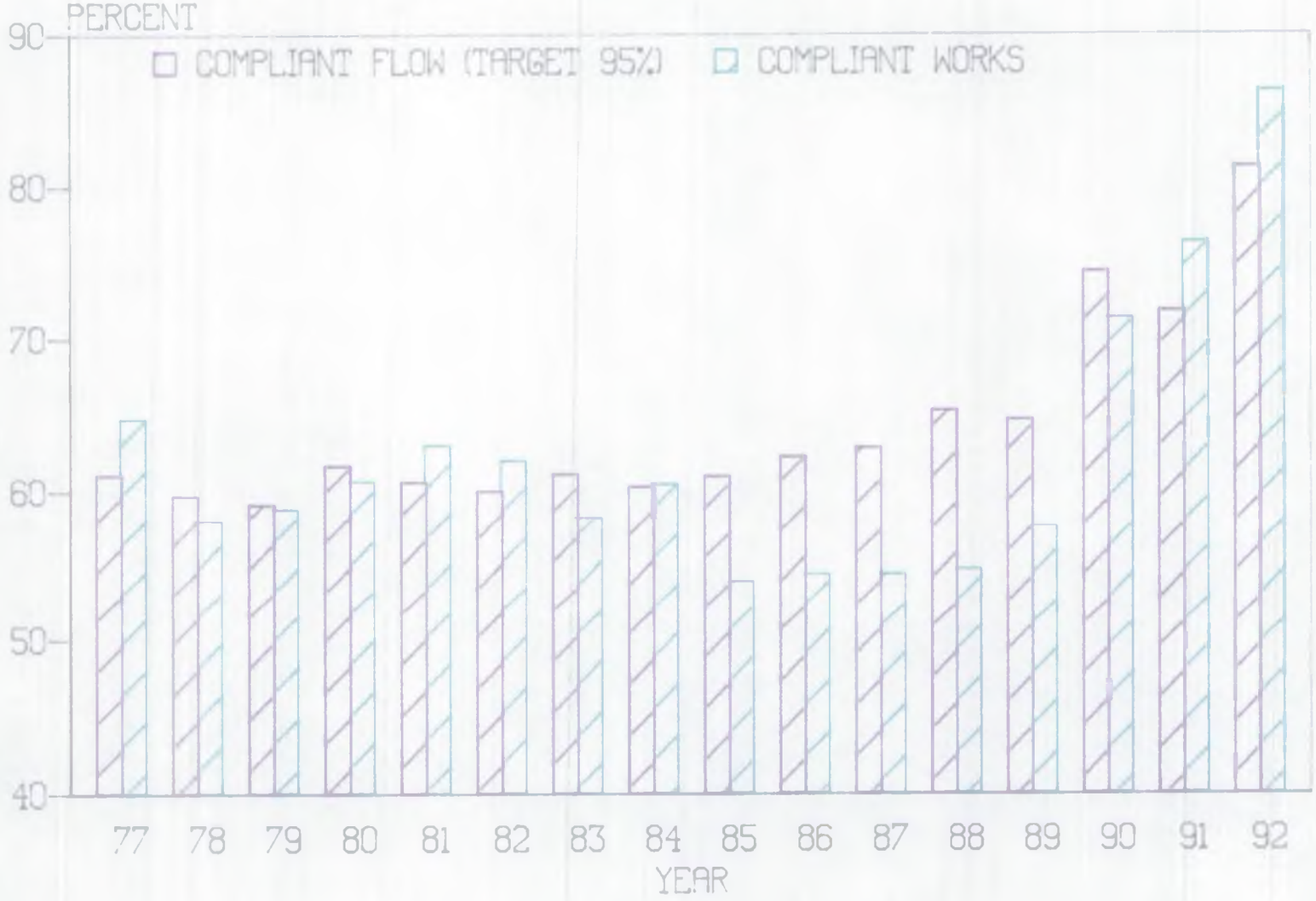


FIGURE 4.4

COMPLIANCE WITH RIVER NEEDS CONSENTS



Some works also have additional standards for sanitary determinands which are absolute limits on quality. These must not be exceeded at any time and are called Upper Tier Limits. Upper tier limits apply to works with Time-Limited Consents and all numeric STW consents issued since the NRA was formed.

The percent of discharges which fail the Upper Tier Limits in their Consents is now 4.8 (4 discharges), compared with 11.9 at the end of 1991.

Non-sanitary determinands, include List I and II metals and nutrients. In 1992, Legal Consents for 35 discharges included criteria for non-sanitary substances, generally in absolute terms. Two STWs had a single failed sample, Cambridge for lindane, and Poppy Hill for cadmium.

At the end of 1992, 354 small discharges had Legal Descriptive Consents, the same number as at the end of 1991. About 343 were inspected at least once during the year, compared with 352 in 1991.

Figure 4.3 shows how the compliance of these discharges has altered over the last two years. The proportion which complied at the latest inspection is 97% (333 discharges).

Compliance with Legal Consents is a measure of how well performance matches that imposed by enforceable standards. Against this measure, **the performance of Utility discharges is the best ever recorded,** reflecting capital investment in sewage treatment works made by the Utility over the last few years.

Performance against a River Needs Consent gives an indication of the action needed to cater for growth and achieve Water Quality Objectives. Figure 4.4 shows that since December 1991 the Percent of Compliant Flow judged against River Needs Consents has increased from 71.7% to 76.3%, and the Percentage of Compliant Works has improved from 81.2% to 86.2 over the same period. The figure was only 54% in 1988.

Can we see these improvements in absolute terms?

Nitrification is a good indicator of STW performance in Anglian Region. Table 4.2 gives estimates of the ammonia loads (as nitrogen), discharged in effluents and shows a reduction of 37% over the period 1988 - 1992:

TABLE 4.2

Effluent Ammonia Loads - Comparison between 1988 and 1992

	YEAR (Number of discharges)	
	1988	1992
Tonnes Ammonia/day	6.70 (372)	4.19 (381)

Improvements in effluents are also indicated in the median values of ammonia in rivers over recent years (see Table 2.3).

4.3 Non-Utility Discharges

4.3.1 Types of Consent

Consents for Non-Utility discharges are generally set to achieve the Quality Objectives for the receiving water. They equate to **Legal River Needs Consents** (see Part 4.2.1).

Discharges with the greatest potential to affect the environment have numeric limits in their Consents. Legally, all numeric limits for Non-Utility discharges are absolute, even those for the Sanitary Determinands. Most Non-Utility discharges are made from small, "private" sewage works and small industrial premises and they therefore have Descriptive Consents.

4.3.2 Applications for Consent

The number of Applications decreased from 490 in 1991, to 457 in 1992. Of these, 381 were for sewage effluents. The proportions of applications in different categories are shown in Figure 4.5. During 1992, 422 Consents were issued.

In addition, nearly 2,200 Variations of Consent were issued, following a review of the way discharge volume was defined. The purpose of this was to make charging more equable (see 4.7).

4.3.3 Discharges

The total of 5068 Non-Utility discharges may be categorised:

Sewage Treatment Works	3,662 *
Industrial Effluents	532
Surface Waters	755
Agriculture	68
Miscellaneous	51

* This figure excludes septic tanks of which there are 10,719.

