NRA

National Rivers Authority
Anglian Region

NRA Anglian 149

Water Quality Report - 1990

BACKGROUND

The National Rivers Authority (NRA) is charged with the duty of improving the quality of the Water Environment. The Authority is a public body which came into being in September, 1989.

The NRA operates through a Board and National Head Office. The Anglian Region is one of ten Regional Units.

This report describes trends in water quality and the key events which happened in 1990 in the Anglian Region.

This year we have continued to build on the organisation of the Region within the context of our new national identity and objectives. At the same time, we have maintained continuity with past activities and helped to develop and implement policies which will address our future tasks.

EXECUTIVE SUMMARY

We report trends in the quality of rivers over the past seven years. About 4% less of river lengths complied with River Quality Objectives than in 1989. The main causes are dry weather and a switch in the emphasis of monitoring. The change appears not to have been caused by discharges of sewage effluent.

We discuss the 11-year trend in the biological quality of rivers. There has been an improvement since 1989.

A few sites failed criteria for the Dangerous Substances Directive.

The trend in pollution incidents since 1974 is reported. The total number in 1990 was 1,885, an increase of 14% on 1989.

We report trends in river water nitrate concentrations since 1935.

Water-based recreation was disrupted at many lakes and reservoirs by Blue-green Algae.

We report trends in the quality of Bathing Waters since 1986. In 1990 the number of failed waters improved to two.

We provide trends in the performance of discharges since 1982. The proportion of sewage treatment works operated by Anglian Water Services, which complied with their Consents in 1990 is 91% - an improvement since 1989.

The number of enquiries of the Water Act Register has increased steadily since it opened in 1985. There were over 350 in 1990, an increase of 85% since 1989.

In 1989, we took over 36,000 samples for chemical analysis for audit purposes. We used River Quality Indices and the Laboratory Information Management System to ensure efficient use of this resource.

In preparation for calculating the measures needed for achieving Water Quality Objectives we have completed further mathematical models of rivers, estuaries and coastal waters.

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Part 1. INTRODUCTION

1.1 National Aims

The Authority's responsibility for the quality of the water environment extends to all Controlled Waters. Controlled Waters include rivers, lakes, groundwaters, estuaries and coastal waters.

The Authority has stated that it will protect and improve the Water Environment. The NRA aims 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 as possible, to recover the costs of improving the water environment from those who benefit;
- assess performance towards achieving Environmental Quality Objectives and identify overall trends in water quality.

1.2 Duties

The prime duties of the NRA include:

- to achieve Water Quality Objectives in all Controlled Waters;
- to monitor the extent of pollution in Controlled Waters;
- 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 into Controlled Waters;
- to maintain Public Registers of Water Quality Objectives, Applications for Consents, Certificates and sampling data;
- to keep maps of Controlled Waters for public inspection;
- to advise and assist the Department of the Environment on matters of water pollution;

- to exchange information with water undertakers on pollution matters.

The NRA has declared that it will operate openly in discharging its duties and balance the interests of all who benefit from and make use of Controlled Waters.

1.3 Tasks

To achieve its aims for water quality, the NRA 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;
- minimise the risk of damage from accidents and pollution incidents.

During 1990, we enhanced our systems for the management of our monitoring programme. All information on routine sampling points and sampling obligations are held on computer. In the computer, this information is displayed as a menu (see Figure 1.1) and linked automatically to maps. The computer display allows us, or the public, to see all the monitoring done at any location, at a glance.

The system covers all the chemical and biological analyses provided by our Laboratory Services. More than 115 sets of chemical analyses are needed to cover the requirements of the legislation and other duties. An example is given in Figure 1.2.

Three developments have helped us to manage the sampling programme. The first, the Laboratory Information Management System (LIMS), ensures efficient use of laboratory resources, minimises the risk of errors, and helps to ensure that all commitments for sampling and analysis are met (Part 9).

The second is the Sampling Information Management System (SIMS). This combines the monitoring requirements at each sampling site and then checks that LIMS is analysing for the requirements.

The third development involves River Quality Indices. This is a system which checks the water quality information in our computer databanks to confirm that all data are logged correctly (Part 2.6).

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

FIGURE 1.1

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SIMS - Sampling Information Management System
 ┌──── Main Menu ────┐
 │   Select a Site   │
 │   Display Data    │
 │    Utilities      │
 │   Display Map     │
 │  Configure SIMS   │
 └───────────────────┘

                                                   ┌ Options ┐      ┌ US ──┐
                                                   │  Edit   │      │S US x│
                                                   │ Forward │      ┌ EF ──┐
                                                   │Backward │      │T EF x│
          ┌ RQ ──┐        ┌ FF ──┐                 │ Append  │      ┌ DS ──┐
          │R RQ √│        │A FF √│                 │ Delete  │      │U DS x│
          └──────┘        └──────┘                 └── Esc ──┘      └──────┘
┌ HM ──┐ ┌ EC ──┐ ┌ NN ──┐┌ SS ──┐┌ RL ──┐┌ PC ──┐┌ WD ──┐┌ AQ ──┐ ┌ DC ──┐ ┌ SI ──┐
│B HM x│ │C EC √│ │D ┌ Feature File - FWATER ──────────────────┐ x│ │J DC x│ │K SI √│
└──────┘ └──────┘ └─│R01BFBR01     TL8182014800   37/32        │──┘ └──────┘ └──────┘
           ┌ SW ──┐ │R.BRAIN GUITHAVON FLUME                  │    ┌ NS ──┐ ┌ LI ──┐
           │P SW x│ │Area:E Dist:C Live ? Y                   │    │M NS x│ │L LI √│
           └──────┘ │08-12-1990  New LIMS Name.               │    └──────┘ └──────┘
           ┌ BR ──┐ └─────────────────────────────────────────┘    ┌ CP ──┐
           │Q -- -│                                                │N CP x│
           └──────┘                                                └──────┘
────────────────────────────────────────────────────────────────────────────
Site : R01BFBR01, R.BRAIN GUITHAVON FLUME.
File : C:\PLB\FEATURES\\FWATER, C:\PLB\FEATURES\\FWATER-X.
Edit the currently displayed site.
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PROPOSED ANALYSIS SUITES

RF - HARMONISED MONITORING ANNUALLY

CODE	DETERMINAND NAME	UNITS	BOTL
00613	PH	PH UNITS	A
00683	TURBIDITY (FTU)	FTU	A
00721	COLOUR FILTERED(0.45UM MEMBRANE)HAZEN	HAZEN	A
00761	TEMPERATURE C	CEL	O
00772	CONDUCTIVITY AT 25 DEG C	USIE/CM	A
00812	OXYGEN DISSOLVED % SATN	% SATN	C
00822	OXYGEN DISSOLVED MG/L AS O	MG/L O	C
00851	BOD 5 ATU TOTAL	MG/L O	A
01113	AMMONIA AS NITROGEN	MG/L N	A
01165	NITROGEN TOTAL OXIDISED AS NITROGEN	MG/L N	A
01184	NITRITE AS NITROGEN	MG/L N	A
01351	SOLIDS PARTICULATE (105 C) (SUSPENDED)	MG/L	A
01581	HARDNESS TOTAL AS CACO3	MG/L CACO3	A
01621	ALKALINITY TOTAL AS CACO3 (PH 4.5)	MG/L CACO3	A
01724	CHLORIDE	MG/L CL	A
01751	CYANIDE TOTAL	MG/L CN	G
01771	FLUORIDE	MG/L F	A
01806	PHOSPHATE ORTHO AS PHOSPHOROUS	MG/L P	A
01823	SILICATE REACTIVE DISSOLVED AS SI02	MG/L SI02	A
01835	SULPHATE	MG/L	A
02073	SODIUM	MG/L NA	L
02113	POTASSIUM	MG/L K	L
02173	SILVER 0.45 UM MEMBRANE FILTERED UG/L	UG/L AG	1
02374	MAGNESIUM	MG/L MG	L
02414	CALCIUM	MG/L CA	L
02830	BORON TOTAL	MG/L B	A
03012	CARBON ORGANIC DISSOLVED (ACID SPARGED)	MG/L C	O
04015	MANGANESE 0.45UM MEMBRANE FILTERED	MG/L MN	Y
04035	MANGANESE TOTAL	MG/L MN	I
04197	IRON 0.45UM MEMBRANE FILTERED	MG/L FE	Y
04217	IRON TOTAL	MG/L FE	I
04611	DETERGENTS ANIONIC AS MANOXOL OT	MG/L M.OT	F
04632	DETERGENTS NON IONIC AS LISSAPOL NX	MG/L L.NX	E
07291	CHLOROPHYLL A UG/L	UG/L	B
07494	PHENOLS DISTILLED (MONOHYDRIC) AS PHENO	MG/L	H
25490	E COLI PRESUMPTIVE	NO/100ML	Z
73244	TIN TOTAL UG/L	UG/L SN	I
73251	SELENIUM 0.45UM MEMBRANE FILTERED	UG/L	Y
73261	VANADIUM TOTAL	UG/L	I
73271	VANADIUM 0.45UM MEMBRANE FILTERED	UG/L	Y
73282	ANTIMONY 0.45UM MEMBRANE FILTERED	UG/L SB	Y
73291	BARIUM 0.45UM MEMBRANE FILTERED	UG/L	Y
73301	BERYLLIUM 0.45UM MEMBRANE FILTERED	UG/L	Y
73311	COBALT 0.45UM MEMBRANE FILTERED	UG/L	Y
73331	MOLYBDENUM 0.45UM MEMBRANE FILTERED	UG/L	Y
73351	TELLURIUM 0.45UM MEMBRANE FILTERED	UG/L	Y
73371	THALLIUM 0.45UM MEMBRANE FILTERED	UG/L	Y

Continued...

PROPOSED ANALYSIS SUITES

RF - HARMONISED MONITORING ANNUALLY contd.

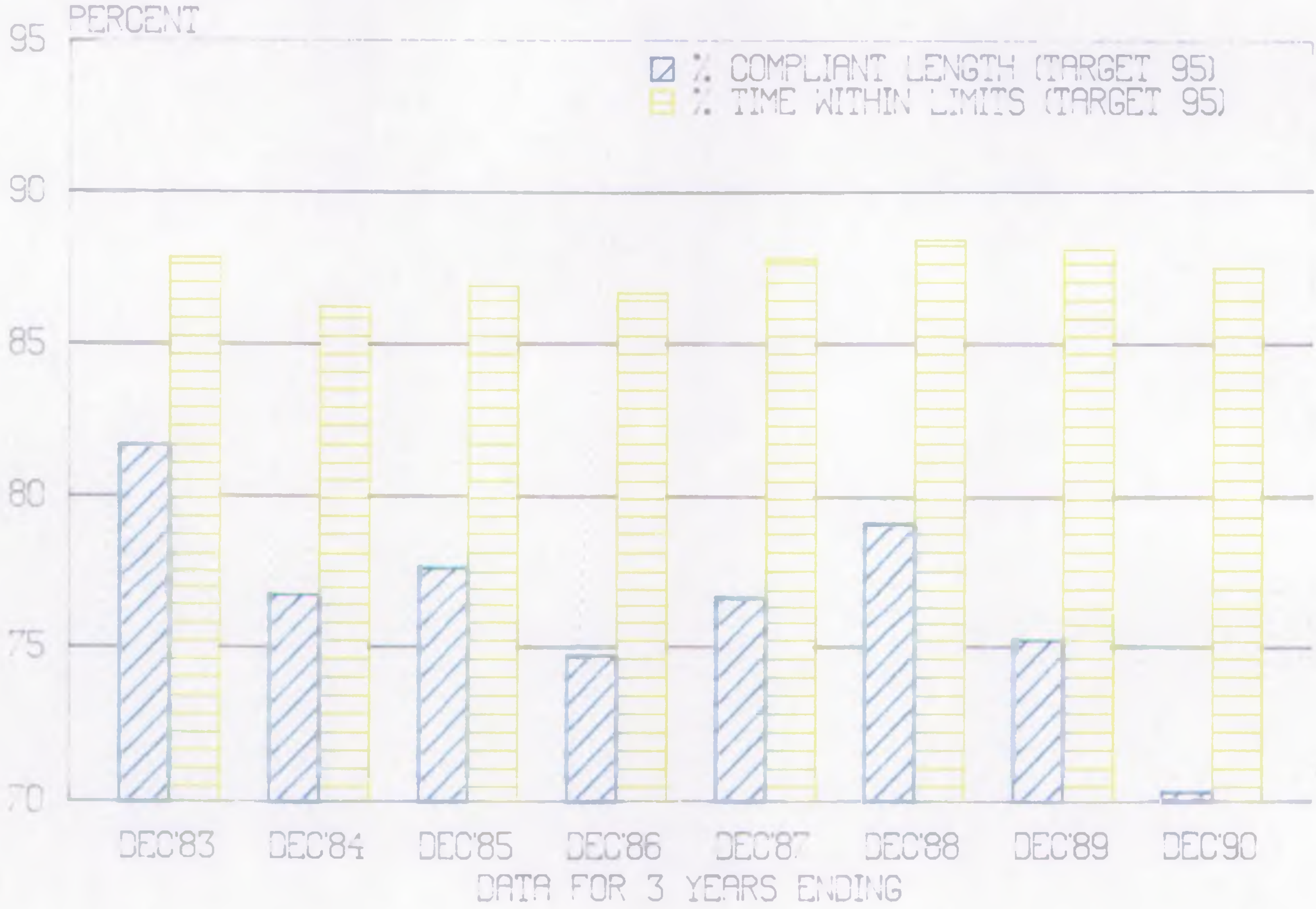
CODE	DETERMINAND NAME	UNITS	BOTL
73381	TIN 0.45UM MEMBRANE FILTERED	UG/L	Y
73401	TITANIUM 0.45UM MEMBRANE FILTERED	UG/L	Y
73421	URANIUM 0.45UM MEMBRANE FILTERED	UG/L	Y
74252	COBALT TOTAL UG/L	UG/L CO	I
74311	TIN ORGANIC TOTAL	UG/L SN	P
90381	PHOSPHATE TOTAL (ORTH + COND + ORG)	MG/L P	A
91983	SILVER TOTAL UG/L	UG/L	Q
91992	BERYLLIUM TOTAL UG/L	UG/L	I
92004	ANTIMONY TOTAL UG/L	UG/L SB	I
92017	BARIUM TOTAL UG/L	UG/L	I
92601	ARSENIC 0.45UM MEMBRANE FILTERED UG/L	UG/L AS	Y
92611	ARSENIC TOTAL UG/L	UG/L AS	I
92645	CADIUM 0.45UM MEMBRANE FILTERED UG/L	UG/L CD	Y
92655	CADMIUM TOTAL UG/L	UG/L CD	I
92682	MERCURY 0.45UM MEMBRANE FILTERED UG/L	UG/L HG	U
92692	MERCURY TOTAL UG/L	UG/L HG	J
97251	SELENIUM	UG/L SE	I
97271	HYDROCARBONS DISSOLVED AND EMULSIFIED	UG/L	T
98874	CHROMIUM TOTAL UG/L	UG/L CR	I
98884	CHROMIUM 0.45UM MEMBRANE FILTERED UG/L	UG/L CR	Y
98894	COPPER TOTAL UG/L	UG/L CU	I
98904	COPPER 0.45UM MEMBRANE FILTERED UG/L	UG/L CU	Y
98914	LEAD TOTAL UG/L	UG/L PB	I
98925	LEAD 0.45UM MEMBRANE FILTERED UG/L	UG/L PB	Y
98934	NICKEL TOTAL UG/L	UG/L NI	I
98944	NICKEL 0.45UM MEMBRANE FILTERED UG/L	UG/L NI	Y
98954	ZINC TOTAL UG/L	UG/L ZN	I
98964	ZINC 0.45UM MEMBRANE FILTERED UG/L	UG/L ZN	Y

quality models is giving us consistent and authoritative methods of setting Consents for discharges to Controlled Waters.

We have also developed further our systems for the audit of performance against water quality standards and extended their use to set priorities for action, using information derived from the Index of Discharge Impact (Part 5.3).

FIGURE 2.1

PERFORMANCE OF RIVERS AGAINST RIVER QUALITY STANDARDS



Part 2: RIVERS & GROUNDWATERS

2.1 Chemical Monitoring

2.1.1 Routine sampling

Many of our systems for auditing water quality depend on good river chemistry data. For 1990, the programme of chemical monitoring was further refined to secure consistency across the Region and to prepare for the 1990 River Quality Survey (Part 2.4). The programme covered:

TABLE 2.1

Routine Freshwater Monitoring Frequencies.

Sample Type / Frequency p.a.	BA	BF	BG	BH	CD	Total by Frequency band.
< 2	0	71	0	14	3	88
2 - 4	0	43	0	10	0	53
12	6	861	7	15	6	895
48	0	17	0	0	0	17
Total by Type.	6	992	7	39	9	1053

Sample type key :

BA = Reservoir water,
BF = River / stream water,
BG = Canal water,
BH = Lake / broad / pond water,
CD = Raw supply water from impoundment.

The total length of freshwaters characterised by this sampling is 4,685 km. The total number of samples is 11,600 and the total number of sites is 1,053 (see also Table 9.1).

Samples of river sediments were collected at over 60 sites, mainly for purposes linked to the Dangerous Substances Directive. The frequencies ranged from one to four per year.

Our routine groundwater programme covered over 500 sites and involved the collection of more than 2,100 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 2.12).

National guidelines have been drawn up for monitoring freshwaters. They should not impose a requirement for a great deal of extra resource, on our Region.

2.1.2 Continuous Monitoring

We maintain a network of Automatic Water Quality Monitoring Stations, which provide continuous measurements of water quality. Some provide information on the quality of effluents entering rivers, but most are placed on rivers directly above intakes for potable supply.

It is part of NRA policy to extend the network to include other sensitive waters, as well as requiring them on more of the important sewage and industrial effluents, for example:-

- at or above potable supply abstractions.
- at water transfer scheme abstractions or outfalls.
- downstream of large effluent discharges.
- on the lower reaches of a major watercourse.
- downstream of major conurbations.
- at subcatchment confluences.
- at estuarine or coastal sites affected by discharges.

In the last two years, many have been refurbished and the number of new stations in the region is increasing. Over 20 are now linked by telemetry networks in the region.

Most monitor and record results for a range of parameters from temperature, pH, dissolved oxygen, conductivity, chloride and nitrate. Generally, instrumentation is housed in a secure structure on the river bank, and water is pumped from the stream, passed probes, then returned to the stream. Results are logged on a small local microcomputer outstation and then telemetred periodically to processors in the Areas and at Regional Head Office at Peterborough.

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).
River stretches are placed in one of the following classes:

Class 1a - Good Quality
Class 1b - Good Quality
Class 2 - Fair Quality
Class 3 - Poor Quality
Class 4 - Bad Quality

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

The classification of rivers for 1990 will be given in a future report from the NRA Head Office (see Part 2.4). It is planned that a Regional map will be produced at the same time.

2.3 River Quality Objectives

River Classes provide an absolute measure of river water. 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.

River Quality Objectives (RQOs) are used to 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 so as to ensure that River Quality Objectives were met and maintained.

The River Quality Objectives defined for the purposes of water quality management are:

- Abstraction for Public Water Supply;
- Salmonid Fishery (supporting a breeding population of trout or grayling);
- Cyprinid Fishery (supporting a breeding population of coarse fish);
- Amenity and Conservation (subdivided into three categories - high, moderate and low);
- Abstraction for Industrial Water Supply;
- Spray Irrigation of Field Crops;
- Livestock Watering;

Each of these requires that a set of water quality standards is met. We have assigned River Quality Objectives to 1,350 individual stretches of river, totalling 7,843 km.

Each river stretch has a group of uses which were assigned to it after full public consultation. The amalgamation of the standards for all these uses gives a complete set of standards for that part of the river. Water quality is then managed to achieve this set of standards.

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 (see Part 2.5).

2.3.1 Compliance

The determinands most often involved in decision-making are the Dissolved Oxygen (as absolute concentrations of mg/l), 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 feature also in the Directives issued by the European Community.

River quality is highly variable and the use of sampling means that there is always a risk that we report wrongly that water quality has changed, or failed to meet a standard, or complied with a standard. This risk, which is largest at low rates of sampling, is controlled by using statistically sound methods of assessing compliance and change.

River quality is also affected by the weather. To smooth out these effects, and to increase our ability to detect small changes in quality, we use three years' data to report performance.

Every three months, we audit and report the chemical quality of over 4,460 km of our rivers against the River Quality Objectives, using results from around 880 sampling points (in 1990, most of the remaining 3,280 km were monitored biologically - see Part 2.7). The trend in performance against the standards for Dissolved Oxygen, Biochemical Oxygen Demand and Ammonia is shown 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 1990, the percent of time spent within the required limits was 87.5%, compared to 87.9% for the three-years ending in December, 1989.

For the three years ending in December 1990, 70.3% (3,190 km) of river lengths were of the required quality. This compares with the 74.6% (3,390 km) for the three years ending in December, 1989. This suggests that river quality in 1990 was worse than in 1987. Figure 2.2 shows that changes of this magnitude have been seen before, for example from 1983 to 1984 and from 1985 to 1986.

In the Anglian 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 the effects of algae on the measurement of the BOD are ignored, the total length meeting standards in 1988/90 would increase from 70.3 to 80.3 percent. This supports the case for much of the poorer quality being drought-related.

Why did this reported change in quality occur?

We can investigate this by looking at median values of water quality. 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. Thus the use of median values has several advantages:

- it offers a stable estimate of trend,
- it is relatively insensitive to changes in sampling rate; and thus
- it is a good way of comparing water qualities between sites, rivers and years.

Results from analyses of median values for the four parameters used in RQO compliance assessment, are shown in Table 2.3.

TABLE 2.3

Median Values For Each Determinand (mg/l)

Determinand	1987	1988	1989	1990
BOD	2.4	2.4	2.1	2.12
Total Ammonia	0.16	0.15	0.13	0.11
Unionised Ammonia	0.002	0.002	0.002	0.002
Dissolved Oxygen	9.8	9.7	9.5	9.39

Dense growths of algae may have contributed to some local increases in BOD, but improvements in overall concentrations can be seen in the statistics for BOD and ammonia. These are the principal parameters to be affected if effluent qualities deteriorate, yet they have improved, and values for dissolved oxygen have deteriorated. Dissolved oxygen compliance is reported in absolute values (mg/l). The solubility of oxygen decreases as temperatures increase. Thus regionally, concentrations of dissolved oxygen in the rivers, were depressed by elevated temperatures.

These figures suggest that the apparent decline in compliance with River Quality Objectives is not caused directly by STWs.

A further reason for the apparent decline in the compliant length lies in the harmonisation of the sampling programme introduced over the past three years. This has led to increased sampling rates for rivers in the north and centre of our Region. About seven percent more samples were collected during the period 1988/90 than in the period 1987/1989. The programme has largely settled down now and these shifts in emphasis will not occur again. and these new rates mean that we can now pick up as significant, smaller violations of the river quality standards. Hitherto we have missed these.

Further evidence that effluents have not caused this decline, comes from the sub-set of river lengths which lies directly downstream of the discharges from large STWs. This length totals 490 km or 11% of the total length of river which is monitored chemically. The works deal with 73% of the total flow of all effluents discharged to freshwaters. We can report the qualities of these river lengths separately from other stretches. For the three-year period ending December 1990, 66% (320 km) were of the required qualities and met their required standards for 86% of the time. The values for these statistics are very similar to those for the three years ending in December, 1989.

2.4 The 1990 Survey

The chemical and biological quality of rivers has been reported nationally every five years, and a further survey was performed in 1990.
It was recognised that there were differences around the country in how the NWC classification system was applied, and that the system led to

incorrect reports of change. These were aspects of the NRA's work addressed by a national Water Quality Group, chaired by the Welsh Regional General Manager. Our Regional Scientist is a member of that group.

Two national working groups were established, one to deal with Chemical data, the other for biology. Our Regional Scientist chaired and lead the chemical group, which had representatives (Liaison Officers) from every region.

It was essential that the results for 1990 could be compared sensibly with the NWC Survey for 1985, at the same time as preparing the way for Statutory Quality Objectives (Part 2.5).

To achieve this, the 1990 Survey aimed for:

- continuity with 1985;

at the same time as achieving:

- full objectivity and national consistency.

These are conflicting requirements which were only achievable by reporting two sets of results:

[a] those obtained from a Survey based on similar procedures to those used for 1985;

[b] a Survey based on the universal use of a fixed set of procedures, the *NRA Survey*.

The subjectivity of past Surveys is unacceptable for quality standards which are to have statutory force. But the removal of this judgement will give a high risk of error in classification. The NRA plans three developments to reduce this risk:

- the assessment will be based on three years' data;
- biological data will be used to improve precision;
- the 1990 NRA Survey will establish a baseline - a sound statement of river quality in 1990. After 1990, using this baseline, we shall look for statistically significant changes in Class.

The high level of audit and reporting that have been developed in this Region allow us to adapt readily to such requirements.

Anglian Region has taken on the role of collating chemical and biological data from all the regions, to produce reports for the 1990 NWC as well as NRA surveys.

2.5 Statutory Quality Objectives.

Following the 1990 NRA Survey, the Government will introduce *Water Quality Objectives* which will be statutory. The results from the 1990 Survey will be used as a basis for these.

The group has produced a report entitled "Proposals for Water Quality Objectives", which includes a series of recommendations and provides a basis for consultation on the implementation of Statutory Quality Objectives, for all controlled waters.

Basic recommendations are:-

The Statutory Quality Objective for a stretch of Controlled Water should be in three parts:

- *a Target Class, based on a classification system which is expected to remain unchanged in the future;*
- *a set of Use-related Objectives which can be allowed to develop as new standards and new Uses are introduced; and,*
- *a requirement to comply with the Directives issued by the European Commission.*
- *in addition to the achievement of Statutory Quality Objectives, the NRA should plan for No Deterioration from the existing quality of Controlled Waters.*

The Statutory Water Quality Objectives will be used to plan the measures needed to secure the aims of the NRA.

2.6 River Quality Indices

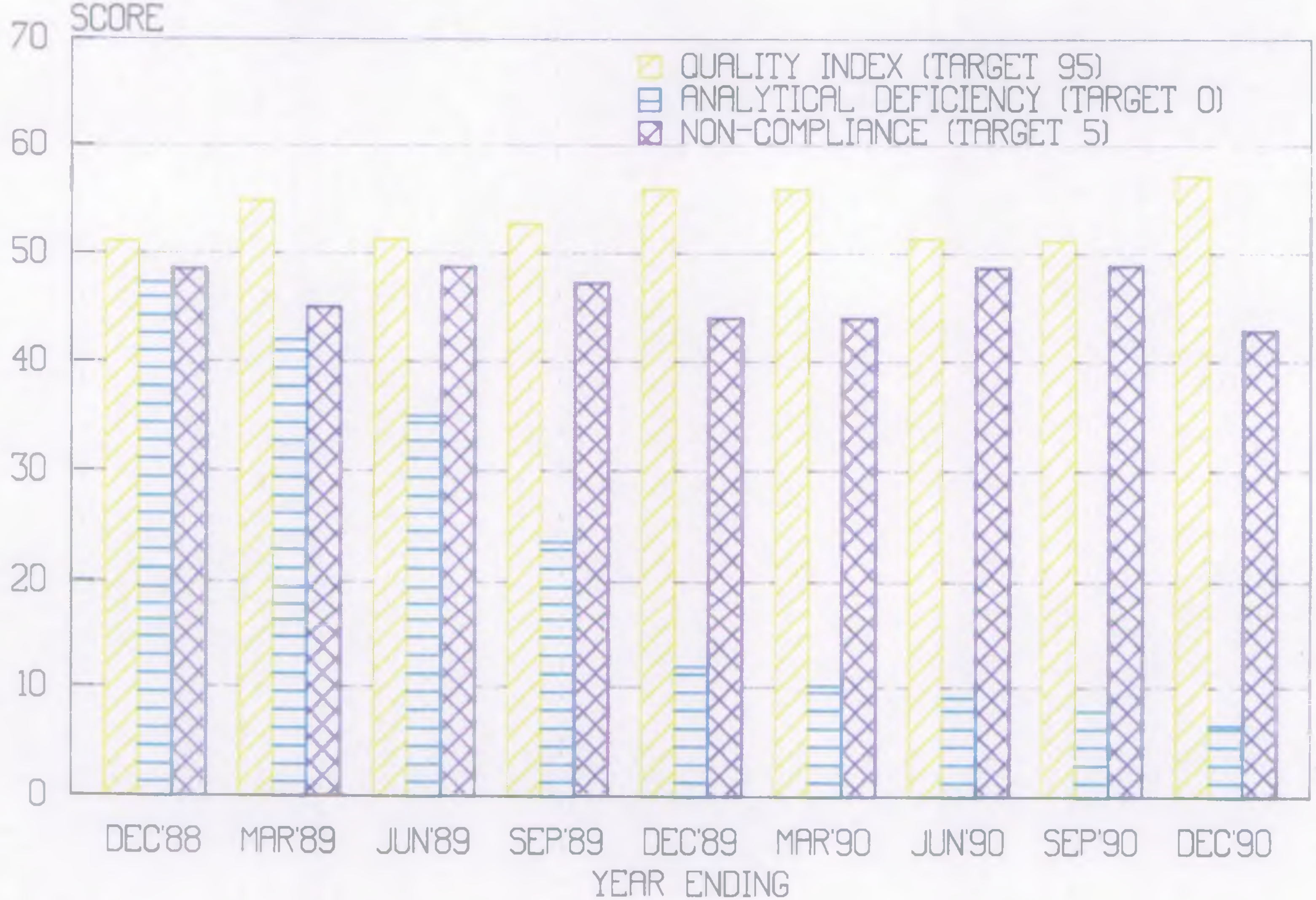
At many sites we need to assess compliance with the standards for over 40 different determinands. The management of this large and complex workload is aided by a system of River Quality Indices.

The Indices are scores which summarise water quality and measure performance in managing resources for environmental monitoring (see Part 1.3). 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

FIGURE 2.2

REGIONAL INDEX



The Indices are used 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 2.2 shows changes in the Regional River Quality Index over the nine quarters since December 1988. 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.

The figure also shows improvements in our ability achieve our sampling programme (in the reducing scores for the Analytical Deficiency).

2.7 Biological Monitoring

Recognition by the NRA of the importance of biology in assessing the quality of our aquatic environment is illustrated by the increase of time and resources utilised in the biological monitoring for 1990.

The number of biological samples taken from freshwaters throughout the region has increased steadily from 1,690 in 1988, to around 7,500 last year. These surveys examine the flora and fauna of flowing and still-waters.

Animals collected from the rivers are identified and the biological quality of that site assessed on the invertebrates detected. Some invertebrates are indicators of high biological quality as they are sensitive to a deterioration in the quality of their habitat. These invertebrates would score highly in the BMWP scoring system. The BMWP (Biological Monitoring Working Party) scoring system is used to summaries biological data and ranges from 0 to >150 as illustrated below.

TABLE 2.1

THE BMWP SCORE SYSTEM

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

Changes in variety of invertebrates found throughout the year indicate not only the natural variation and life cycles of the animals, but also changes in the water quality of a river.

Chemical analysis by the NRA includes the major environmental parameters that indicate changes in water quality. However there are many potential pollutants that are not assessed. Various invertebrates are sensitive to these pollutants and are therefore important indicators of specific pollution problems. Without biological monitoring some pollution incidents or long term changes in water quality could otherwise go undetected.

2.7.1 National Reporting Sites

For the past 10 years comparisons have been made of the biological quality of 240 sites original sampled in the 1980 National River Quality Survey and are referred to as National Reporting Sites. The results are shown in Figure 2.3. The 1990 data continues the trend of improving biological quality since 1982. These sites are situated on major rivers and so the effects of the drought experienced this year would not necessarily be evident form the biological value of these sites.

The total length of river biologically assessed has increased this year to 7610 km. The data are used to assess the compliance with the set biological target for each stretch of river. The percentage length of river compliant with the target has increased.

	1989		1990	
	km	%	km	%
Length compliant	6370	85.6	6650	87.4
Length failing	1070	14.4	961	12.6
Total length assessed	7440		7610	

2.7.2 The 1990 Water Quality Survey

In 1990 a comprehensive study of biological river quality was undertaken as part of the 1990 Water Quality Survey. Apart from some stretches that were assigned Low Amenity River Quality Objectives (Part 2.3), all lengths were sampled in three seasons - spring (defined as March to the end of May), Summer (June to the end of August) and Autumn (September to the end of November). A total of approximately 3,200 samples was taken.

A standard, nationally-agreed sampling technique was used to maximise comparability, replicability and the number of invertebrate taxa collected from each site. The regions were assisted in Analytical Quality Control by the Institute of Freshwater Ecology. The results of this exercise also provided an independent audit of the results.

Data from the 1990 Survey together with data from all the other NRA Regions, will be used to classify the biological quality of the rivers throughout Great Britain.

2.7.3 Other Biological Sampling/Surveys

The work carried out in 1989/90 is summarised in Appendix I.

2.8 RIVPACS

RIVPACS (River Invertebrate Prediction and Classification System) is a computer package, developed by the Institute of Freshwater Ecology with two main aims:-

(a) Classification of the rivers in Great Britain, according to the invertebrates found.

(b) The prediction of the invertebrates that should be found given a set of environmental variables.

Within RIVPACS is an existing river classification system based on 438 unpolluted reference sites using biological and environmental data. The environmental data includes, for example the depth and width of each river. Data can then be compared with this classification system enabling the rivers throughout Britain to be classified.

When the environmental variables of a site are fed into RIVPACS, it is able to predict the variety of invertebrates that should be found and the BMWP score. These predictions assume the site of sampling is unpolluted. If the BMWP predicted by RIVPACS is higher than the observed value, the results suggest that some form of pollution may have occurred. The absence and/or presence of invertebrates compared with those predicted may help explain the severity of pollution incidents. In this way recovery from pollution incidents may also be monitored.

Research is presently being undertaken to assess the RIVPACS predicted results, with the 1990 data from the River Glen and the River Gwash.

2.9 EC Directives

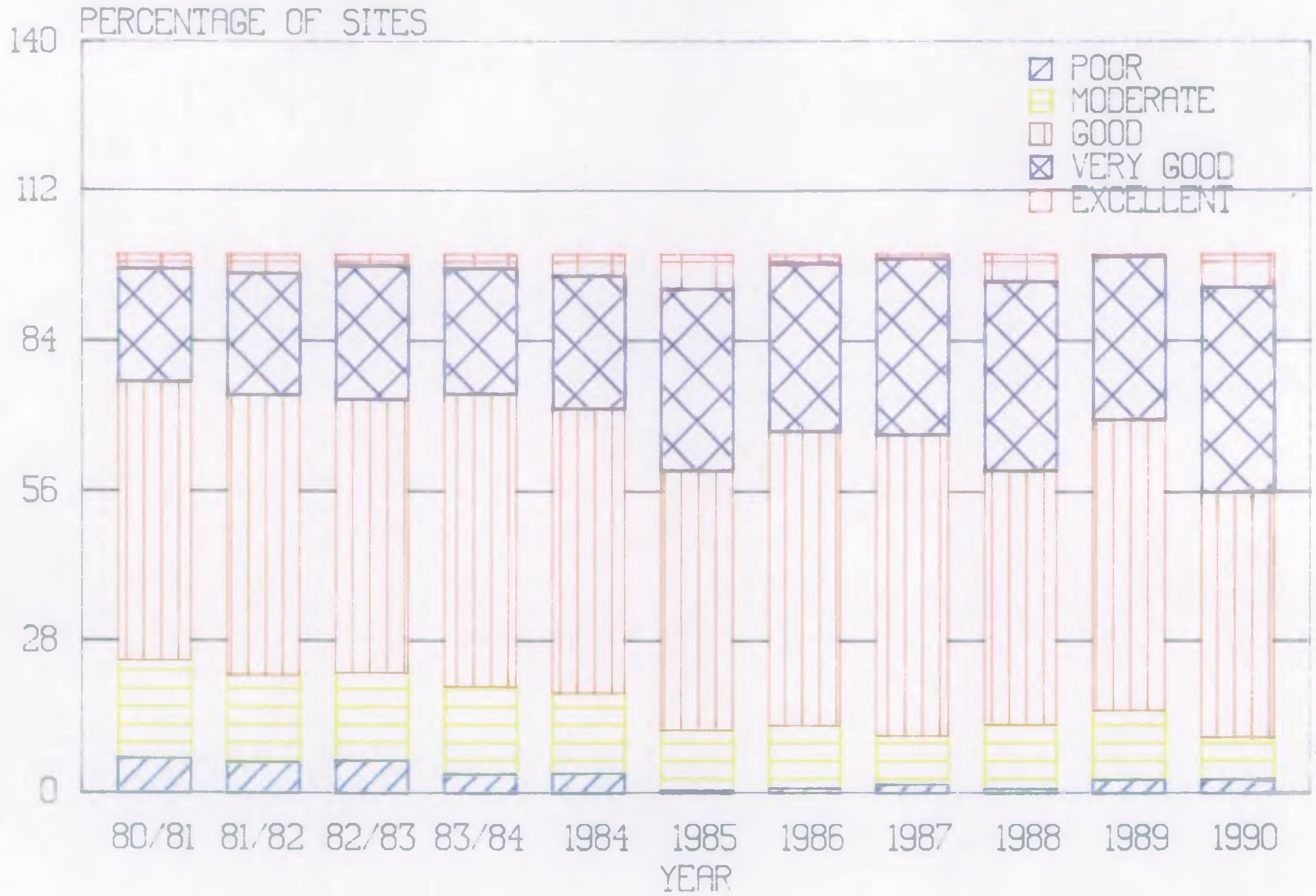
The management of river water quality is affected directly by several of the Directives issued by the European Commission including:

- Directives on Dangerous Substances;
- Surface Water Abstracted for Drinking Water;
- Freshwater Fisheries.

The Directives contain a variety of requirements with respect to monitoring and reporting. They have a major impact on the planning of our sampling programme. Their role as a basis for justification of improvements, e.g. through the regulation of discharges, is becoming increasingly prominent.

FIGURE 2.3

BIOLOGICAL QUALITY OF RIVERS (BMWP SCORE)



The Urban (previously Municipal) Waste Water Treatment Directive was progressed during 1990 and was finally adopted in March 1991. This Directive requires the construction of sewerage systems and sewage treatment facilities, and the achievement of minimum effluent standards. Nutrient removal will be appropriate for discharges to waters where these substances are considered to be problematic. Implications for the Water Services companies and the NRA are considerable. This Directive will affect discharges to all surface waters (fresh and saline), and potentially also groundwaters. Interpretation and ongoing development of aspects of the Directive are currently being undertaken.

For the Directives in force during 1990, the situation is summarised below:

2.9.1 Dangerous Substances

The Dangerous Substances Directive contains two lists of pollutants and outlines the approach to be adopted in controlling the substances in each. List I includes materials which are toxic, persistent, and which accumulate in the environment. List II covers pollutants with less serious potential effects.

2.9.1.1 List 1 Substances

The List I substances for which environmental standards have currently been set are: lindane, cadmium, mercury, the drins (dieldrin,aldrin,endrin,isodrin), pentachlorophenol, DDT, carbon tetrachloride, chloroform, hexachlorobenzene, hexachlorobutadiene, trichloroethylene, trichlorobenzene, tetrachloroethylene, and 1,2 dichloroethane.