4.3.4 Monitoring

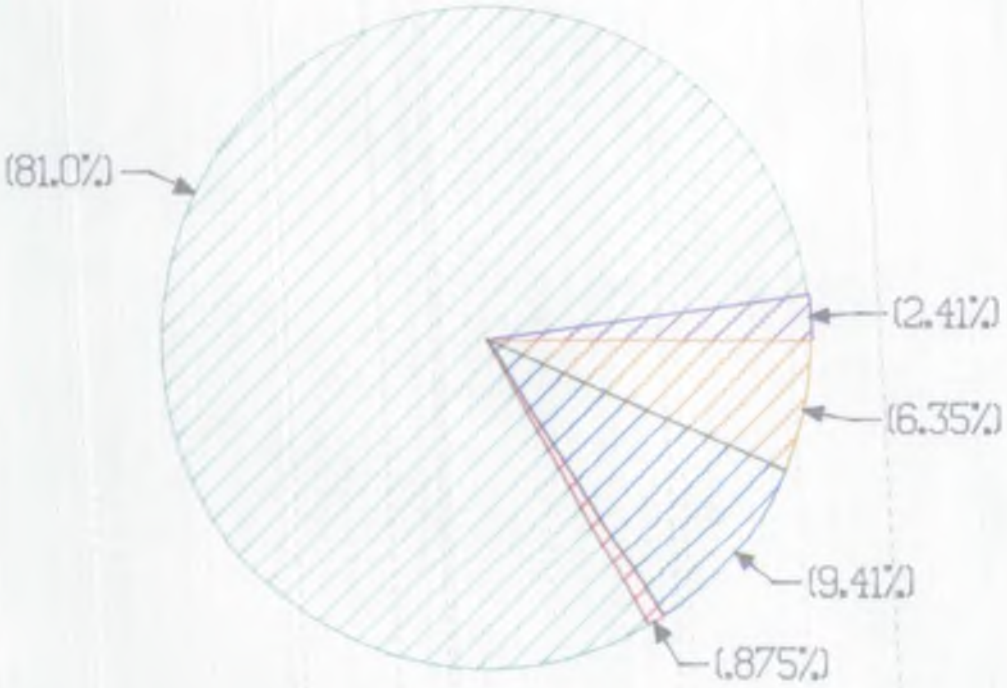
Most Non-Utility discharges are small and their potential effect on the environment is negligible. We monitor only those effluents judged to have a potential for impact (as a safeguard we rely on the biological monitoring of watercourses to tell us if we have misjudged the potential impact of discharges).

Sampling frequencies range from twice per week for the larger discharges, for example those made to the Humber, to a minimum of four times per year for smaller discharges. Some others, not on the routine sampling programme, were sampled as part of occasional inspections.

Of the 401 Private Sewage Treatment Works with numeric consent limits, 43% (173 discharges), were sampled in 1992, compared to 37% (149 discharges) the previous year. In addition, 42 discharges to Controlled Waters are made from Crown Property. These are the responsibility of the Property Services Agency.

FIGURE 4.5

NON-UTILITY : APPLICATIONS



RECEIVED

- [x] SEWAGES TO LAND
- [ ] SEWAGES TO RIVER
- [x] TRADES TO LAND
- [x] SURFACE WATERS TO RIVER
- [ ] TRADES TO RIVER

The NRA has legal powers to control only those industrial discharges which discharge direct to Controlled Waters. Over 180 industrial effluents in this category were sampled in 1992, compares with 170 in 1990. Most discharges of effluent from traders' premises are made direct to foul sewers. These are managed by Anglian Water Services and our control of these rests with setting consents for the Company's discharges from the treatment works which receive the waste.

4.3.5 Compliance

Legally, Non-Utility Consents are set as absolute values and not as 95-percentiles. On this basis, the proportion of compliant Private Sewage Treatment Works was 56% (96 discharges), compared with 40% (38 discharges) in 1991. The proportion of compliant industrial discharges increased from 46% (71 discharges), to 49% (92 discharges).

The figure for discharges owned by the Property Services Agency was 55% (24 discharges), indicating a slight improvement since 1991.

At face-value the compliance of Non-Utility discharges appears to be worse than the compliance of discharges operated by the Water Company. However, two mitigating factors must be taken into account. First we should judge the compliance of both types of discharges as 95-percentiles. Second we should compare performance using the Company's compliance with River Needs Consents. This was 86% in 1992. Table 4.3 gives figures for the Non-Utility discharges which may be compared with this:

TABLE 4.3

Non-Utility Discharge (% Compliance with Percentiles)

	1992	1991	1990
STW	88	80	73
Trade	78	72	64
Crown Properties	86	76	81

The legal compliance of Non-Utility discharges is the highest recorded.

4.4 Priority Lists and the Index of Discharge Impact

The Index of Discharge Impact (IDI) is a number which allows us to identify discharges which have the greatest apparent or potential impact on receiving waters. It is calculated from statistics for the compliance of discharges with their River Needs Consents, and from an assessment of compliance of receiving waters with their quality standards. These data are then weighted according to our views on the relative importance of different waters.

We use the IDI to produce ranked lists of discharges where we would like to see improvements in the quality of their effluents. These lists form the basis of

discussions with the dischargers, on a number of matters including investment.

4.5 Targeting and Tripartite Sampling

When the samples we take at a discharge fail to meet the Legal Consent, the discharge becomes a candidate for the routine collection of Tripartite Samples. These are samples which are specially collected, documented and analysed. The main sample is split into 3 parts: one part is analysed by the NRA, one is given to the discharger and one is held in reserve. They provide the basis for legal procedings. If more Tripartite Samples fail than is allowed by the Look-up Table, the discharger can be prosecuted in court.

At the end of 1992, we were targeting 7 utility sewage treatment works by taking tripartite samples of their effluent. Eight discharges, Briston, Southminster, Acle, Doddinghurst, Northrepps, Hexton, Wells, and Marston, had enough failed Tripartite Samples for us to be able to successfully prosecute the Utility during 1992.

4.6 Charging for Discharges

4.6.1 A scheme of charges for consented discharges has been introduced in stages since 1990. It was introduced to recover part of the costs of the NRA's pollution control function, in accordance with the Water Resources Act. There are two kinds of charge, an Application Charge, and an Annual Charge.

4.6.2 Application Charge

The charging scheme covers the processing of applications for consent. For 1992/93, the charge rates were:

Sewage effluents of less than 5 m^3/day	-	£ 60
Cooling water of less than 10 m^3/day	-	£ 60
Uncontaminated surface water	-	£ 60
All other effluents	-	£420

4.6.3 Annual Charge

In 1991, an annual recurring charge was introduced on most categories of discharge. It is due to run for three years and will then be reviewed. Small domestic sewage discharges of less than 5m^3/day are exempt.

The Annual Charge is calculated using a weighting based on the size, nature and location of the discharge, three features which influence the NRA's costs for carrying out pollution control. The weighting is multiplied by the unit charge for the financial year, which is set in agreement with the Government. For 1992/3, it is £324.

Here are some examples for a full year:

Emergency overflow from a pumping station to stream -	£ 129.60
Drainage from Trade premises to a watercourse -	£ 324.00
Cooling water of high temperature, pH or chlorinity -	£ 324.00
STW serving 1,000 people, discharging to estuary -	£ 2,916.00
Large trade effluent, toxic substances, to estuary -	£36,540.00

In 1992, charges were levied on 5,780 discharges. Of these, about 4,000 are owned by Anglian Water Services.

4.7 Integrated Pollution Control

Integrated Pollution Control (IPC) was introduced in 1991 under the Environmental Protection Act 1990. IPC is administered by Her Majesty's Inspectorate of Pollution (HMIP).