The Directive applies to discharges to both fresh and saline surface waters. The usual cycle is that we have to provide lists of significant discharges, monitor the receiving waters, and report to the Government (which then reports to the Commission). This year, we are providing DoE with updated inventories for all List I substances. We also have to control, through issuing and reviewing consents, all significant discharges of listed substances.

In addition to monitoring for List I substances at discharge related sites, background monitoring for cadmium and lindane was also undertaken in accordance with the Directive. This is known as National Network monitoring and is carried out mainly at the tidal limits of major rivers. In mid-1990, the DoE extended the National Network monitoring to cover all List I substances (although this is not strictly required under the Directive). Our sampling regime has been extended to accommodate this change.

With regard to the discharge-related receiving water sites:

(a) There were no failures to meet the Directive quality criteria in any of the 5 freshwater sites designated under the Mercury Directive, nor the 22 sites for the Cadmium Directive.

(b) The single freshwater site designated under the Lindane Directive passed the quality standard. This is on the Sincil Dyke, downstream of Canwick. There were no freshwater sites designated under the Carbon Tetrachloride, Pentachlorophenol and DDT Directive.

(c) Under the Drins Directive, six freshwater discharge-related sites were monitored against the water quality standards. Of the three sites which exceeded the DoE criteria, two were in ditches draining to the Witham Haven. They are related to a site where historic spillages of wood treatment chemicals contaminated the ground. Of these exceedences, one (for endrin), was associated with too high an analytical limit of detection, rather than a failure of an environmental quality standard. The real failure was for total drins, in a small drainage ditch. There were no problems from sites further downstream. We are maintaining close contact with the company involved, who have indicated their intention to commit major capital investment to improving the contamination problem. The third exceedence was again due to a limit of detection problem.

Background monitoring over and above the National Network, was carried out for the second year in succession for the Drins Directive. This involved 22 sites in our Region.

The remaining substances in the Drins Directive are Hexachlorobenzene, Hexachlorobutadiene and Chloroform. For these we are half way through a 2 year background monitoring programme, which has been agreed with DoE and finishes at the end of 1991. This monitoring is being undertaken at our Harmonised Monitoring sites. To date no industrial discharges, either direct to river or to sewer have been identified as containing these substances.

The environmental standards for the chlorinated solvents (trichloroethylene, trichlorobenzene, tetrachloroethylene, and 1,2 dichloroethane) are not yet in force. The Commission require the first report in 1993 and we will therefore commence monitoring for Directive purposes in 1992. As a first step, we will now be identifying whether there are any discharges of these substances in our Region.

2.9.1.2 <u>List II Substances</u>

Of the 52 sites monitored for List II metals only the Willow Brook site failed to meet the prescribed standards. The failure was for zinc. The industrialist responsible for the zinc discharge will be pressured to take action to control the concentrations.

The Hog Dyke was a borderline pass for copper.

1990 was the first monitoring year under the Directive for triorganotin compounds. The two freshwater sites both failed, they are on Buck Beck and New Holland Main Drain. Both sites are downstream of timber treatment yards. There are no known discharges from either yard but more detailed inspections will now be undertaken.

2.9.2 Surface Water Directive.

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, DoE have never asked us to report on this Directive, but we run audits throughout the year to check on compliance with water quality and sampling requirements. We intend to produce internal reports in the near future.

2.9.3 Freshwater Fisheries

This Directive specifies water quality standards for the protection of game and coarse fisheries. In Anglian Region, 400 km of game fishery and 950 km coarse fishery have been designated under the Directive. Of these stretches, 314 km game fishery and 811 km coarse fishery complied with the quality standards.

The major parameter causing non-compliance was dissolved oxygen. Oxygen levels in the water were depressed due to the long, hot, dry summer. Certain stretches were affected by high levels of ammonia and these have been attributed to discharges from STWs.

2.9.4 Groundwater Directive

This prohibits the discharge of List I substances to groundwaters. Revised guidance on the interpretation of the Directive has been issued by the Department of the Environment. It means that many substances,previously allowed to soakaway into the ground,will have to be collected for disposal off site.

In October 1990, the DoE issued two documents relating to the EC Directive on Protection of Groundwater Against Pollution caused by certain Dangerous Substances, these being:

(a) DoE Circular 20/90 which gives guidance and information on the classification of listed substances for the purposes of the Directive. A stricter approach to the control of substances emanating from waste disposal sites is prescribed.

(b) A DoE consultation paper on the Government proposals for a national classification scheme of listed substances with respect to the Directive. This contains more specific rules than circular 20/90, and it is proposed that the NRA should carry out the classification of substances.

2.9.5 Proposed Directives

The following proposed environmental Directives are currently undergoing consideration and development:

- Ecological Quality of Surface Water;

- Protection of Fresh, Coastal, and Marine Waters against Pollution caused by Nitrates from Diffuse Sources;

- Harmonising and Rationalising Reports on the Implementation of certain Environmental Directives.

- Landfill of Waste

Progress on these Directives will depend mainly upon the political will of the Member State which holds the presidency of the Commission.

2.10 Pollution Incidents

The reporting of incidents which result in pollution commenced in 1975. They are summarised in Figure 2.4. The total number reported in 1990 was 1,885, an increase of 14% on 1989's figures.

Amongst the biggest pollution incidents in the year were:-

- *Routine analysis of a private supply borehole in Bury St Edmunds by the District Council found severe contamination by solvents which included trichloroethane. The source was found to be a broken private sewer. The Council obtained a court order to curtail the use of the supply.*

- *Approximately 15 km of the Wendling Brook, near Dereham, were affected and about 12 trout were killed when liquid nitrogenous fertiliser was lost from a storage tank on a farm.*

- *The first rain after a dry spell washed a spillage of urea from a dry dyke into the River Till, near Gainsborough. Over 8 km of the river were affected, and more than 5,000 fish died. The spillage originally came from a road tanker.*

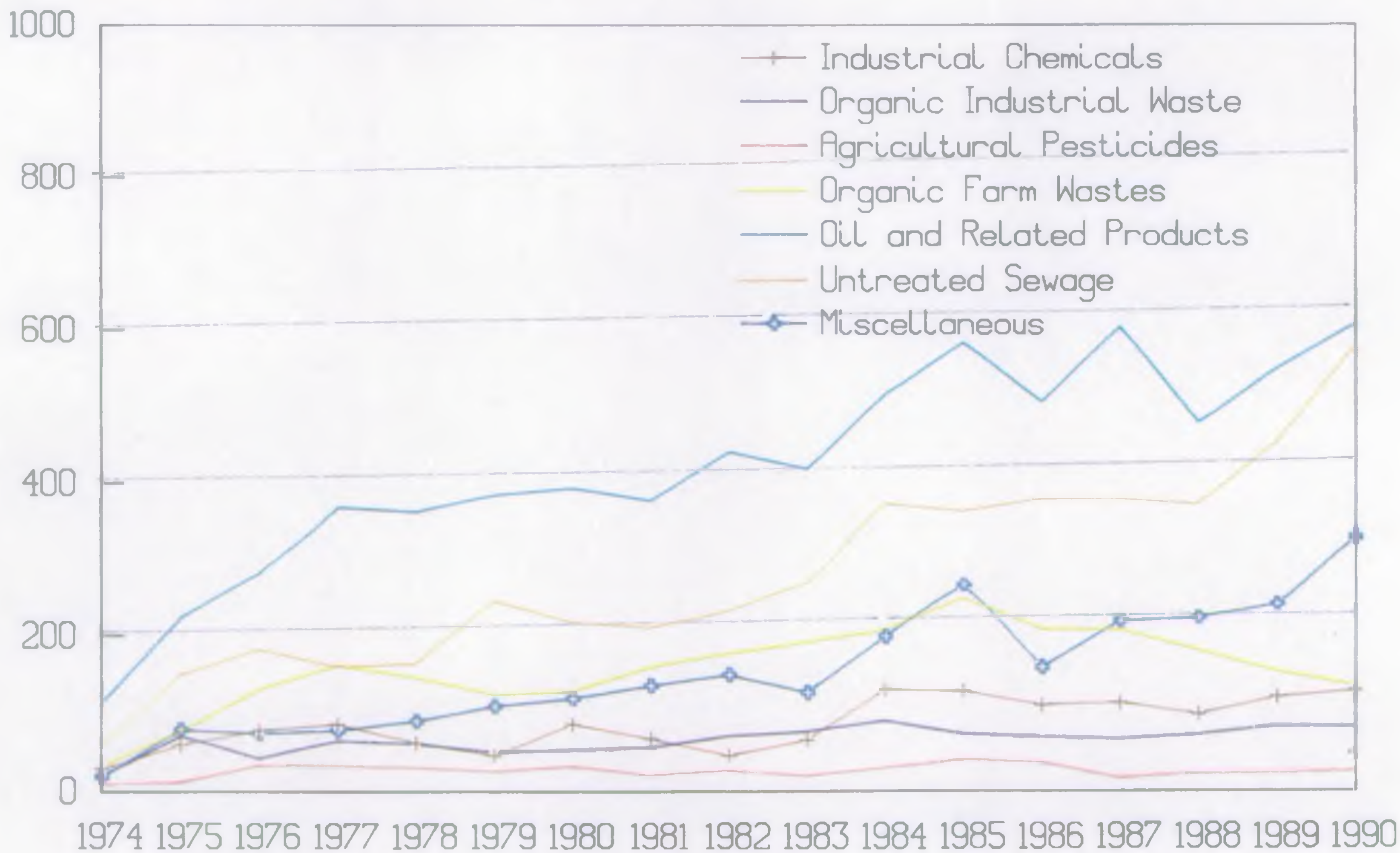
- *About 300 mixed fish were killed when a farmyard spillage of diesel and urea was washed into a tributary of the Hobhole drain near Boston. The drain was affected for 1.5 km.*

- *A long running discharge of plating and spray-shop waste via a deep soakaway contaminated part of the aquifer near Mildenhall. This aquifer is important as a potable water source.*

- *During the hot summer several 'small' sewage discharges caused a number of fish kills. The combination of heat, low oxygen levels and low river flows contributed to the number.*

FIGURE 2.4

NUMBERS OF POLLUTION INCIDENTS



Overall, the number of reported incidents was higher than in 1989, despite the mainly dry conditions, which tend to reduce incidents associated with storm discharges and run-off. This illustrates, and is partly explained by, the volatility of these statistics. It will always be difficult, if not invalid, soundly to define trends within regions, or to qualify differences between regions.

Better legislative powers and our growing effectiveness at pollution prevention will tend to reduce incidents and their impacts. However, as our monitoring becomes even more effective, and public awareness continues to grow, so we may see greater numbers of incidents being reported. We would expect these to be in categories of less significance.

We also expect to find more evidence of historic and on-going chronic pollution, because we are now looking harder for it.

Figure 2.5 gives a breakdown of incidents resulting in fish mortalities. Despite the hot, dry summer, with low flows, numbers were not exceptionally high.

2.11 Prosecutions

It is an offence to discharge polluting matter into streams and a number of prosecutions are taken each year. 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. The cases brought to court in 1990 are listed in Appendix II and the trend in the numbers of prosecutions is shown in Figure 2.6.

2.12 Groundwater

Half of the drinking water supplied in the region is taken from groundwater, which in most cases requires treatment only by disinfection. In addition there are thousands of abstractions for agricultural and industrial water supplies and many wells are used for private supplies of drinking water.

The protection of the quality of groundwater is of great importance, particularly because groundwater pollution is very difficult to remedy once it has occurred. In areas where the aquifer is overlain with clay or other impermeable strata, pollution spilling onto land poses greater risks to rivers than to groundwater.

FIGURE 2.5

NUMBER OF POLLUTION INCIDENTS RESULTING IN FISH MORTALITIES

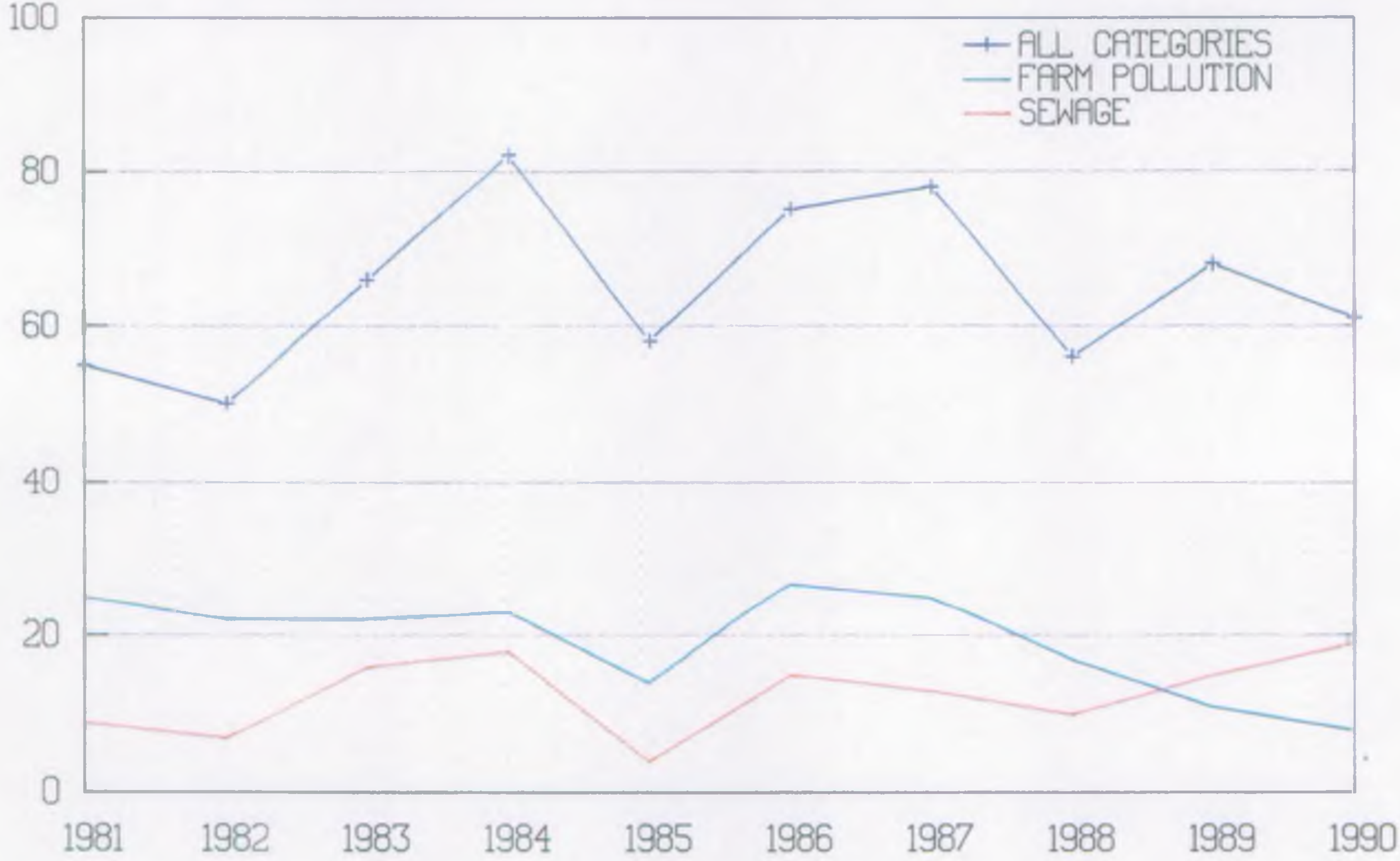
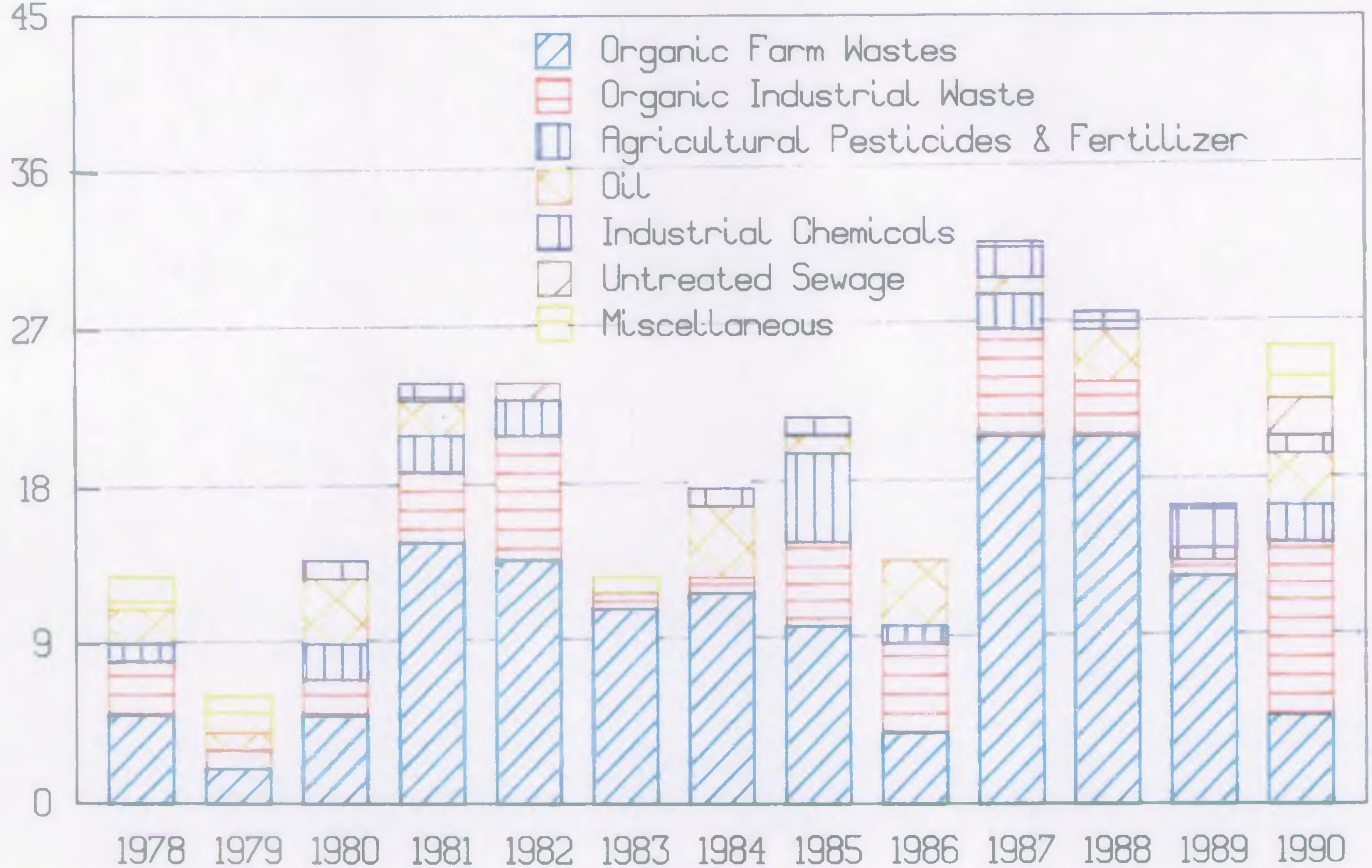


FIGURE 2.6

NUMBERS OF PROSECUTIONS FOR POLLUTION INCIDENTS



2.12.1 Monitoring

Many of the boreholes which gave us water quality data for groundwaters are now owned by Anglian Water Services. Work is continuing on the definition of the NRA Monitoring Network. Pilot studies have been carried out, notably in Lincolnshire and in Norfolk.

About 500 points are routinely monitored to provide information on groundwaters. Analytical sets range from those for the chlorinity and overall ionic strength of the water, to complex lists including metals, pesticides and microbes.

National guidelines have been drawn up for monitoring groundwaters. If implemented as policy, they will require extra resources for our Region.

2.12.2 Protection

Policies on Aquifer Protection will give priority to protecting areas where the aquifer is exposed directly to the land surface. A Regional policy was produced in 1989 and is referred to in dealings with planning authorities. We are involved in the development of a national policy.

Through the waste disposal site licensing authorities (County Councils), we are increasing the pressure on site operators to improve effluents reaching controlled waters. For example, major remedial works are nearing completion around Foxhall and Kesgrave waste disposal sites near Ipswich, and at Wangford, south of Lowestoft. The "Dilute and Disperse" philosophy leads to threats to watercourses, and collection ditches and effluent treatment plants are being installed instead.

Our staff are working very closely with County Councils and abstractors, to investigate and improve the situations around a number of contaminated water supply sources. These include a borehole in Bury St Edmunds, contaminated by solvents leaking from a broken private sewer, and part of the aquifer near Mildenhall, contaminated with plating and spray-shop waste. A source, at Isleham contains traces of petroleum-derived substances which are being monitored to identify the scale of the problem, its likely source and remedial action.

In November, traces of a herbicide pollutant were discovered in a borehole at Etton, near Peterborough. We are conducting a detailed investigation of the source of the groundwater around the site. The water is treated using Granular Activated Carbon, and it is expected that this will deal effectively with the herbicide.

2.13 Nitrate

2.13.1 Nitrate in Rivers

Concentrations of nitrate in rivers vary with site and season. Figure

2.7 illustrates this variability and shows trends at four major surface water abstraction sites in the region.

The technique known as Multiple Regression has been used to identify trends, and to relate nitrate concentrations to river flows. The method has been used to predict future levels of nitrate in our rivers and reservoirs. The results indicate that average concentrations of nitrate in surface waters may continue to rise by 1 mg per litre per year.

2.13.2 Nitrate Sensitive Areas

The Water Act allows for the designation of areas in which it is desirable to control the application of nitrate fertilisers, by changes in agricultural land-use. These are termed Nitrate Sensitive Areas, or NSAs. In 1989, the NRA notified the Ministry of Agriculture, Fisheries and Food (MAFF), of a number of prospective NSAs. The Ministry then announced 12 candidate areas with ten further areas where advisory campaigns will be mounted.

After meetings with farmers and other organisations the Ministry introduce a pilot scheme in ten of the original areas. Two of these are in the Anglian Region - at Sleaford and Branston Booths near Lincoln.

We are routinely monitoring 26 sites (boreholes, springs and streams) associated with these NSAs, plus several sites in the advisory campaign areas (see Figure 2.8). Information from this monitoring, plus data from Anglian Water Services ltd and Cambridge Water Company, are routinely sent to MAFF. It is hoped to establish whether changes in farming practices can reduce the leaching of nitrate from farmland.

The scheme is voluntary and will run for five years. Farmers will be offered compensation for any significant changes to their agricultural practice. Extreme cases will be covered by a premium payment scheme and will involve the conversion of arable land to unfertilised grassland.

2.14 Blue-Green Algae

Following the animal fatalities and human illnesses associated with toxic blue-green algae during the summer of 1989, the NRA set up a Toxic Algae Task Group, chaired by our Regional Manager (Environment and Fisheries). The group developed a national algal monitoring programme was developed for. Monitoring was carried out from the beginning of May to the end of October, a period when blue-green algae are most prolific. The aim of this programme was to identify those waters that were likely to produce abundant populations of blue-greens in future years and to increase education and awareness of the problems that can arise.

A critical point in the programme was reached when over 25% of all monitored waters contained significant levels of blue-green algae. Then, a general alert was issued. In the Anglian Region alerts were given on an area basis and by the end of July all three areas had issued a

Figure 2.7

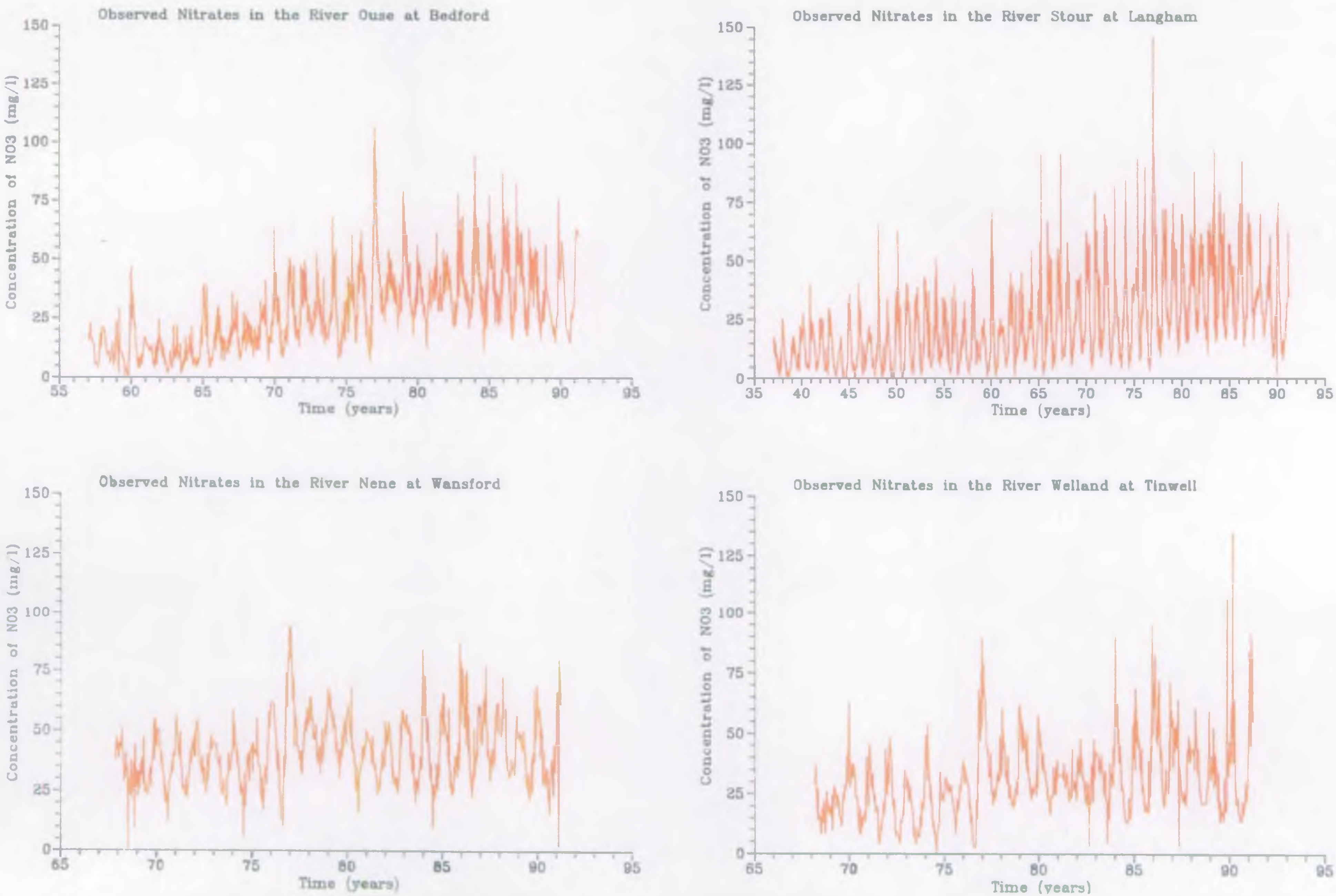
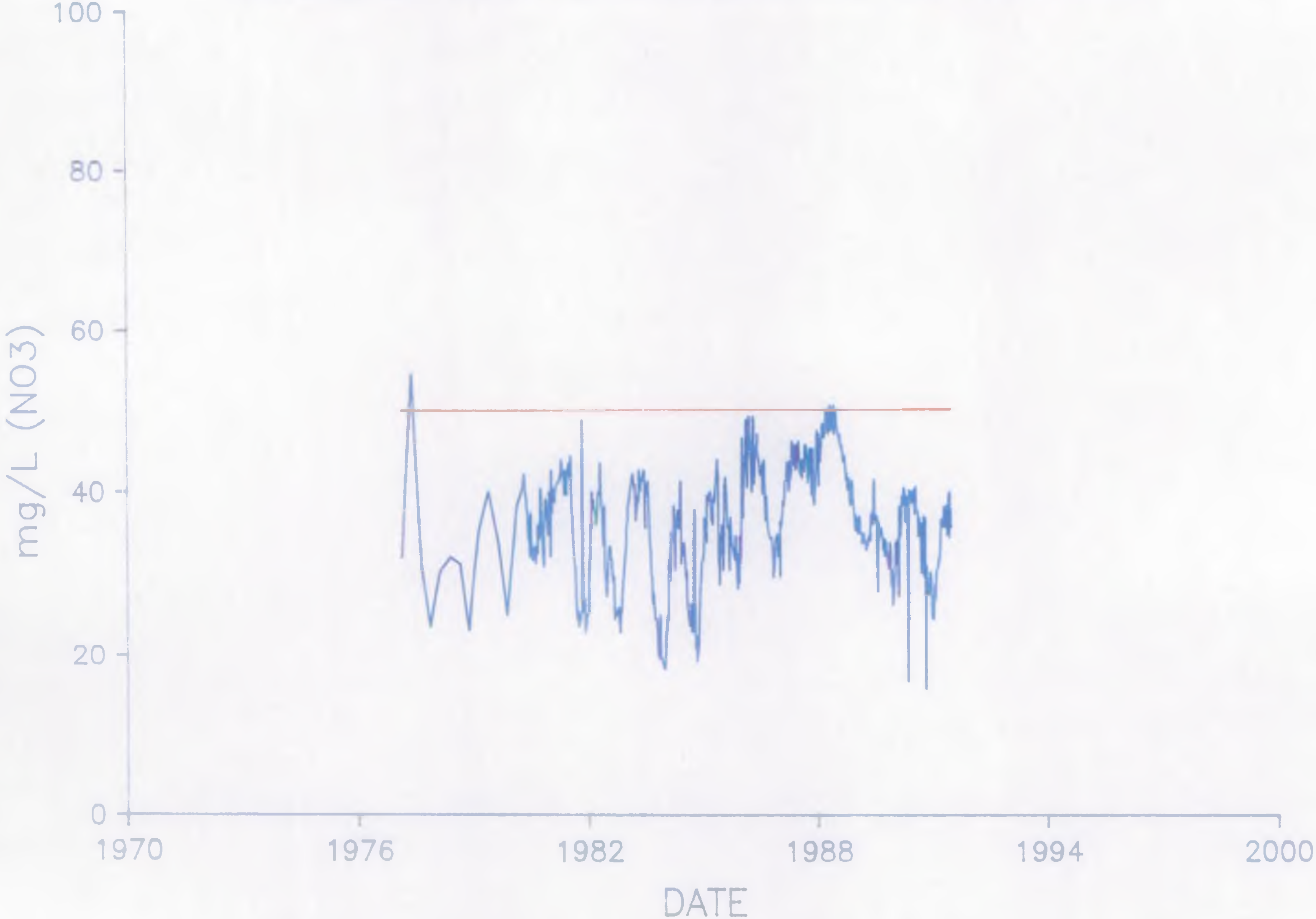

Observed Nitrates in the River Ouse at Bedford
Concentration of NO3 (mg/l)
Time (years)
Observed Nitrates in the River Stour at Langham
Concentration of NO3 (mg/l)
Time (years)
Observed Nitrates in the River Nene at Wansford
Concentration of NO3 (mg/l)
Time (years)
Observed Nitrates in the River Welland at Tinwell
Concentration of NO3 (mg/l)
Time (years)

FIGURE 2.8

BRANSTON BOOTHS - NITRATE CONCENTRATIONS



general alert.

During the routine monitoring programme the Anglian Region sampled 227 waters for blue-green algae. A total of 88 waters, distributed throughout the three areas, were subject to routine monitoring and 139 were monitored on request of owners and members of the public. A total of 106 waters were identified as containing abundant or significant populations of potentially toxic blue-green algal species (56 of these were routinely monitored waters). Only five waters were closed for recreational activities due to abundant algae.

Sampling continued after October on those waters that were identified as having significant populations of blue-greens. In total 13 waters were found to have problems of which 11 contained scums and/or blooms.

Algal abundance progressively increased from May and reached a peak in August, however in some cases, scums continued to persisted during November and December.

Toxicity tests were not carried out as part of the routine monitoring programme. Results of NRA testing in 1989 had shown that in cases where waters contained a blue-green algal scum, there was a 60 - 70% chance of it being toxic.

By September 1990 the Task Group had published a national report on toxic blue-green algae and their incidence on a national scale during 1989. In advance of the production of the report the Task Group has produced a leaflet and standard press releases. Solutions to reducing algal problems are likely to be long term. In order to reduce the toxicity incidents in the short term, a leaflet, outlining the potential dangers, was produced to alert members of the public and water users to avoid blooms and scums. The leaflet was distributed to Environmental Health Officers, Water Companies, water sport and recreational clubs and various councils.

Press releases and letters were distributed where a problem was identified. Media packages were issued periodically and and when an area alert situation was reached press releases were sent out.

Chief Environmental Health Officers were also kept informed of the issue of the NRA's plans. These proved to be successful in resolving a number of problems particular concerning the responsibilities of EHOs and the role of the NRA.

During 1990 there were no confirmed cases of illnesses associated with blue-green algae in the Anglian Region, an indication that the monitoring programme was largely successful. The 1990 routine monitoring programme identified those sites where potential blue-green algal problems are likely to arise. Lake ecology changes very little from year to year, so the Toxic Algae Task Group will be able to divert resources, in future years, to developing schemes that address the real factors that cause algal problems, as opposed to repeating routine monitoring programmes from year to year. Future programmes will have a greater emphasis on the development of Action Plans for individual water bodies. Additional monitoring will also be carried out at a series of six long term reference sites.

The Group has also identified a number of research and development projects, some of which have been running since the end of 1990. Most of these projects are aimed at identifying the fate, production and behaviour of toxins, evaluating and developing measures to control eutrophication and formulating predicative models to identify conditions under which algal populations are likely to develop.

2.15 The Norfolk Broads

It is now widely accepted that the key to reversing the eutrophication problems in the Broads is to control the quantity of phosphorus entering them. Although phosphorus inputs from point sources such as STWs, has been reduced, the sediments of the Broads still contain large quantities of phosphorus which is released into the water body under certain conditions, perpetuating the eutrophication problems.

During 1990 there was a marked improvement in the effectiveness of phosphorus removal from STWs where ferric sulphate dosing has been applied. The only exception was at Stalham where total phosphorus in the effluent increased during November and December (see also Part 5.5).

Phosphorus levels upstream of Barton Broad have shown a declining trend since 1981 when ferric-dosing of effluents became effective. However, in 1990 concentrations, increased slightly as a result of low river velocities, allowing phytoplankton to develop. Similarly all sites for the River Bure Broads show a marked increase in phosphorus during 1990. Again this is likely to be related to low river flows, which provided less dilution of effluents, and to phosphorus release from the sediments.

2.16 Pesticides

The problem of low concentrations of pesticides in surface and groundwater has remained an important issue. (see Part 2.12.2).

We have taken a number of initiatives in order to resolve the problem at national level. These have included discussion with the major users such as British Rail and the Department of Transport, and discussions with Government Departments and the manufacturers on guidance given to the users. The Region has also been co-ordinating a revision of the BASIS stores "Fire and Water" inspection scheme, and reporting of pesticide pollution incidents.

2.17 Integrated Catchment Control

The NRA is investigating the integration of its regulatory and operational roles on a catchment basis. There are several reasons needs for this. Making dischargers and other authorities aware of the roles they play in the aquatic environment, building strategies for managing and improving catchments and so on. There is also the potential for conflicts between the objectives of some of the NRA's duties, for example between Flood Defence and Conservation, and between Water resources, Water Quality and Fisheries.

In 1990, the first formal Catchment Plan for the region, was drawn up for the River Cam, around Cambridge. Aspects of the plan included:

- Aims, policies and practices,
- Target Levels of Service,
- The current situation, and,
- Action and investigations required.

These were grouped grouped under seven main functional headings. The main water quality actions identified were to:-

- Obtain improvements to six Anglian Water Services effluents,
- Obtain improvements to three trade effluents,
- Expand the network of telemetry on quality monitors on the larger effluent discharges,
- Implement the Aquifer Protection Policy,
- Expand on ecological and biological monitoring.

2.18 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, Chelmer, Gipping, Great Ouse (parts), Ivel, Little Ouse, Mardyke, Nene (parts), Stour, Thet, Waveney, Welland, Wensum, Wid and Witham.

The WRC nitrate model for the Central Lincolnshire Limestone has been uprated and the recent trends in concentrations have been successfully explained. Lower concentrations appear to have been associated with reduced rainfall over the last three years. The model predicts that without Protection Zones, concentrations will continue to increase.

The model is currently being used to examine the impact of changed land-use with the two Nitrate Sensitive Area's, and we shall continue to feed results from our monitoring programme into this work. Initial results suggest that nitrate concentrations will decline rapidly at first following land-use changes, but that it will take more than ten years for concentrations to fall below 50 mg/l.

Part 3: ESTUARIES

There were no significant changes in water quality during 1990. Most lengths of estuary are of good quality although there are localised areas of pollution around some outfalls. All estuaries support fish life and allow the passage of migratory fish, principally eels.

3.1 Monitoring

Routine sampling for water quality in estuaries was performed at over 90 sites. A further 80 sites were sampled for special surveys. The total number of samples collected was in excess of 2,100.

The frequency of sampling ranged from quarterly to fortnightly and included sampling for Directives.

Samples of sediments were mainly collected for investigations of discharges which might contain Dangerous Substances, and as part of the Humber monitoring programme. The frequencies ranged from one to four per year.

Biological monitoring was performed on all of our major estuaries. Numbers of samples are given in Appendix I.

3.1.1 Dissolved Oxygen Monitor - Lower Humber Estuary

Since 1985, a continuous dissolved oxygen (DO) monitor has been installed on a jetty at Stallingborough on the south bank of the Humber Estuary, belonging the SCM Chemicals, Ltd. It records values of DO at 15 minute intervals. An example is shown in Figure 3.1.

The quality specification for DO in the Humber is that it should not drop below 55% for more than 5% of the time. Results show that DO was generally between 70% and 95% saturation. Thus DO levels in the Lower Humber Estuary during 1990 were satisfactory.

3.2 Classification

Estuaries are classified on the basis of quality, according to the system devised by the Department of the Environment and the National Water Council. This is called the Classification of Estuaries Working Party (CEWP) System after the working party which set it up. The CEWP System is highly subjective and is being re-evaluated by a national working group.

A summary of the results for 1990 is given in Figure 3.2 with data for previous years for comparison. Most lengths of estuary are in Class A with 25% of Class B and 7.5% of Class C. There is one small length of Class D (in the Orwell).

FIGURE 3.1

Dissolved Oxygen in Lower Humber Estuary - 1990.