The main objective of IPC is to prevent, minimise or render harmless discharges of the most persistent pollutants entering the whole environment, i.e. air, land and water. IPC lists the specific pollutants as Prescribed Substances and the industrial processes that produce most of the prescribed substances as Prescribed Processes.

Operation of a prescribed process requires an Authorisation (a detailed regulatory document issued by HMIP). All new operations need to be Authorised immediately. It was decided to split the large numbers of existing Prescribed Processes into groups, and deal with them on a rolling programme for completion in 1996. In 1992 categories from the fuel and power industry applied, together with industries covered by the HMIP waste disposal categories and the mineral industry.

Before the introduction of IPC, all discharges to Controlled Waters required Consents from the NRA (see Part 4.1). Discharges not resulting from Prescribed Processes will continue to be dealt with in this way. However, where the significant bulk of the discharge originates from the Prescribed Process, an Authorisation will replace the NRA Consent.

The NRA is a statutory consultee in the authorisation process for sites where a discharge is made to Controlled Waters. We provide detailed recommendations to HMIP on the conditions that must be included in the Authorisation in order to control the quality of the discharge and protect the aquatic environment.

HMIP must ensure that the conditions of an Authorisation are at least as tight as the NRA recommendations, but HMIP can require more stringent limits in its Authorisations based on two principles of IPC. The first is that the operator should use the "Best Available Technique Not Entailing Excessive Cost" (BATNEEC) to minimise all discharges from the process, and the second that the operator should choose the "Best Practicable Environmental Option" (BPEO) for any discharge made.

During 1992, we were consulted on 32 IPC applications, most of which were for the area of the South Humber Bank. As a result, improvement programmes have been secured for these effluents.

IPC is a step towards the complete integration of pollution control under the auspices of an Environmental Protection Agency.

5.1 Information

The Register contains copies of 34,000 Consent records, including Variations and Revocations. Of this total, 20,000 are for current, active discharges. About 600 Applications were added in 1992. Details are retained on the Register until 5 years after Consents are revoked.

Since June 1992, the Register has held copies of all Applications and Authorisations issued by HMIP, for sites in Anglia (see Part 4.7), together with paper records of analytical data for the Prescribed Processes, supplied by HMIP.

The Register also makes available the results of analysis of 326,000 environmental and effluent samples taken since August 1985. Results from new samples are being added at 50,000 per year. In all, the Register gives public access to several million analytical results.

5.2 Enquiries

During 1992, the number of Register enquiries increased by 32%. A total of 644 enquiries for information were received, of which 230 were from students. Scholars ranging from junior school to research student levels, make extensive use of the Register facilities to assist with their studies. Trends and categories of enquiries are shown in Figure 5.1.

The NRA also provides information not required to be held on the Register. This includes data on biology, fisheries and sediments. The Freedom of Access to Environmental Information Regulations (see Part 2.7.8), introduced in 1992, give statutory force to this practise.

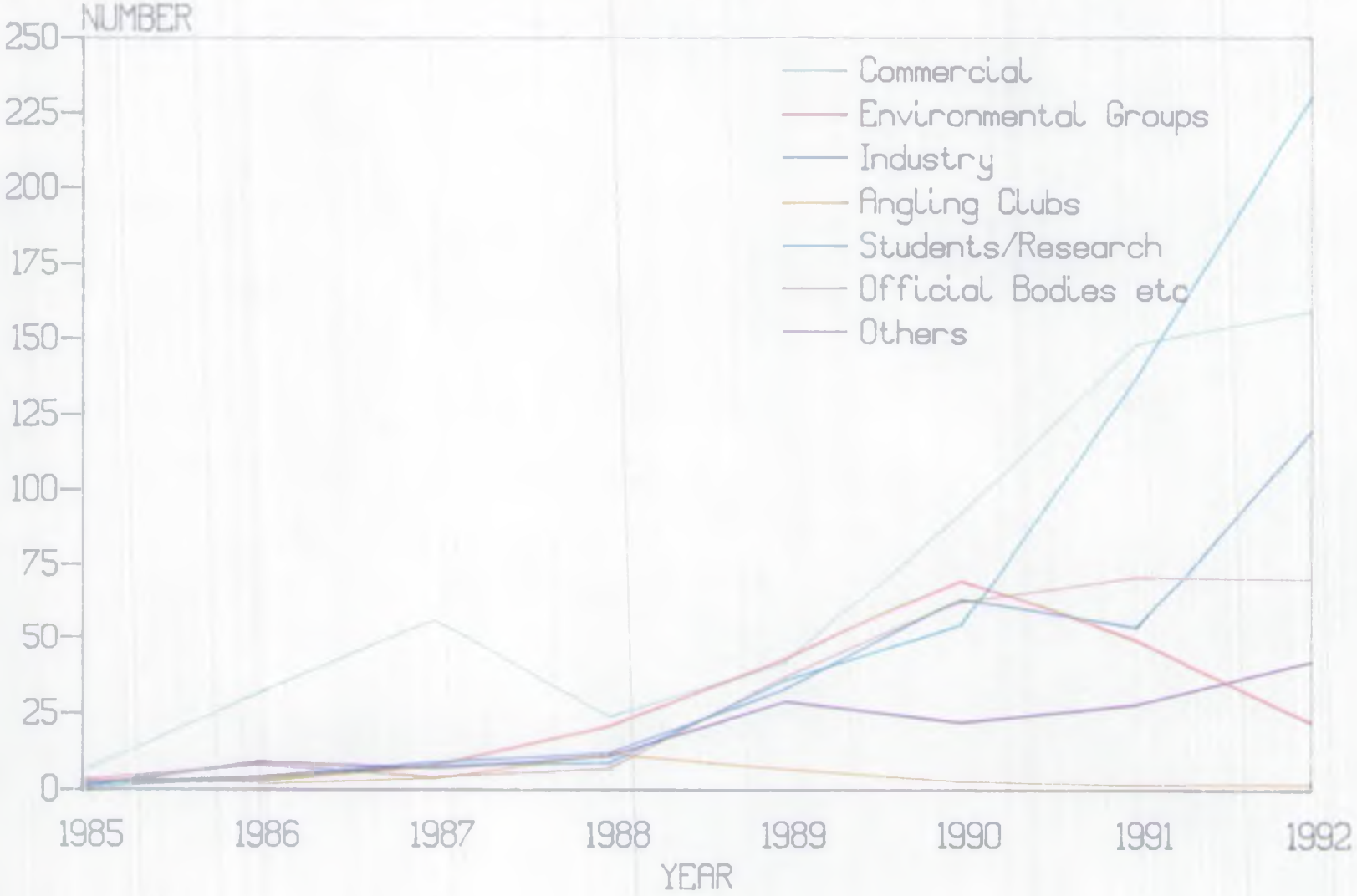
Immediate access is provided for sample results from August 1985. Results for samples of environmental waters prior to August 1985 can also be made available on request.

The Register uses a computer-based mapping system. An example is given in Figure 5.2. This makes it easier for the enquirer to find out what is available. As well as enhancing the display of data, the system assists with data retrieval.

The Register is kept at Peterborough and is open on weekdays (except Bank Holidays) from 9.30 to 16.00. Inspection of the Register if free. A small charge may be made for data retrieval.

FIGURE 5.1

WATER ACT REGISTER ENQUIRIES




SP
Altcnburn Brook
Brathain
SP999 610

FIGURE 5.2

EasyMap

NRA Anglian

Freshwater and AWS monitoring near Brampton.