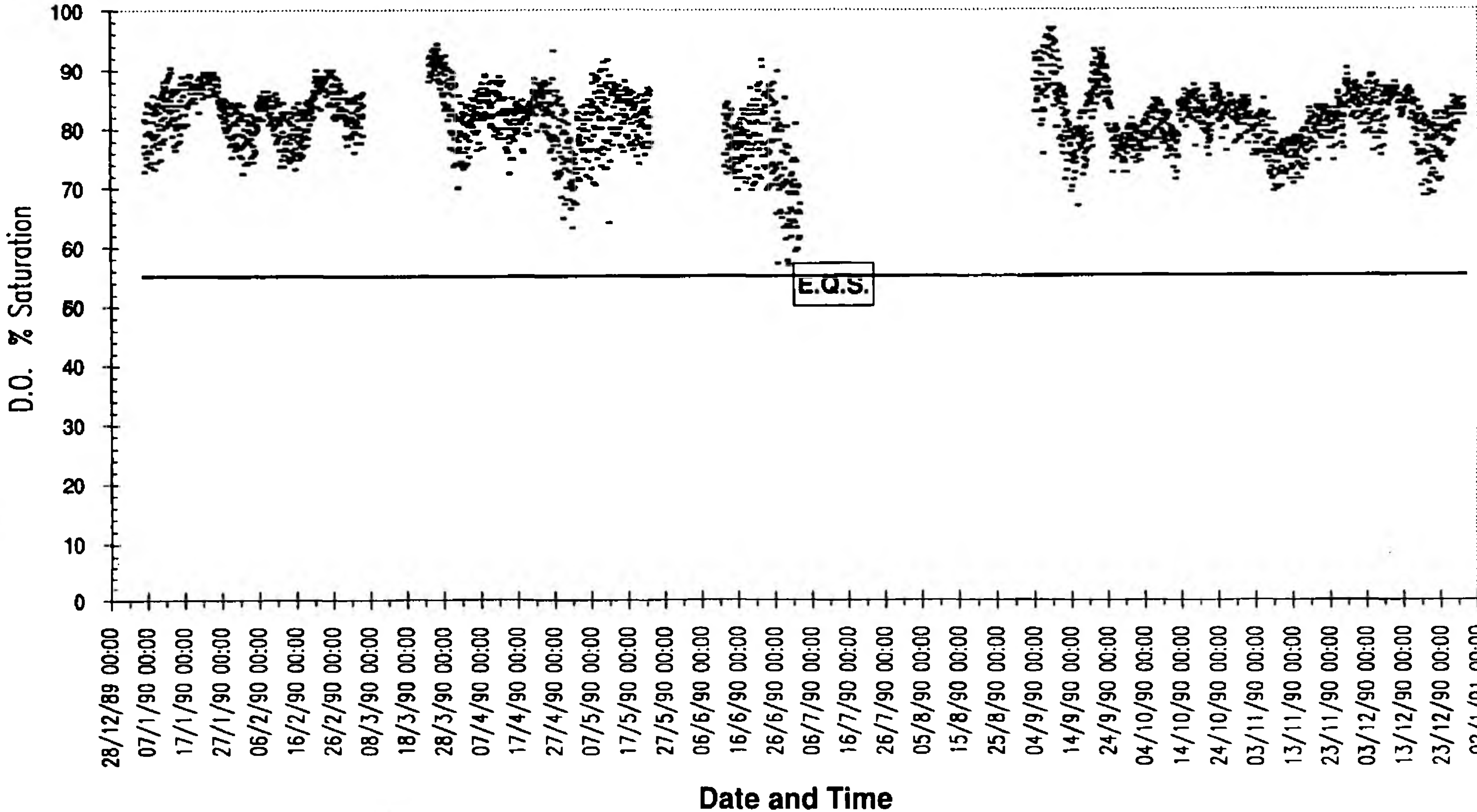
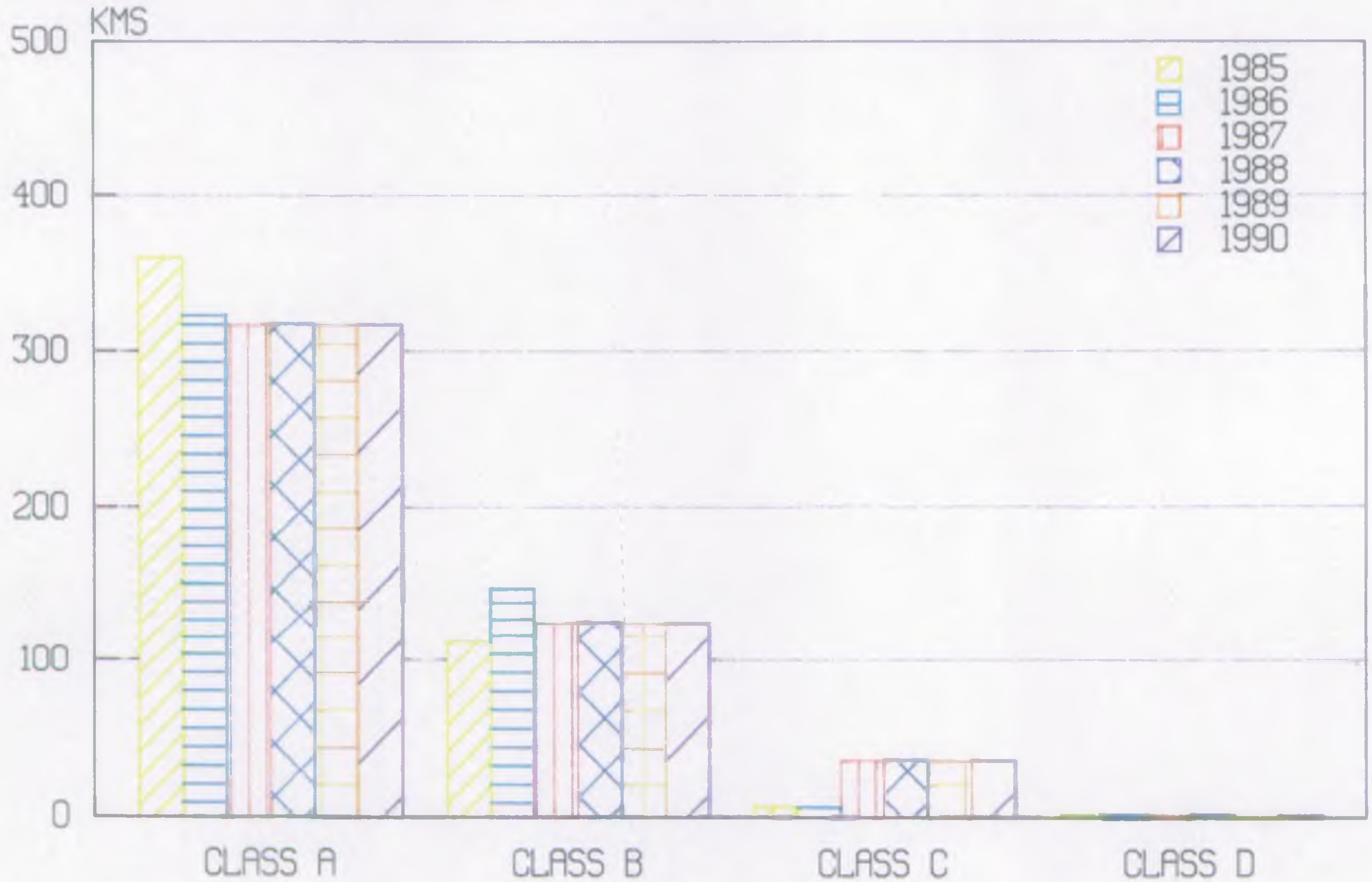


FIGURE 3.2

ESTUARIAL WATER QUALITY



The 1990 Survey referred to in Section 2.4, encompassed estuaries as well as Freshwaters.

3.3 EC Directives

3.3.1 Dangerous Substances

All discharge related-estuarine monitoring sites passed the Directive List I quality standards. There were four for Lindane, three for Mercury, five for Cadmium, one for Pentachlorophenol, one for Carbon Tetrachloride, and one for the Drins. We also undertook background monitoring for List I substances, as required by the DoE.

Five of the eight sites for the List II metals passed, the failures being:

- Two in the Humber Estuary;
- One in the Orwell.

The copper failures in the Humber resulted from inputs to the river system which are upstream of the Anglian Region - work by WRC has shown that this copper is bound up with organic matter and has low toxicity. The failure in the Orwell is thought to relate to a discharge in Ipswich and investigations have been instigated.

1990 was the first monitoring year under the Directive for triorganotin compounds. Only one estuarine site is monitored:

- Cut End, Witham Haven;

The site failed the Directive standard, and reasons for this are being investigated.

3.3.2 Urban Waste Water Treatment

As outlined in Part 2.9, this Directive has significant implications for the UK water industry. Discharges to saline waters will be particularly affected, with full (i.e. secondary) sewage treatment becoming the "norm," in contrast to the best past practice of minimal treatment (e.g. screening) and discharge via a long sea outfall.
In some instances, standards to be imposed are tighter than those which we have derived for the needs of the receiving waters (see Figure 3.3).

3.3.3 Shellfisheries

This Directive requires special monitoring of water quality in areas designated as shellfisheries. Six such areas are designated in our region. The relevant waters were monitored as required by the Directive, although there was no formal requirement to report the results this year. No contraventions were recorded.

A Draft EC Regulation on Health Conditions for Production and Sale of Live Bivalve Molluscs was published early in 1990. This will establish common public health measures relating to the bivalve shellfish industry, and provide for a classification of shellfish beds based on the bacterial count of harvested shellfish. If implemented, it has significant implications for the NRA and for the Water Services plcs. Improvement of sewage treatment discharges (and hence facilities) which affect commercial shellfish beds is a likely consequence.

3.3.4 Titanium Dioxide

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

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

In 1988, the outfalls from both factories were relocated to deeper water where dilution and dispersion would be much greater. A major survey in 1989 confirmed that the re-siting of the outfalls produced a substantial reduction in the size of the affected area.

Chemical and biological monitoring of the receiving waters in 1990 was carried out as required by the Directives and reported to DoE.

This was the second full year of monitoring since the two discharges were moved into deeper water. There has been a continuing reduction in the iron concentrations resulting from the discharges. The biological monitoring results show a deterioration in status around the outfalls compared to 1989, but it is not clear whether this decline relates to the discharges or is just a natural fluctuation.

The DoE are in the process of drafting Directions to the NRA under the Water Act 1989, which will enshrine within UK law, one of the Titanium Dioxide Directives. This Directive lays down the timescales within which reduction and elimination of pollution from these discharges must be achieved. They also require the NRA to monitor in accordance with the Directive. Compliance with the Directions will not entail us in any additional workload.

3.4 Red List

The second North sea Conference (held in 1987) agreed to a 50% reduction in loads of certain dangerous substances to the North sea, from the loads discharged in 1985. The UK Government identified a list of 23 such substances. This is known as the Red List.

Following some preliminary screening survey work in 1989 the NRA started full survey work in July 1990. Rivers, trade effluents and sewage effluents were all sampled

The objective of the survey was to identify the sources of at least 90% of the Red List load being discharged to Anglian estuaries and coastal waters.

Chemical analyses of many of the samples has proved to be difficult and time consuming. Novel and sophisticated analytical techniques have had to be adopted to produce results.

Many of the Red List substances are agricultural pesticides that are applied seasonally. A full years data will be needed before a reliable picture will emerge as to the amounts of these substances that reach the North Sea through Anglian rivers and estuaries. Once such results are available measures to reduce the Anglian output will follow in future years.

3.5 Mathematical Modelling

Mathematical Models constructed by the Water Research Centre have been extended to include techniques for calculating effluent standards defined as 95-percentiles. This feature, and the inclusion of the option to model microbes and nutrients, illustrates the way in which we are able to adapt and up-date the models to meet increased demands.

The Nene Estuary Model has been used to help determine future quality standards for discharges to the estuary so that water quality can be improved. A typical set of predicted water quality data is shown in Figure 3.3.

A model of the Crouch and Roach Estuary system has been completed and another model, for the Colne Estuary, is nearing completion by the Water Research Centre.

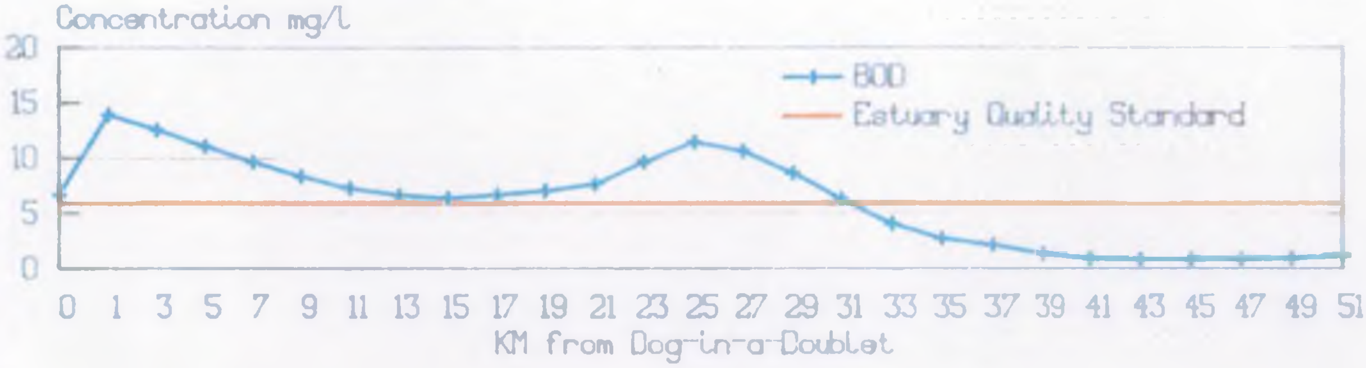
Researchers from Birmingham University have produced a water quality model for predicting the concentrations of dissolved oxygen and the transport of heavy metals in the Blackwater Estuary.

Further models are planned over the next five years for the Stour, Orwell and Harwich Harbour systems, as well as for the Witham, Welland and Yare estuaries (see also Part 4.2). Plans are also in hand for a water quality model of the Wash.

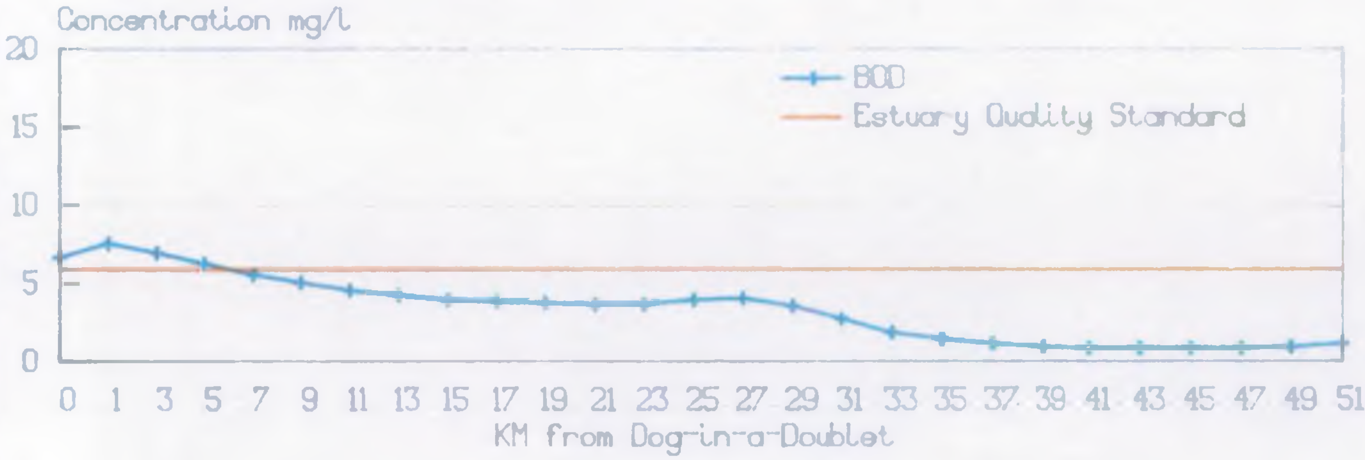
The aim of the modelling work is to provide a suite of consistent techniques for calculating the measures needed to achieve our objectives for water quality.

FIGURE 3.3
Nene Estuary Model Predicted Water Quality

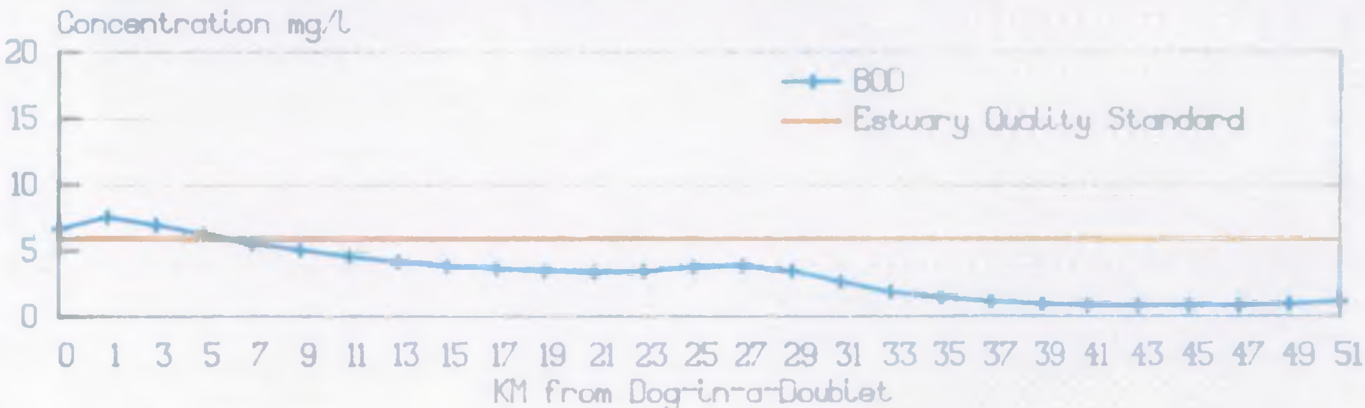
Existing Conditions



Proposed Interim Conditions



Proposed Conditions under UWWT Directive
(Urban Waste Water Treatment Directive)



Part 4: COASTAL WATERS

The coastal waters of the Anglian Region have some of the strongest tides in the whole of the North Sea. In the Humber estuary and the Wash the tidal range (the difference in height between low water and high water) can be as much as 7 metres.

These tides ensure that discharges are rapidly diluted and dispersed. Also, compared with rivers and estuaries, there are relatively few discharges of industrial or sewage effluent to coastal waters. As a result quality of coastal waters is good.

4.1 Monitoring

Routine sampling of water was performed at 50 points during 1990, including sites at the 28 identified Bathing Waters. In addition to monitoring required for the Bathing Water Directive, samples were collected from over 100 sites, mainly for investigations associated with the Dangerous Substances Directive.

An extensive survey of waters along the Eastern Area coast was undertaken to gain background data on concentrations of nutrients, metals and viruses. Samples were collected from a helicopter.

Biological monitoring was performed at several sites on our coastline. Numbers of samples are given in Appendix I.

4.2 Mathematical Modelling

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 of discharges from existing and proposed outfalls on the bacterial quality of recreational waters and fisheries.