Date: 01-09-93
Time: 15: 45
Scale=1: 150949

Site Icon Key
- Freshwater
- Saline Water
- Sediment
- Groundwater
- Biology
- AWS
- Non-AWS

No. of Sites=49

EasyMap Version 1.6h, Aug.1993

Part 6: CAPITAL DEVELOPMENT PROGRAMME

The initial budget awarded for Capital Development in the financial year 1992/93 was £737,000. Later additional sums raised the final programme total to £787,000.

The number of schemes funded by the Department of the Environment was 54. Assets developed under these schemes are as follows:

TABLE 6.1

DOE ENVIRONMENTAL CAPITAL PROGRAMME

Type of Asset	Number	Cost (£ 000's)
Water Quality Monitoring Stations	6 (8)	98 (87)
Pollution Control	18 (7)	201 (148)
Marine Survey Facilities	6 (7)	98 (375)
Scientific Equipment	11 (13)	84 (201)
Laboratories	13 (9)	306 (480)
Totals	54 (44)	787 (1,291)

Figures for 1991/92 are given in parentheses.

These figures reflect an increased commitment to investigating and remedying pollution, especially of groundwaters, and the continuing development of analytical facilities.

7.1 Scope

The Authority has a statutory duty to undertake research to support its functions.

Throughout a project, the benefits are assessed and contrasted against risks and costs. This ensures that projects are developed cost-effectively, using the most appropriate option to address the Authority's needs. Competitive tendering is used to derive the best price for the required work.

There are two research programmes. These are the National R&D Programme, which addresses National issues, and the Regional Operational Investigation Programme, which covers projects of a site- or Region-specific nature, within Anglian.

We maintained our commitment to the National R&D Programme, with 29 staff leading 41 projects. We have already developed areas of expertise in Blue-green Algae, Water Resource Management, Coastal Engineering and Groundwater Management, and these were consolidated in 1992 with the addition of more projects in these areas. Our National R&D expenditure of £948,000 for the fiscal year 1992/93 was the largest of any Region within the NRA for the third successive year.

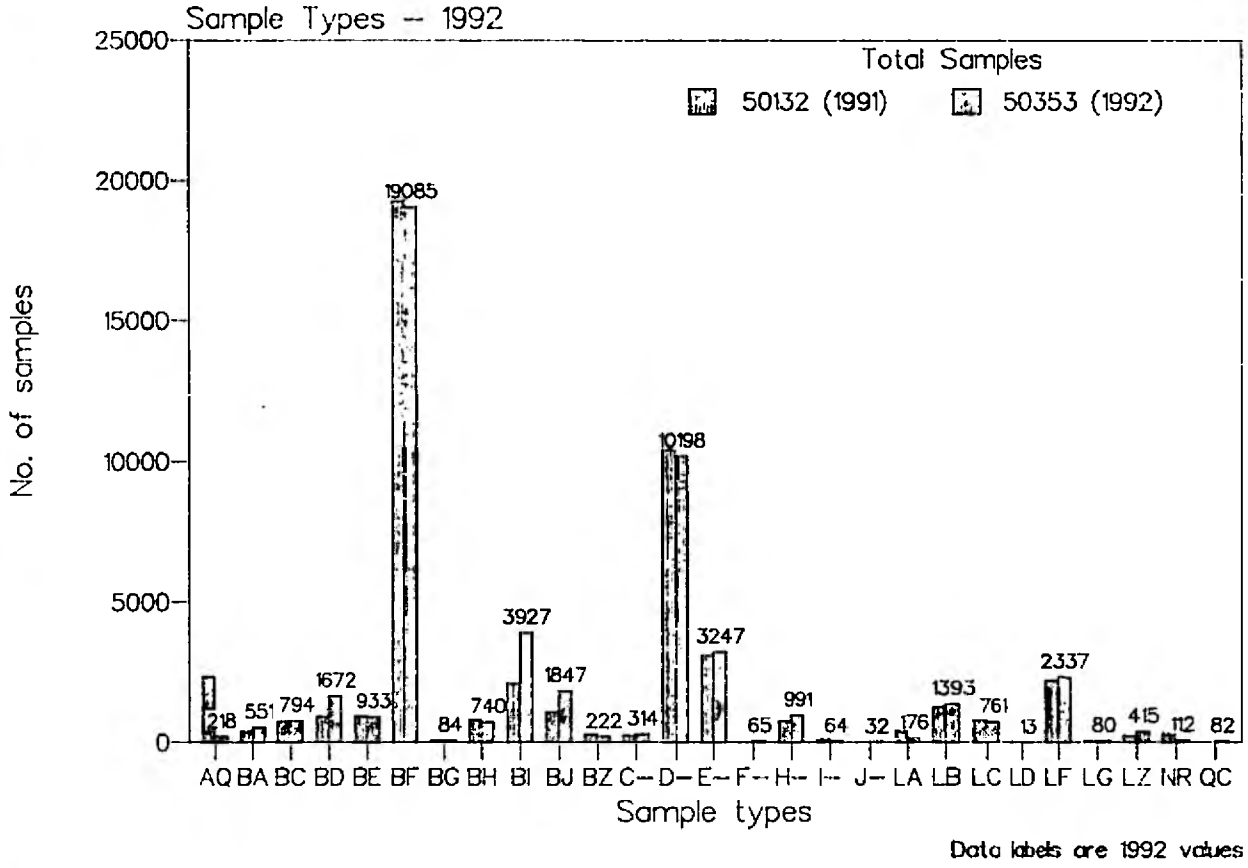
We developed and managed 27 projects in our Regional Operational Investigations Programme in 1992. Expenditure was £452,000, a reduction of £121,000 from the previous year. This was because of a reduction in the number and size of new projects, and an increase in projects in the National R&D Programme which address Regional issues. External collaborative funding contributed £16,000 to these projects.

7.2 Benefits

Benefits from research projects include:

- development of approaches and policies to ensure the fulfilment of statutory duties;
- responses to new environmental challenges;
- development and application of innovative approaches, novel methods or techniques;
- improvements in effectiveness and efficiency; and,
- furthering our understanding of the aquatic environment.

Fig. 8.1 – Sample Breakdown



SAMPLE TYPES

AQ	Analytical Quality Control
BA	Reservior Water
BC	Spring/Artesian Water
BD	Pumped Groundwater
BE	Static Groundwater
BF	River/Stream Water
BG	Canal Water
BH	Lake/Broad/Pond etc.
BI	Estuarine Water
BJ	Coastal Water
BZ	Miscellaneous Environmental Water
C-	Any Supply Water
D-	Any AWS 'D' Type Effluent
E-	Any AWS 'E' Type Effluent
F-	Any Leachate
H-	Any Solid
I-	Any Biota
J-	Any WTW Effluent
LA	AWS STW Final Effluent
LB	Non-AWS STW Final Effluent
LC	Surface Water Drainage
LD	Any Other Sewage Discharge
LF	Industrial Effluents
LG	Agricultural Effluents
LZ	Miscellaneous Discharges
NR	NRA - Samples from other NRA Regions
QC	Quality Control - Inter-Laboratory Calibration

Part 8: CHEMICAL LABORATORY SERVICES

The Regional Chemistry Laboratory officially received National Measurement Accreditation Service (NAMAS) accreditation, in May, 1992. This is an internationally recognised mark of quality assurance which imposes strict operating and audit procedures on the laboratory. We have continued to operate under this scheme and the schedule of accredited analytical methods has been extended to cover more than 400 tests.

The Region organises the analysis of ranges of determinands as sets or **Suites**. In total, these number about 200, and cover determinands to be analysed for **Uses** (e.g. the Surface Water Directive), as **Groups** (e.g. List II metals) and for **Site-specific** purposes (e.g. of an effluent with a very complex set of, specific Consent conditions). The most comprehensive suite requires the analysis for over 90 determinands.