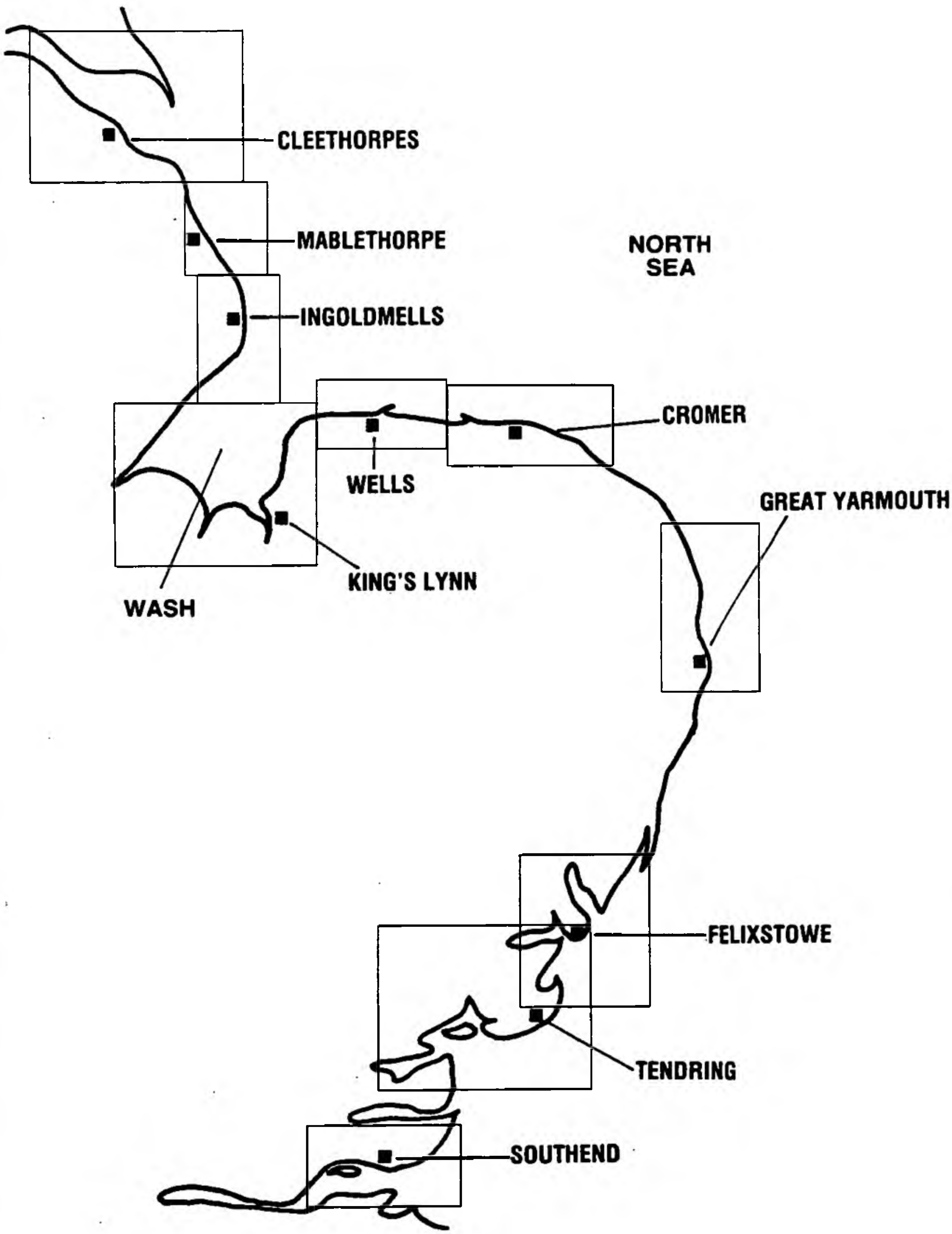
Following the success of this study, models were proposed for ten further locations, which are shown in Figure 4.1.

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 region of the NRA.

The construction of the models takes two stages. The first is a mathematical description of the tidal movements (hydrodynamics) of the water. The next stage requires a description of how bacterial pollution can be expected to disperse in sea water. Most models work on the average microbial quality of a cell 333m square.

FIGURE 4.1

COASTAL MODELLING FINE GRIDS



During 1990, further information to build the models was acquired. These data were gathered from a number of sources, including the Admiralty, the Harbour Authorities and boat and helicopter-based field surveys by Anglian Water Services.

Copies of all completed models are maintained on our own computer. We have made further enhancements to the output, so that animated displays can be shown on any PC we chose. Figure 4.2 shows an example of such a display.

4.3 North Sea

The Third North Sea conference was held in the Hague on 7/8 March 1990. The Declaration adopted by the conference strengthened and added to commitments made at the Second Conference held in London in 1987.

The 1990 conference agreed a common list of dangerous substances to which the precautionary approach to pollution control should apply. This list included most of the substances on the UK Red List but was more extensive than the Red List. In response to this, where we can sensibly do so, we have increased the range of determinands we analyse for our Red List samples to include the extras.

The North Sea Task Force agreed a Monitoring Master Plan. Within the UK this was devised by the Marine Pollution Management Group and the commitment incorporated into a national baseline monitoring programme. We have two estuaries, the Humber and the Wash, within the programme and baseline monitoring will start on these two estuaries in 1991.

Nutrients and eutrophication of coastal waters was a third major discussion topic at the Conference. The NRA has responded to this by implementing an algal monitoring programme for bathing waters and by contributing to the JoNuS research programme (described below).

4.4 JoNuS Programme.

A Joint Nutrient Study (JoNuS) programme was started by MAFF in conjunction with the University of East Anglia (UEA) and Plymouth Marine Lab (PML) in May 1990. The Department of the Environment were unable to provide the anticipated funds. The opportunity was taken for the NRA to participate by the collection and analysis of nutrient samples from the Wash estuaries and also providing boats and equipment for other areas of the sampling programme.

In addition to obtaining nutrient data for the Humber estuary, the Wash and its estuaries, information will also be available concerning nutrient mobilisation mechanisms, leading to management guidance for nutrient-rich discharges.

FIGURE 4.2

COASTAL MODEL DISPLAY SYSTEM v1.0 NRA ANGLIAN REGION November 1990

RUN 1 UNTREATED SEWAGE FLOW = 99.6 L/S (ave). COLI CONC = 10**8/100ml

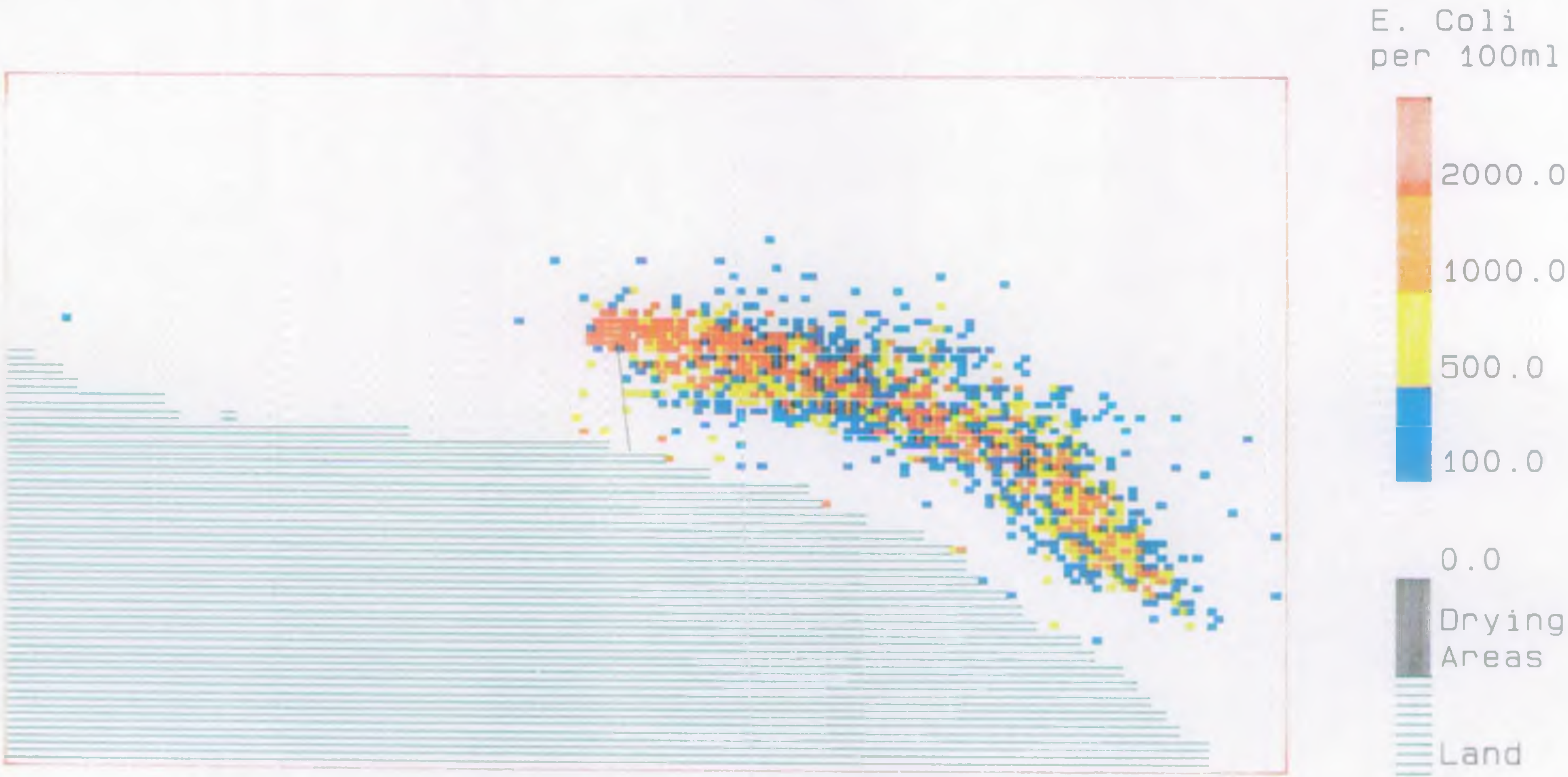
CROMER (L) Spring tide 333m grid

NO WIND
60/20
5.00m2/s diffusion
As Scarborough

Noon (HW +3: 55)

1km

N



4.5 Paris Commission

In 1988 the Paris Commission decided to implement a comprehensive annual survey of selected pollutants to Convention waters. The first study was carried out in 1990. the objective of the survey was to monitor 90% of the input of each selected pollutant.

In the Anglian region 17 rivers, 14 sewage effluents and eight trade effluents were monitored. Rivers were monitored close to their tidal limit. Major trade and sewage effluents downstream of these points were also monitored.

Figure 4.3 shows estimates of the contribution made by rivers, trade and sewage effluents to the total load from the region.

4.6 Coastal Survey Vessel

During 1990 it was decided to purchase a purpose built coastal survey vessel for the Region. David Abels Boatbuilders of Bristol were commissioned to supply the vessel as one of three for the NRA. Completion will be in July 1991. The first surveys are expected to commence at the beginning of September 1991.

The vessel is a 16.5m twin screw steel built boat. There will be living accommodation for three and galley space for six. The licensed carrying capacity will be twelve people.

There will be $13m^2$ of survey cabin space, for processing chemical, biological and bacteriological samples. we plan to carry out some analyses on board, for example on nutrients, and bacteria. An artists impression of the boat is shown in Figure 4.4.

4.7 EC Directives

4.7.1 Dangerous Substances

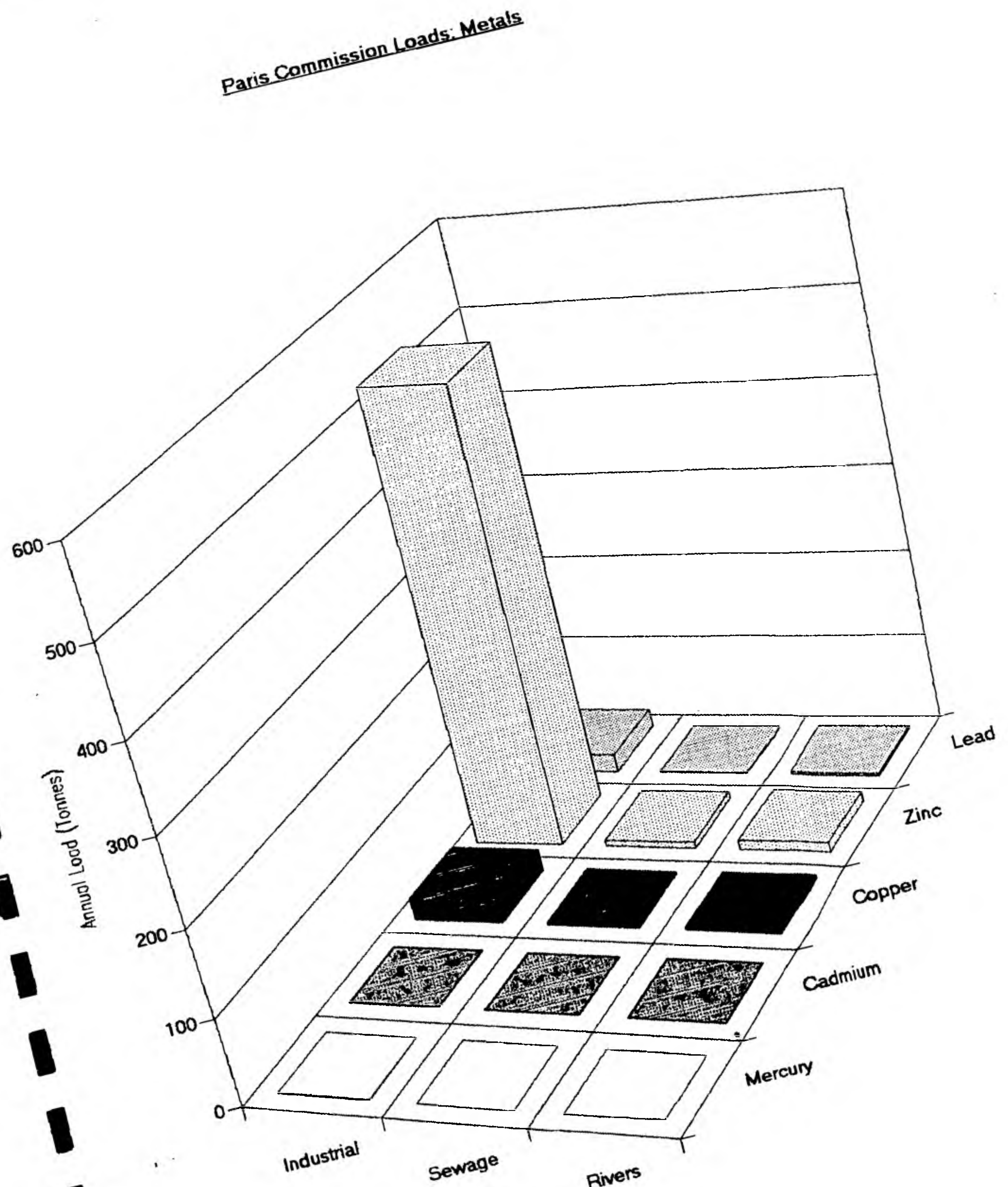
The only designated site (for List II substances) passed the quality standards.

4.7.2 Bathing Water

Of the 29 Anglian Region sites identified under the Bathing Waters Directive, 27 passed this year. This compares with 23 out of 28 in 1989. Southwold The Denes was the newly identified water.

The current "pass/fail" method of assessing compliance with the Directive has several drawbacks, based mainly on its statistical volatility. The large variation in bacterial numbers over a short period of time coupled with the relatively infrequent sampling rate required by the Directive may result in bathing waters failing for statistical reasons rather than those of poor water quality. Bearing in mind these drawbacks it is useful to look at the trend in bathing water quality from a dif-

FIGURE 4.3


Paris Commission Loads: Metals
Annual Load (Tonnes)
600
500
400
300
200
100
0
Industrial
Sewage
Rivers
Lead
Zinc
Copper
Cadmium
Mercury

Paris Commission Loads: Nutrients

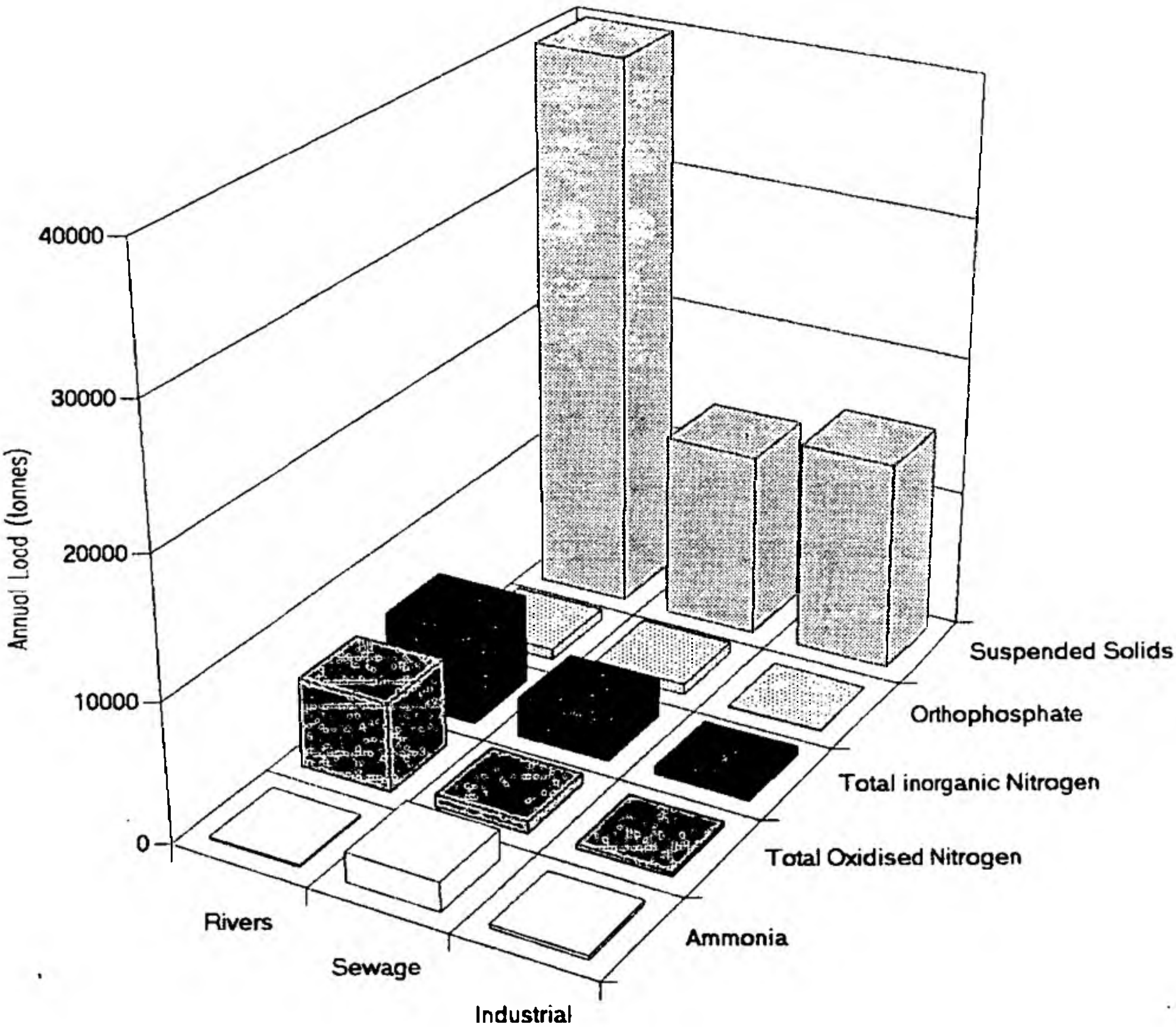


FIGURE 4.4

ferent viewpoint, using the Median values of the Total and Faecal Coliform parameters for each bathing water over the bathing season (see also Part 2.3.1).

By ranking the median values of all bathing waters for each of several years and plotting them graphically, it is possible to see the trend in bathing water quality in the relative positions of the different year's graphical results. Thus Figure 4.5 plots the median Faecal Coliform values for each bathing water for each of the years 1987 to 1990 against the proportion of beaches with a median less than that particular value. Essentially the further is the graphical plot to the right for a particular year, then the better the bathing water quality for that year.

In general there would appear to have been a trend in steady improvement of water quality in the years 1987 to 1990. Approximately 89% of bathing waters had a median of less than 500 faecal coliforms per 100 ml in 1987. In 1990 this figure had risen to nearly 97%, showing a significant improvement in bathing water quality over the 4 year period. If this trend continued for the 1991 bathing season, and the weather was cooler than in 1990, it would indicate that the improvement in bathing water quality was due to remedial capital expenditure schemes by Anglian Water Services Utility. However, if the summer was again dry and sunny, improvements in water quality would be assumed to be due to a combination of weather effects (causing increased bacterial die-off and reduced storm-water overflow operation) and improved sewage treatment efficiencies.

During 1990, draft Regulations and Water Quality Objectives under the Water Act 1989, were produced by the DoE. These, when enacted, will enshrine within UK law, the requirements of the EC Bathing Water Directive. The NRA will have a duty to achieve compliance with the Objectives within a specified timescale. The final documents are expected to be issued shortly.

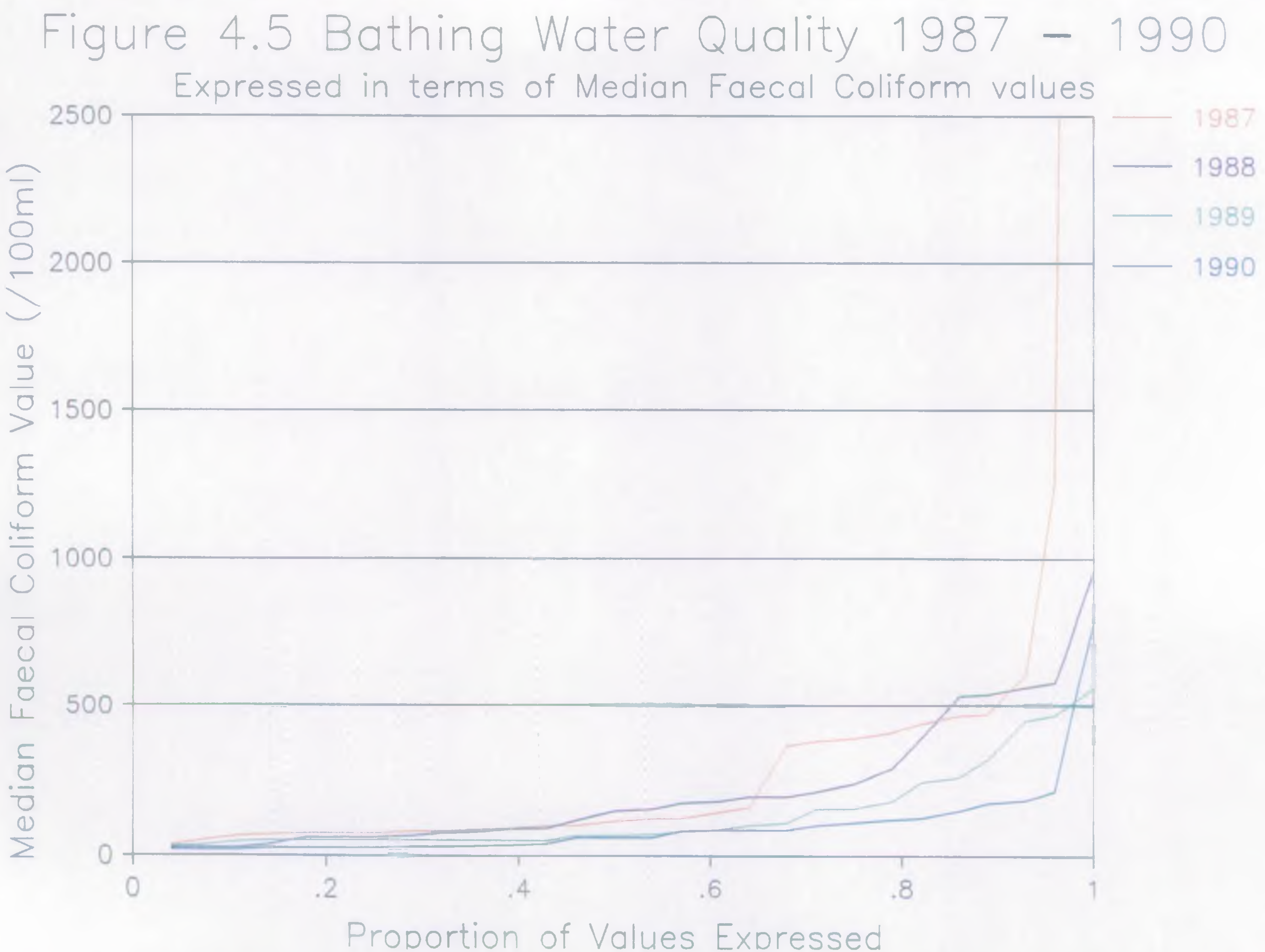


Figure 4.5 Bathing Water Quality 1987 - 1990
Expressed in terms of Median Faecal Coliform values
Median Faecal Coliform Value (/100ml)
2500
2000
1500
1000
500
0
0
.2
.4
.6
.8
1
Proportion of Values Expressed
1987
1988
1989
1990

TABLE 4.1

BATHING WATER DIRECTIVE

Compliance with Standards for Total and Faecal Coliforms

Compliance with Standards for Total and Faecal Coliforms

BATHING WATER	1987	1988	1989	1990
Cleethorpes	Fail	Fail	Fail	Fail
Mablethorpe	Fail	Pass*	Fail	Pass*
Sutton on Sea	Fail	Fail	Pass	Pass*
Moggs Eye	Pass	Pass	Pass*	Pass
Anderby	Pass*	Pass	Pass*	Pass
Chapel St. Leonards	Fail	Pass	Pass	Pass*
Ingoldmells	Fail	Pass*	Pass*	Pass*
Skegness	Pass	Pass	Pass*	Pass*
Heacham	Pass	Fail	Pass	Pass*
Hunstanton	Pass	Fail	Pass	Pass
Wells	Fail	Pass*	Pass*	Pass*
Sheringham	Fail	Fail	Fail	Pass
Cromer	Fail	Fail	Fail	Pass
Mundesley	Pass	Pass*	Pass	Pass
G.Yarmouth North	Fail	Pass	Pass	Pass
G.Yarmouth Pier	Fail	Fail	Pass*	Pass*
G.Yarmouth South	Fail	Fail	Fail	Fail
Lowestoft North	Pass	Pass	Pass	Pass*
Lowestoft South	Pass	Pass	Pass	Pass
Southwold The Denes	--	--	--	Pass
Felixstowe North	Pass	Pass	Pass	Pass
Felixstowe South	Pass	Pass	Pass	Pass
Dovercourt	Fail	Fail	Pass*	Pass*
Walton	Fail	Pass	Pass*	Pass
Frinton	Pass	Pass*	Pass	Pass
Holland	Fail	Pass	Pass	Pass
Clacton	Fail	Pass*	Pass	Pass
Jaywick	Pass	Pass	Pass	Pass*
Brightlingsea	Fail	Pass*	Pass*	Pass*

* These sites have had at least one failing sample.

Part 5: DISCHARGES

The discharge of wastewaters is controlled by granting a Legal Consent. A Consent is the legal permission to discharge pollution to a Controlled Water, and one is required for every sewage or trade effluent discharged to the environment. Consent is also required for contaminated discharges of surface water drainage (except from roads).

Before the 1989 Water Act, Consents for the discharges operated by Anglian Water Services were issued by the Secretary of State for the Environment under Part II of the Control of Pollution Act. Consents for all other discharges were issued by the former Water Authority, Anglian Water.

Since the Water Act (1989), all Consents have been issued by the NRA. Because they have different types of Consent, we distinguish between STWs owned by the main Utility (Anglian Water Services) and those which are not. The latter are called Non-Utility discharges.

5.1 Utility Discharges

5.1.1 Discharges

Discharges made by the Utility may be categorised thus:

Sewage Treatment Works	1053
Storm Sewage Overflows	1100
Emergency Overflows	1000
Surface Water Sewers	1200
Water Treatment Works	200

Of the STWs, 700 had Legal Consents which included numeric limits on the quality of the effluent. Descriptive consents applied to 353 small works and a few large coastal outfalls.

5.1.2 Types of Consents

The *Legal Consent* is the consent now in force. This may contain numeric limits on the quality and quantity of the effluent. For small works the Legal Consent may be a statement of the type of treatment which must be provided. This is a *Descriptive Consent*.

Compliance against numeric Legal Consents is reported each year to the Department of the Environment.

The *River Needs Consent* has no legal force but is a working estimate of the Consent which may be needed in the future to achieve the Quality Objectives for Controlled Waters (see Section 1.2).

In the run up to privatisation, Water Authorities were given a chance to reduce their risk of prosecution. *Time-limited Consents* were granted for about 200 discharges in our Region which failed their Legal Consents. These relaxations were conditional, since the new private water company would have to bring these works into compliance by 1992, with the old Legal Consent (or a Consent based on maintaining the 1984 load, if this were more strict). For discharges where the extra cost was less than 10%, the Company would achieve the River Needs Consent.

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

5.1.3 Policy on Setting Consents

The policy of the Anglian Region, (and the draft national policy of the National Rivers Authority), is that all revised or new Consents will maintain the quality of Controlled Waters (*No Deterioration*) and meet Water Quality Objectives by achieving River Needs Consents. The Water Quality Objective is the same concept as the River Quality Objective, but is applied to all kinds of Controlled Water.

The main policy of the Utility is to ensure compliance with Legal Consents. The company has identified works at risk of failing Legal Consents and intends to design schemes to meet the current discharged load.

The Company will want to apply to the Director General for Cost-Pass-Through for expenditure beyond this which is required to achieve River Needs Consents.

5.1.4 Applications

During 1990, 161 Consent Applications were received from the Utility. By the end of the year, the total number of Applications lodged with us was 391. These are classified in Figure 5.1.

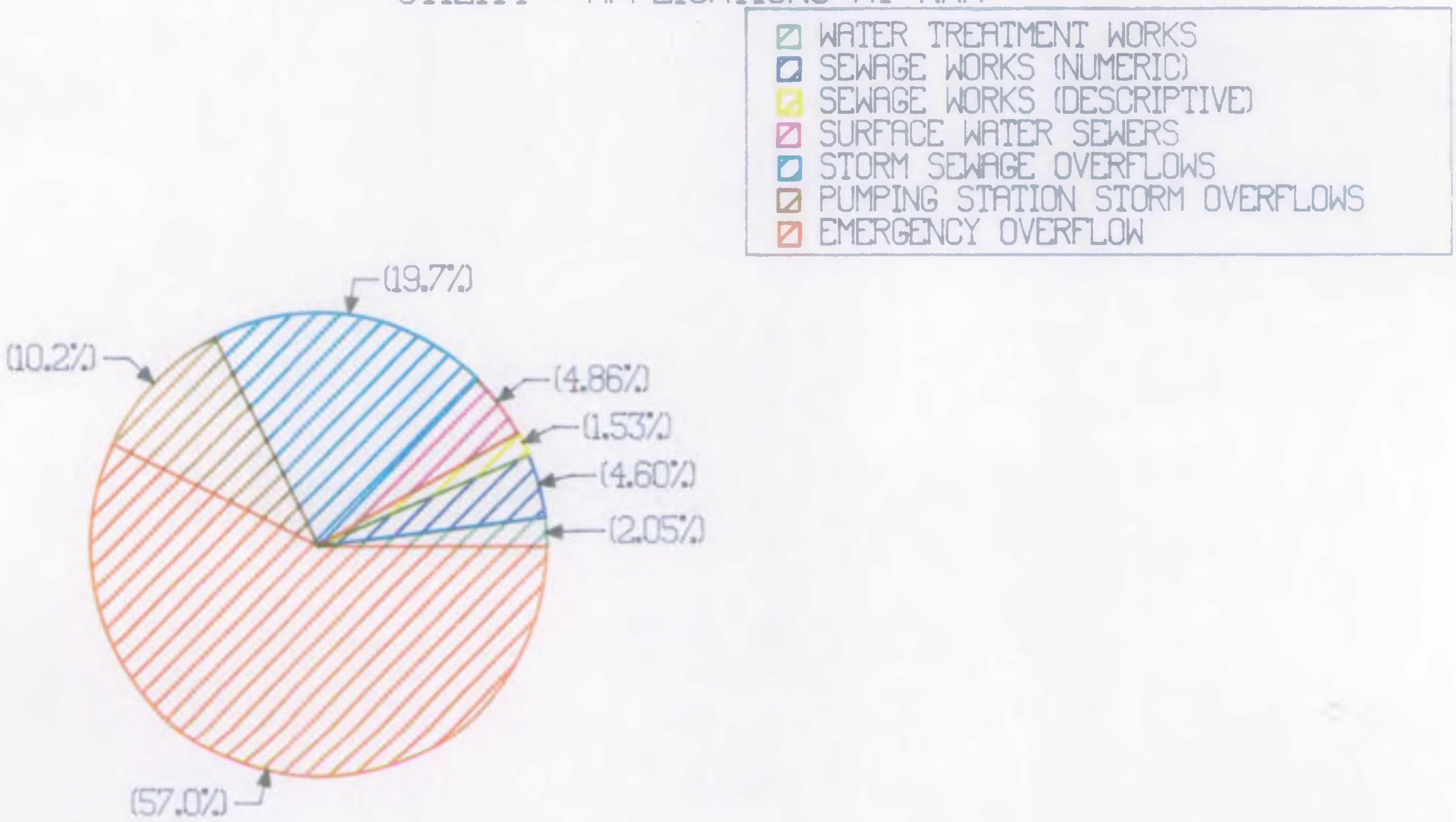
During 1990, 50 Consents were issued. Of these, 22 were for STWs and most of the rest were for storm or emergency overflows. The low number of consents issued was due to the time required to formulate the new policies of the NRA.

5.1.5 Monitoring

The minimum frequency at which a discharge is sampled is governed mainly by its size. The size of the works is a key factor governing the potential impact of the effluent on the Environment. The number of samples taken at works is indicated in the following table:

FIGURE 5.1

UTILITY : APPLICATIONS AT NRA



Equivalent Population ('000s)		Samples per Year
>100		48
> 10	<100	41
> 5	< 10	17
> 1	< 5	8
	< 1	4

A secondary factor, the degree of treatment provided at the works, is also used to determine the sampling rate. This factor is applied by starting with the category produced from the above table and moving to a higher or lower category according to the following rules:

Secondary treatment:	No change
Primary treatment:	Down one class
No treatment:	Down two classes
Tertiary treatment:	Up one class

These adjustments work well where river quality is good because the degree of treatment will reflect what has been constructed in order to protect the Environment. A final condition was added to cater for sites where the current degree of treatment may be inadequate: if the River Needs Consent for the BOD is less than 20 mg/l, the sampling rate is moved up by one class.

Some Legal Consents contain criteria for List I and List II Dangerous Substances (Part 2.9). We analyse for these determinands monthly.

During 1990, the planned number of samples was 12,325. 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 12,827.

We aim 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.

National guidelines have been drawn up for monitoring effluents. We expect to be able to meet these within our current resources.

5.1.6 Compliance with Standards

Two summary statistics are used to monitor performance. The first, the *Percent of Compliant Works*, is a simple statement of the number of sites 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 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. Other determinands are called non-sanitary. 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.

Works with Time-Limited Consents have additional standards which are absolute limits on quality. These must not be exceeded at any time and are called Upper Tier Limits.

Figure 5.2 shows the performance of works since 1981, against the percentile limits in their Legal Consents. Results cover all discharges which have numeric standards on the effluent quality. Performance against Legal Consents is better than ever before.

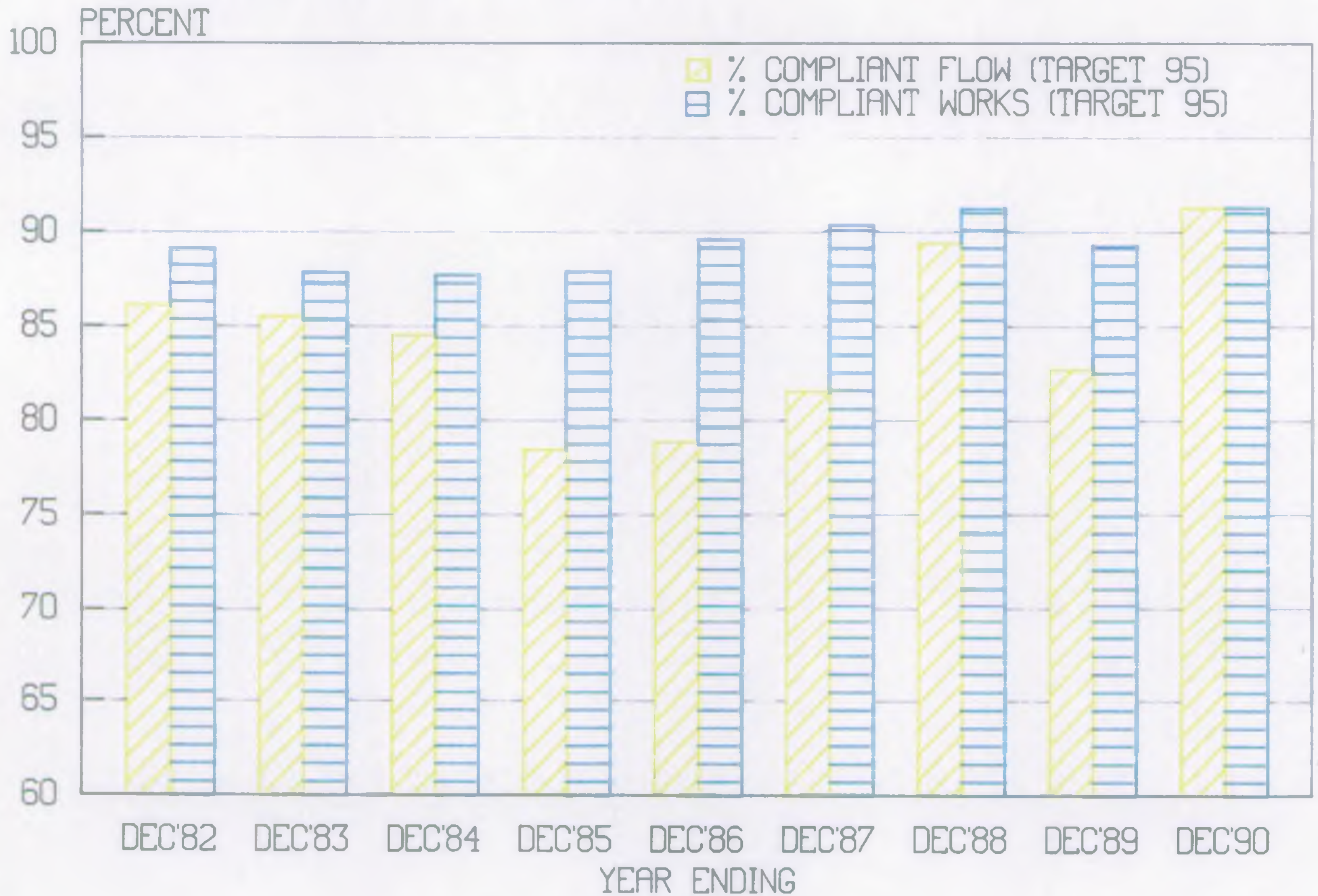
Around 20% of all flows are discharged to Tidal waters. Table 5.1 summarises the proportions of discharges to Non-Tidal and Tidal waters and shows the improvements seen over the last year.

Table 5.1: Sanitary Criteria

Receiving Water	Number of Works	Percent Compliant: Works		Percent Compliant: Flow	
		1989	1990	1989	1990
Non-tidal	666	90.1	91.9	83.4	92.4
Tidal	34	73.5	82.4	77.4	87.0
Total	700	89.2	91.3	82.6	91.3

FIGURE 5.2

COMPLIANCE WITH LEGAL CONSENTS



The percent of discharges which fail the Upper Tier Limits in their Time-Limited Consents is now 11.0 (21 discharges), compared with 25.0 at the end of 1989. No discharges failed these limits significantly. This compares to 11 which failed significantly in 1989.