All analyses are carried out using strict methods of control on precision. As part of the NAMAS scheme the laboratory runs a quality control check on every batch of samples. The checks showed an overall improvement in performance throughout the year.

In addition, the laboratory participates in the National Marine and AQUACHECK Quality Control Schemes organised by the Water Research Centre. Performance in both is good and still improving. The laboratory has been ranked highly in the marine scheme by a working group set up by the National Marine Monitoring Group.

During the year, new equipment was purchased to replace ageing technology and to improve capacity and efficiency.

Numbers of samples handled for routine monitoring purposes are given in Table 8.1. A number of unplanned samples are also analysed by the laboratory. These may be taken, for example, in response to a pollution incident. The total number of samples processed in 1992 was 50,353, and the total number of analyses was 451,721. A breakdown of the total number of samples taken during 1991 and 1992 is shown in Figure 8.1. The range of determinations continues to increase, particularly for organic solvents and pesticides where groundwater investigations have resulted in an increasing volume of work.

Figure 8.2 shows the continuing increase in workload which the laboratory dealt with during 1992.

Over 600 Tripartite Samples (see 4.5) were analysed in 1992. Analysis, handling the associated documentation and appearances in court create a large workload.

The Regulations on the Control of Substances Hazardous to Health (COSHH) require that inventories of substances are maintained, written procedures produced, training records maintained, and audits performed. The Regional Chemical Laboratory continued to maintain an audit system for all laboratories in the Region.

In addition, the COSHH panel systematically checks a number of laboratories against a formal audit procedure. The laboratory was audited as a trial in 1992, and was found to provide a high degree of compliance with Health and Safety requirements. This was confirmed by the National Health and Safety Advisor.

The concept of Market Testing was introduced into NRA laboratories during 1992.

TABLE 8.1

Routine Sampling Programme: Planned and Actual

Type of sample	SITES		SAMPLES	
	Planned	Actual	Planned	Actual
Controlled Waters:				
Lakes & Reservoirs	70	67	1,441	1,009
Biota	29	33	41	64
Rivers	1,136	1,187	14,108	14,507
Groundwaters	666	715	2,581	2,558
Freshwater sediments	74	76	135	140
Estuaries	119	372	1,267	3,444
Coastal waters	51	200	1,050	1,777
Saline sediments	67	89	85	193
All Discharges	1,649	1,790	16,724	15,373
Total	3,879	4,529	36,382	39,065

Fig. 8.2 – Determinands per Year

Fig. 9.1 – Sample Breakdown

By District – 1992

Note: Norwich District also includes samples taken for Broads Research

Fig. 9.2 – Total Samples per Month 1992

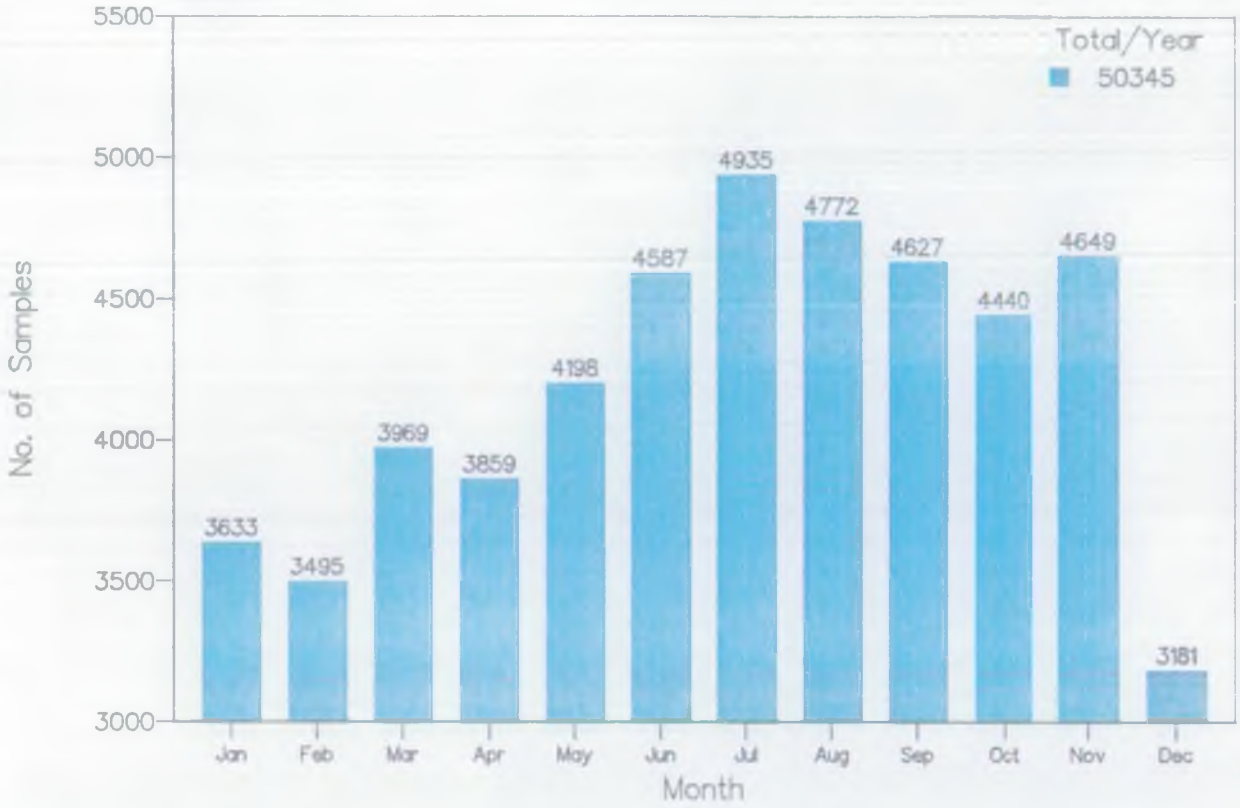


Fig. 9.3 – Total Determinands per Month 1992

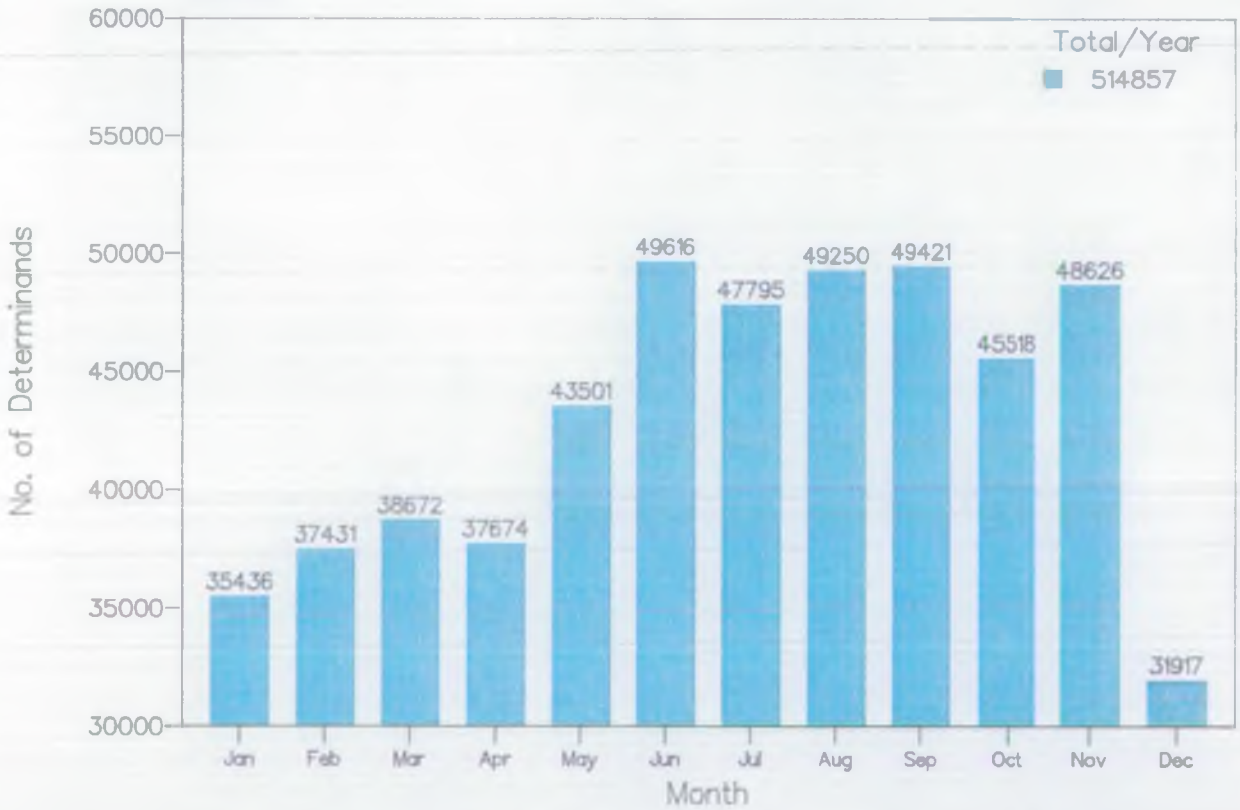
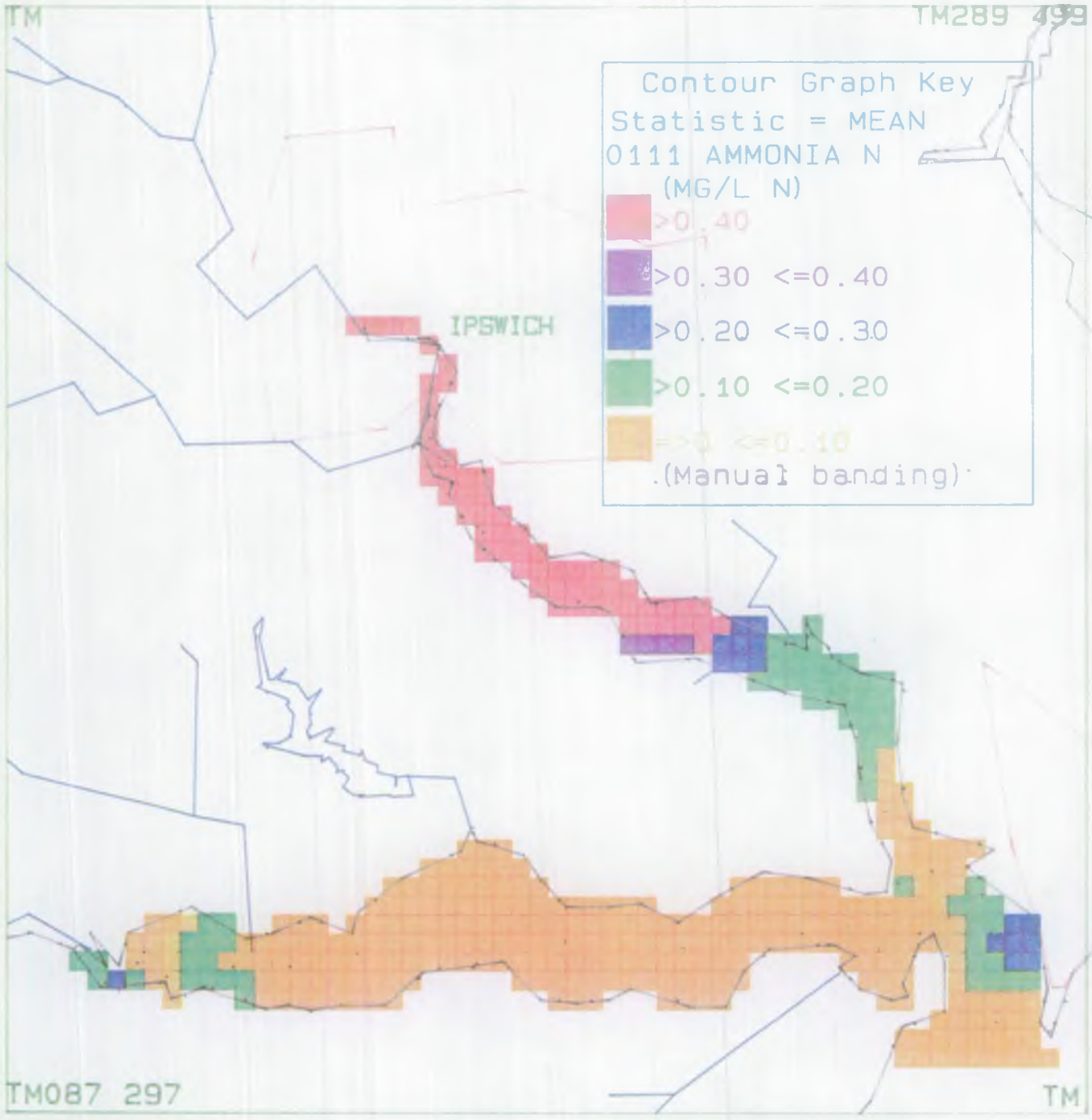


FIGURE 9.4


TM
TM289 499
Contour Graph Key
Statistic = MEAN
0111 AMMONIA N
(MG/L N)
>0.40
>0.30 <=0.40
>0.20 <=0.30
>0.10 <=0.20
<=0.10
(Manual banding)
IPSWICH
TM087 297
TM
Stour & Orwell
Estuaries 1992.
Mean Ammonia, mg/l

Water Quality monitoring is a complex process. Thousands of sites are sampled and hundreds of thousands of analytical results are generated and reported each year. Efficient management would be impossible without computer-based systems for handling information.

The Laboratory Information Management System (LIMS) is operated on a network of PCs, and permits direct capture of analytical results via links to analytical equipment. However, it is much more than simply a data archive; it helps us to manage our monitoring resources by co-ordinating sampling, analysis and storage of results. Validated results are transferred to the Region's Bull mainframe computer for secure long-term storage and for access by the Water Resources Act Register (See Part 5), and a large number of Users.

During 1992, the LIMS has been improved, with better connections to equipment and software, as well as the addition of a package of sample and data management procedures. Examples of routine reports are shown in figures 9.1 to 9.3. The new procedures have helped to ensure that we target sampling and analytical resources even more efficiently.

The Sampling Information Management System (SIMS) is a PC-based system which brings together the various monitoring requirements for each site and confirms that LIMS is set up to analyse for all the requirements. In 1992 we extended SIMS to include new software to audit the chemical sampling programme.

SIMS also contains code to convert data from a variety of sources into a single database format. In 1992 we added to the number of possible conversions and wrote software to populate a chemical database from scratch.

We use another in-house software package, the Water Quality digital mapping system called EasyMap, to display and plot the location of discharges and sampling points in the region. It can also display chemical data over its background map, and in 1992 we extended the display software to handle bubble graphs and contouring (see Figure 9.4). New digital networks were created, and software was developed to link EasyMap to a waste disposal site database, and a conservation site database.

The Water Quality Section acquired a PC version of an Intergraph Geographical Information System (GIS).

In addition, we converted a number of compliance reporting routines from the mainframe to PC. We continued to contribute to the National Water Archive and Monitoring System (WAMS) project, defining its content and operation. A number of our software facilities, including our library package (INFO), are now in use in other Regions and at National Head Office.

Appendix I: Biological Sampling 1992

1. Freshwater - Rivers

a. Macroinvertebrates		
Routine	2,387	(3,656)
Pollution	353	(292)
Special investigation	297	(143)
Others	140	(155)
b. Macrophytes	3	(161)
c. Microbes	392	(967)
d. Phytoplankton/Blue-green algae	2	(118)
e. Zooplankton	0	(81)
f. Others	0	(18)
Total	3,574	(5,591)

2. Freshwater - Lakes

a. Macroinvertebrates	1,820	(1,169)
b. Macrophytes	237	(78)
c. Microbes	53	(25)
d. Phytoplankton/Blue-green algae	1,135	(1,185)
e. Zooplankton	1,092	(851)
Total	4,337	(3,308)

3. Estuary and Coastal waters

a. Macroinvertebrates		
Intertidal	354	(676)
Subtidal	528	(813)
b. Intertidal algae	22	(19)
c. Microbes	1,929	(2,113)
d. Phytoplankton	243	(94)
e. Zooplankton	66	(60)
f. Beam trawl	37	(14)
Total	3,179	(3,789)

4. Borehole

a. Microbes	4	(4)

Appendix II: Prosecutions brought to Court

Incident	Hearing	Defendant	Fine (£)	Costs(£)
Trade effluent, River Thet, Old Buckenham	12.2.92	Poplar Pigs (Banham) Ltd	750.00	614.51
Trade effluent, Black Brook, Gt Horkesley	14.2.92	P G Pix (Farms) Ltd	750.00	620.21
Trade/sewage effluent, Goldsand Bridges Ditch	25.2.92	Anglian Water Services	500.00	1272.77
Trade/sewage effluent, Fossdyke Navigation, Spilsby	28.2.92	Mr R A Cawthorne	200.00	83.84
Trade effluent, unnamed tributary, Ramsey River at Harwich	14.4.92	Harwich Packing Company	500.00 750.00	1,027.37
Trade effluent, River Colne	15.4.92	Colne Valley	500.00 750.00	700.00
Trade effluent, Wootton Brook, Blisworth	24.4.92	ABP (Holdings) Limited	2,000.00 2,000.00 2,000.00 2,000.00	1,000.00
Trade effluent, unnamed tributary, River Fromus, Benhall Green	30.4.92	C Fidler Limited	400.00	520.00
Pig slurry, Bourne Brook, Caxton	11.5.92	Mr Millard and Sons	2,000.00 2,000.00	1,166.58
Trade/sewage effluent, River Mun, North Repps	15.5.92	Anglian Water Services	1,500.00	609.50
Trade effluent into a tributary, River Nar, Beeston	20.5.92	Norfolk Farm	2,000.00	658.94
Trade/sewage effluent, River Wid, Chain Bridge, Doddinghurst	20.5.92	Anglian Water Services	4,000.00	656.00
Pig slurry, ditch entering Sharn Brook	01.7.92	Bedfordia Livestock Limited	10,000.00	948.90
Trade effluent into a tributary of the River Till	03.7.92	John Sheard (Farms) Limited	2,000.00	500.00
Trade effluent, North Sea, Bacton	03.7.92	Amoco (UK) Exploration Co Limited	7,500.00	661.62

Incident	Hearing	Defendant	Fine(£)	Costs(£)
Sewage effluent, tributary, tidal channel of Wells Creek	07.7.92	Anglian Water Services	18,000.00	961.52
Trade/sewage effluent, River Wissey, Stoke Ferry	23.7.92	British Sugar Plc	3,000.00	785.00
Trade/sewage effluent, tributary, Hexton Brook, Hexton	24.7.92	Anglian Water Services Limited	3,000.00	250.00
Trade/sewage effluent, tributary of the River Wensum	28.7.92	John Allpress (Fakenham) Limited	1,000.00 1,000.00	683.21
Trade effluent, ditch leading to North Benfleet Brook, Wickford	31.7.92	Philpot and Sons	500.00	749.92
Trade effluent, Pike Drain at Lincoln	17.7.92	Ruston Gas Turbines Limited	30,000.00	2,750
Pig slurry, tributary, River Til	22.7.92	Mr J E Walsh	500.00 500.00	674.75
Sewage effluent, tributary of the River Ter at Black Notley	23.7.92	Woodlands Nursing Home Limited	4,300.00	610.89
Trade/sewage effluent, tributary of the River Sapiston	31.7.92	David Black and Son Limited	1,500.00	482.15
Trade effluent, Clipstone Brook, Lake Street, Leighton Buzzard	05.8.92	Safeway Plc	5,000.00	596.16
Waste cutting oil, Stambourne Brook	23.9.92	R D Argent	600.00	500.00
Trade effluent, Bar Drove Drain	07.10.92	Hannam and Davy Limited	1,000.00	951.00
Trade effluent, tributary of Layer Brook, Tiptree	09.10.92	Wilkin and Son Limited	2,500.00	854.00
Trade effluent, tributary, Usselby Beck	12.10.92	J H Fenwick	1,500.00	770.00
Trade effluent, moat at Fenstanton	19.10.92	Dairy Crest Limited	4,500.00	100.00
Trade/sewage effluent, Mill Stream at Marston	22.10.92	Anglian Water Services Limited	3,000.00	465.00

Incident	Hearing	Defendant	Fine(£)	Costs(£)	
Trade effluent, tributary of the Chickering Beck	29.10.92	Norfolk Smokehouses Limited		300.00	791.00
Agricultural chemical Chadd Brook	06.11.92	K L Rush		500.00	500.00
Farm waste, Maulden Brook	25.11.92	J F Goodge		Absolute Discharge	400.00
Trade effluent of the River Colne	18.11.92	Acrilite Limited		2,000.00 2,500.00	814.35
Farm oil spillage, River Wissey	18.11.92	South Pickenham Estate Co Limited		250.00	452.36
Trade effluent, tributary, Black Bank Drain	10.12.92	Steven Layn, T/A Layn Produce		1,000.00 1,000.00	668.00

Appendix III: Formal Cautions Issued

Incident	Defendant	Date Issued
Industrial Effluent; R Chater	Castle Cement	11.02.92
Farm effluent; IDB Drain	N D Thomas	04.03.92
Farm effluent; St Botolph's Brook	G M Knighton	26.03.92
Sewage effluent; Fen Creek	Anglian Water Services	08.05.92
Industrial waste; Ditch to R Ter	Lord Rayleigh Farms	07.05.92
Piggery effluent; Yardley Hastings Br	I R Brisby	23.07.92
Oil; R Ouse	C G Holton Sons	03.08.92
Industrial effluent	Harcros Chemicals	12.08.92
Sewage effluent	Kings Lynn BC	11.08.92
Farm waste	Winter & Ptnrs	08.08.92
Effluent	Ashby St Legers Farm	18.08.92
Industrial Chemical Trib. North Lynn Drain	Dow Chemicals	30.09.92
Oil; Padholme Drain	Peterborough Crane Hire Ltd	13.10.92
Farm waste; R Blackwater	S Eglington	12.10.92
Farm waste; Sprindlington Beck	Sprindlington Manor Farm Ltd	12.09.92
Farm waste; Fen Dyke	Smart Bros	18.11.92

Farm waste; R Deben	David Ian Risk	10.12.92
Farm waste; R Deben	Ruth Risk	11.12.92

GLOSSARY

ASPT	Average Score Per Taxon. This is calculated by dividing the biological score (BMWP score) (ibid) by the total number of macroinvertebrate families in the sample.
Aquifer	Layers of underground porous rock which contain water and allow water to flow through them.
Analytical Quality Control	Systems which monitor and control the precision, accuracy and comparability of results.
Blue-Green Algae	Ubiquitous, usually microscopic plankton that can form dense, floating scums in stillwaters during calm weather. Strictly speaking, they are not algae, but Cyanobacteria.
BMWP	An index of biological quality devised for the 1980 National River Quality Survey. The score increases with increasing water quality.
BOD and BOD (ATU)	Biochemical Oxygen Demand. A measure of the amount of oxygen consumed in water, usually by organic pollution. Oxygen is vital for life so the measurement of the BOD tests whether pollution could affect aquatic animal. The value can be misleading because much more oxygen is taken up by ammonia in the test than in the natural water. This effect is suppressed by adding a chemical (Allyl Thio-Urea) to the sample of water taken for testing. Hence BOD(ATU).
Cadmium	A very toxic heavy metal with a wide variety of uses.
Carbon tetrachloride	An organic solvent commonly used as a dry-cleaning agent.
CEWP	An acronyn for the Classification of Estuaries Working Party.
Chloroform	An organic solvent commonly used throughout industry.
Coliforms	Bacteria found in the intestines and faeces of most animals. Their presence indicates faecal pollution by humans or animals.
Controlled Waters	All rivers, lakes, groundwaters, estuaries and coastal waters.
COPA (Pt II)	Part II of The Control of Pollution Act, 1974. Part II is the section dealing mainly with water.
COSHH	Regulations concerning the Control of Substances Hazardous to Health.
Cyprinid Fish	Coarse fish like roach, dace and bream.
DDT	An acronym for Dichloro-diphenyl- tetrachloroethane. This is a persistent organochlorine pesticide no longer approved for use in the

	United Kingdom.
Determinand	A general name for a characteristic or aspect of water quality. Usually a feature which can be described numerically as a result of scientific measurement.
Direct Data Capture	The collection of analytical results from laboratory instruments, by linking the instruments directly to a data storage system - usually a microcomputer.
Dissolving Zinc Anode	A zinc block found on boats. It is designed to dissolve and prevent corrosion of other metal fittings on the boat.
Drins	The abbreviated name for a group of persistent Organophosphorous insecticides, including Aldrin, Dieldrin and Isodrin.
Ecological Quality Index	This describes how close biological quality is to expectations. An index of 1.0 indicates that the animals are unaffected by adverse conditions.
Environmental Quality Objective	A Use or target for a Controlled Water, which the NRA will aim to maintain or secure, e.g. a coarse fishery.
Environmental Impact	A procedure by which a developer assessment describes the effect of his proposals on the Environment. The purpose is to provide information to the public and to decision taking bodies. For big projects the procedure is controlled by an EC Directive.
Ethyl Acrylate	A volatile organic chemical used in the manufacture of plastics.
Eutrophication	The process of nutrient enrichment of surface waters; often the cause of unsightly growths of microscopic plants (algae).
Faecal Coliforms	Usually taken to be synonymous with *Escherichia coli* (*E. coli*). These are coliform (ibid) bacteria characteristic of faecal pollution of mammalian origin. These bacteria are relatively harmless but their presence indicates that harmful micro-organisms may also be found.
Groundwater	Underground water especially in or from aquifers (ibid).
Harmonised Monitoring Site	A site agreed with the DoE under the Harmonised Monitoring Scheme devised in 1974. The sites are used to assess input loads from rivers to estuaries and identify long term trends.
Hexachlorobenzene	A fungicide commonly used for treating cereal crops.
Hexachlorobutadiene	An intermediary compound commonly used in the plastics industry, particularly in Europe.
Invertebrates	A general term for all animals without backbones,ie. all groups except

	the vertebrates.
Legal Consent	The legal permission to make a controlled discharge of any effluent or other matter. Consents are issued under the Water Act (1989).
Lindane	An organochlorine insecticide (1,2,3,4,5,6-hexachlorocyclohexane, also known as Gamma-HCH).
LIMS	Laboratory Information Management System. This is based on micro-computers and generates schedules for sampling and analysis, captures data from instruments, and evaluates and archives the results.
Look-up Table	The numbers of permitted failures in a set of samples is laid down in a Look-up Table, which is referred to in the Legal Consent (ibid).
Mercury	A very toxic heavy metal with a wide variety of uses.
Microcystin-LR	The most commonly occurring toxin in blue-green algal blooms. It is produced by a number of blue-green algae.
Multiple Regression	A mathematical technique for identifying an association between sets of data, for example, river flow and river quality.
NAA	Nitrate Advisory Area. An area where nitrate concentrations in drinking water sources exceed or are at risk of exceeding the EC Drinking Water Directive limit. Free advice is offered to farmers on how to modify current agricultural practice to reduce nitrate leaching to controlled waters.
NSA	Nitrate Sensitive Area. An area where nitrate concentrations in drinking water sources exceed or are at risk of exceeding the EC Drinking Water Directive limit. Payments are name to farmers who voluntarily restrict agricultural practices to reduce nitrate leaching to controlled waters.
NWC Class	A summary of the quality of river based largely on the measured chemical quality. Used by the Government to report on river quality. Originally devised through the National Water Council.
PCB	Polychlorinated Biphenyls. These substances were widely used in the manufacture of electrical insulators.
Pentachlorophenol	An organochlorine fungicide, used primarily for timber preservation.
POLLEASE	A computer-based system for recording pollution incidents
Property Services Agency	The organisation that administers and maintains Crown Property.
Remote-sensing	Formally called a Compact Airborne Spectral Imager, this

Scanner	instrument senses and records 288 bands of reflected water colour, for later comparison to results of water quality samples.
River-Needs Consent	The quality standard required of an effluent in order to achieve Water Quality Objectives (ibid), usually calculated for some estimate of the future flow from a treatment works.
River Quality Indices	A management tool for summarising data used to ensure the sampling programme is achieved, to set management targets, and to alert management to strategic problems of water quality.
River Quality Objective	See Environmental Quality Objective.
Salmonid Fish	Game fish, e.g. trout and salmon.
Surface Water	Rivers, canals, lakes or impoundments.
Taxon	A specific group of macroinvertebrates (a family)
Tetrachloroethylene	A chlorinated organic solvent commonly used as a dry-cleaning agent.
Time-Limited Consent	Legal Consent conditions for the sewage treatment works owned by the Utility, which apply for a limited period of time and only to works where provision has been made for improving the quality of the effluent by capital investment.
Trichlorobenzene	A chlorinated organic solvent.
Trichloroethylene	A chlorinated organic solvent used as a dry-cleaning agent.
Water Act Register	Formerly the COPA Register (see Part 5).
1-2 dichloroethane	A chlorinated solvent used as a de- greasing agent.
95-percentile Standard	A level of water quality, usually a concentration, which may be exceeded for 5-percent of the time. Many water quality standards are expressed as 95-percentiles.
1990 River Quality Survey	The national survey of the quality of rivers, canals, lakes and estuaries which was carried out by the NRA in 1990.