There are 31 discharges with criteria for non-sanitary substances in Legal Consents, of which one STW failed a single sample for cadmium. All limits for non-sanitary determinands are absolute.

At the end of 1990, 353 small discharges had Legal Descriptive Consents, compared with 349 at the end of 1989. About 92% (326 discharges) were inspected at least once in 1990, compared with 69% (241 discharges) in 1989.

Figure 5.3 shows how the compliance of these discharges has altered over the last five quarters. The proportion which complied at the latest inspection is 88% (286 discharges).

Performance against a River Needs Consent gives an indication of the action needed to cater for growth and achieve Water Quality Objectives. Figure 5.4 shows that since December 1989 the Percent of Compliant Flow judged against River Needs Consents has improved from 70.6% to 78.6%, the highest value we have recorded.

5.2 Non-Utility Discharges

5.2.1 Discharges

Non-Utility discharges may be categorised thus:

Sewage Treatment Works	16000
Trade Effluent	1000
Surface Water	2200
Agriculture	2400
Miscellaneous	3800

5.2.2 Types of Consent

Most of the consents on the Water Act Register (Part 6), are Descriptive Consents for discharges of effluent from private STWs and trade premises. Discharges with the greatest potential to affect the environment have numeric limits in their Consents. Legally, all numeric limits for the Non-Utility discharges are absolute, even those for the sanitary determinands.

5.2.3 Applications

The number of Applications for Consent increased during 1990. The total was 1,849 of which 1,361 were for sewage effluents. The proportions of Applications in different categories are shown in Figure 5.5.

FIGURE 5.3

COMPLIANCE WITH DESCRIPTIVE CONSENTS

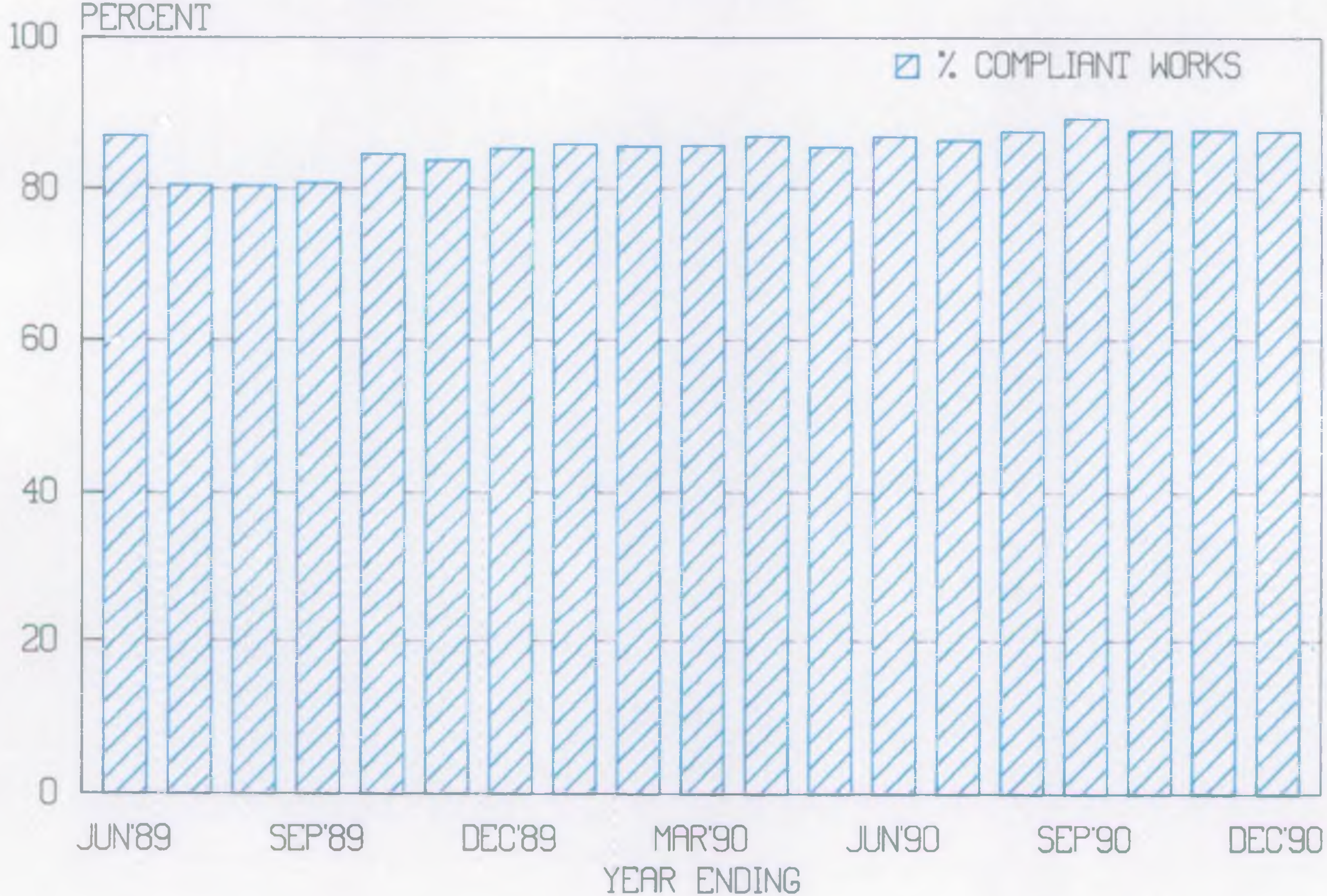


FIGURE 5.4

COMPLIANCE WITH RIVER NEEDS CONSENTS

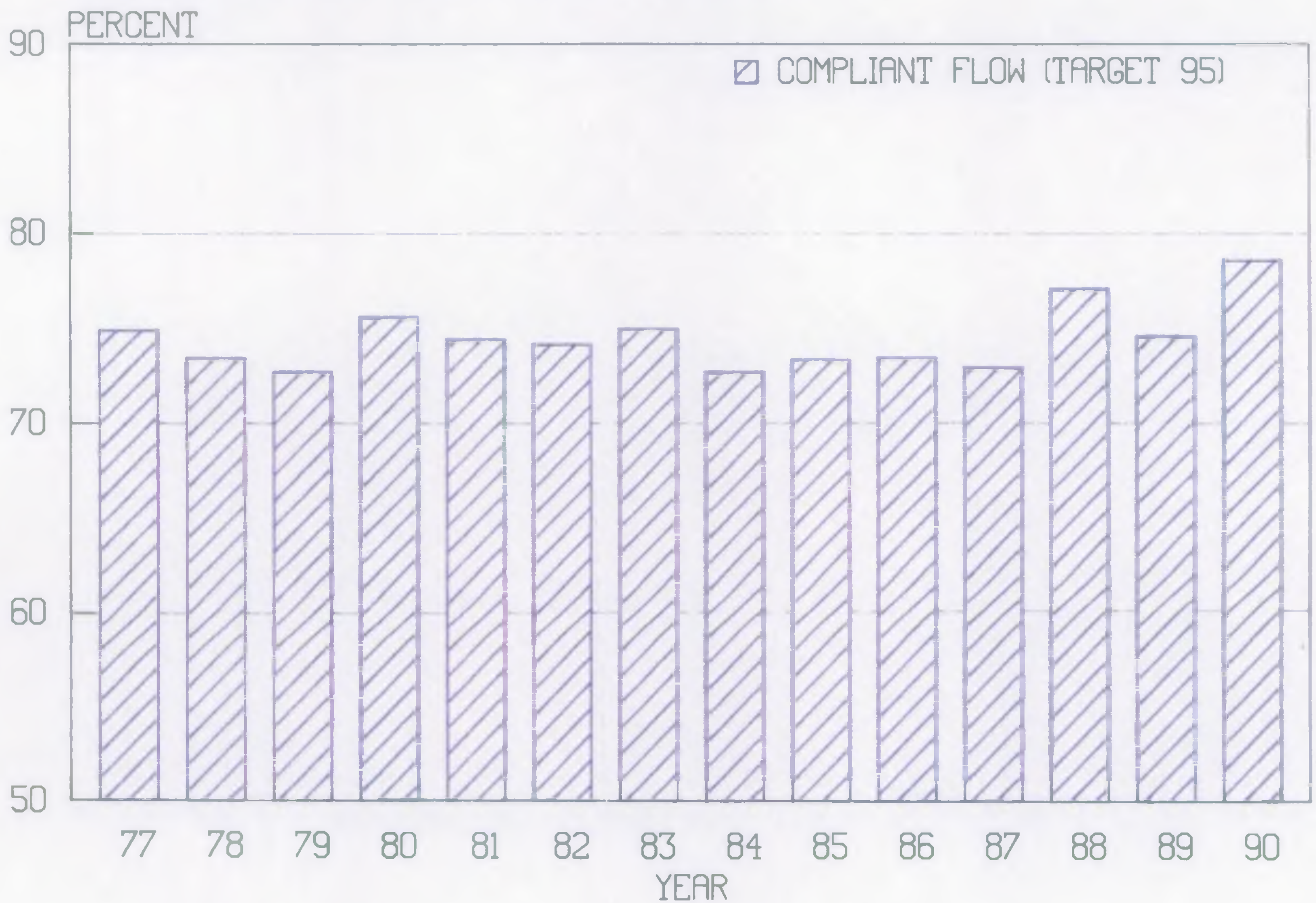
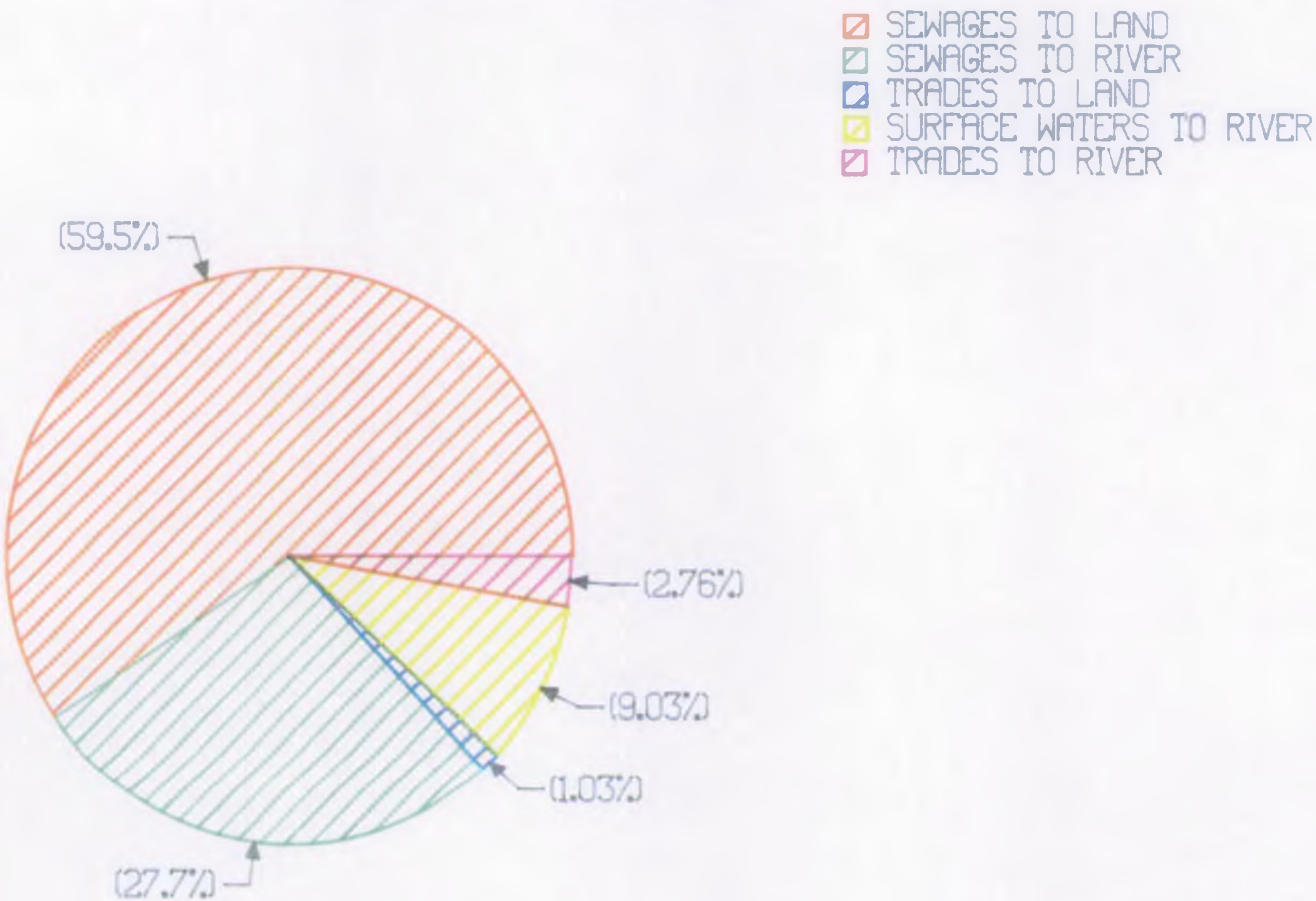


FIGURE 5.5

NON-UTILITY : APPLICATIONS RECEIVED



From 1st September sewage effluent discharges to land have not been consented. Pending the introduction of a National Policy of controlling these discharges we have been sending letters to potential dischargers detailing 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 5.6).

5.2.4 Monitoring

Many of the records on the Water Act Register are for tiny discharges whose effect on the environment is negligible. We monitor only those effluents judged to have a potential for environmental impact (as a safeguard we rely on the biological monitoring of watercourses to tell us if we have misjudged the potential impact of discharges).

The audit sampling frequencies range from twice per week for the larger discharges to the Humber, to a minimum of four times per year for smaller discharges. Some other discharges, not on the routine sampling programme, are sampled as part of occasional or routine inspections.

Of the 172 private STWs, 55% (95 discharges), were sampled, compared to 34% (85 discharges) in 1989. Fifty two of the discharges sampled are the responsibility of the Property Services Agency. These are Crown Property and are exempt from prosecution.

Most trade discharges are direct to sewer. These are managed by the Utility. Our control of these traders rests with setting consents for sewage treatment works. For trade discharges, the NRA issues Consents only for those which discharge direct to environmental water. Over 150 trade effluents in this category were sampled. This compares with 120 in 1989.

5.2.5 Compliance

The proportion of compliant private STWs is 34% (32 discharges). Six fewer discharges than last year are compliant now. The figure for discharges owned by the Property Services Agency is 55% (24 discharges). This is a greater number of discharges than last year.

The proportion of compliant trade effluent discharges is 35% (53 discharges). More discharges are monitored and more are compliant.

The compliance position is poor but the potential impact of most of these effluents is small. The proportions of sites failing when judged as 95-percentiles against the Look-Up table are:

Non-Utility STWs : 27 %
Trade Discharges : 36 %
Crown Properties : 19 %

When assessed on this basis, the compliance figures can be compared more fairly with those for Utility STWs where the failure rate is 6.6% against Legal Consents and 26% against River Needs Consents.

5.3 The Index of Discharge Impact

The Index of Discharge Impact (IDI) is used to rank discharges in terms of their apparent or potential impact on receiving waters. The IDI is calculated from statistics for the compliance of discharges with their River Needs Consents, and from an assessment of compliance of 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 as the basis for producing ranked lists of discharges where we would like to see improvements in the quality of their effluents.

5.4 Targetting and Tripartite Sampling

When a discharge consistently fails to meet its legal consent conditions, that discharge becomes a candidate for the routine collection of *Tripartite Samples*. These are samples which are especially collected, documented and analysed. The main sample is are 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 evidence. If sufficient tripartite samples fail the allowed Look-up Table ratios over a one year period, the discharger can be prosecuted in court.

In the year ending December, 1990, we were targetting 17 Utility STWs by taking tripartite samples of their effluent. Two discharges, Fritwell and East Rudham had enough failed tripartite samples for us to be able to prosecute them. These cases are scheduled to be heard in court during 1991.

5.5 Progress on Consent Conditions

We need to calculate revised standards for discharges for a number of reasons. These include:-

- growth in loads,
- changes in environmental standards,
- new or altered discharges.

We are continuing to extend the number of consents which include standards for fish and invertebrate toxicity testing.

In addition to these, during 1990, standards were revised for all the major trade discharges to the Humber.

Also, to start to formally control nutrients, we issued consents on STWs which for the first time, included limits on phosphorus. The Utility is treating its major reservoirs (e.g. Rutland, Grafham and Covenham), with ferric sulphate to precipitate phosphates out of solution. We approve of this eutrophication reduction method, but we imposed consents on these activities to keep them under control.

We issued a temporary consent for the disinfectant, Peroxyacetic Acid, in Mablethorpe STW effluent. The dosing reduced bacterial contamination of the Bathing Water (see parts 4.2 and 4.7.2).

5.6 Charging for Applications

From 1st September all applications for consent had to be accompanied by a fee. This was as follows:-

Sewage effluents of less than five m^3/day	-	£50.00
Cooling water of less than ten m^3/day	-	£50.00
Uncontaminated surface water	-	£50.00
All other effluents	-	£350.00

5.7 Charging for Discharges

The primary objective of the scheme is to recover the costs incurred in carrying out our duties under Schedule 12 of the Water Act (1989).

In achieving this objective, the scheme will also seek to:

- be consistent with the NRA's policies and objectives of consent enforcement and pollution control,
- avoid conflict with protection and improvement of the water environment,
- demonstrate that the costs will be recovered equably from dischargers in relation to their demands on our resources,
- avoid discrimination between consented dischargers,
- be compatible with other NRA charging schemes,
- enable dischargers to identify the basis of their charge and annual sum, in advance,
- be responsive to changes in external and internal costs and to new policies,
- minimise demands on NRA and dischargers' administrative resources.

A Regional working group was set up to devise the implementation plan and manage the charging arrangements.

Details of around 30,000 consents were held on the Public Register. Of these, many surface water consents were revoked and many 1961 Act Applications were refused. These actions, plus the *de minimus* flow criterion of five m^3/day, mean that charges will be levied on approximately 8,000 consented discharges.

The current scheme was implemented on 1 July 1991, and is planned to run until the end of March 1994. It is complex, but broadly-speaking, every charge is based on a unit (£270 in a full year). This is then weighted to reflect the volume and nature of the discharge and the nature of the receiving water.

Here are examples of charges for a full year:

Domestic sewage of less than five m^3 /day -	No Charge
Emergency overflow from a pumping station to stream -	£108
Drainage from trade premises to a watercourse -	£270
Cooling water of high temperature, pH or chlorinity -	£270
STW serving 1,000 people, discharging to estuary -	£2,430
Large trade effluent, toxic substances, to estuary -	£30,375

Part 6: THE WATER ACT: PUBLIC REGISTER

The Water Act Register contains copies of all Consents to discharge effluent and all Applications for Consents, dating back five years. The Register also holds the results of analysis of samples of effluent and environmental waters.

The Register contains details of around 30,000 Consents and new Applications are being made at a rate of 2,000 per year. The Register holds information on 228,000 samples taken since August 1985, and new samples are added at a rate of 48,000 per year. There are more than a million analytical results.

The Consents and Applications are held as paper copies and the sample results are stored on computer.

The Register is kept at Peterborough and is open for public inspection on weekdays (except Bank Holidays) from 10.00 to 16.30. Inspection of the Register is free. Data retrieval is free to most students in full-time education as well as to water undertakers. Otherwise a charge of £5.00 is made for an initial retrieval, with copies of any data or Consents being charged at 50p per sheet. Complex retrievals will be charged at £15.00 per hour of staff time plus 50p per sheet of data. An appointment to view the Register is not essential, but telephone requests for information will not be accepted.

Details of Consents are retained on the Register until 5 years after they are revoked.

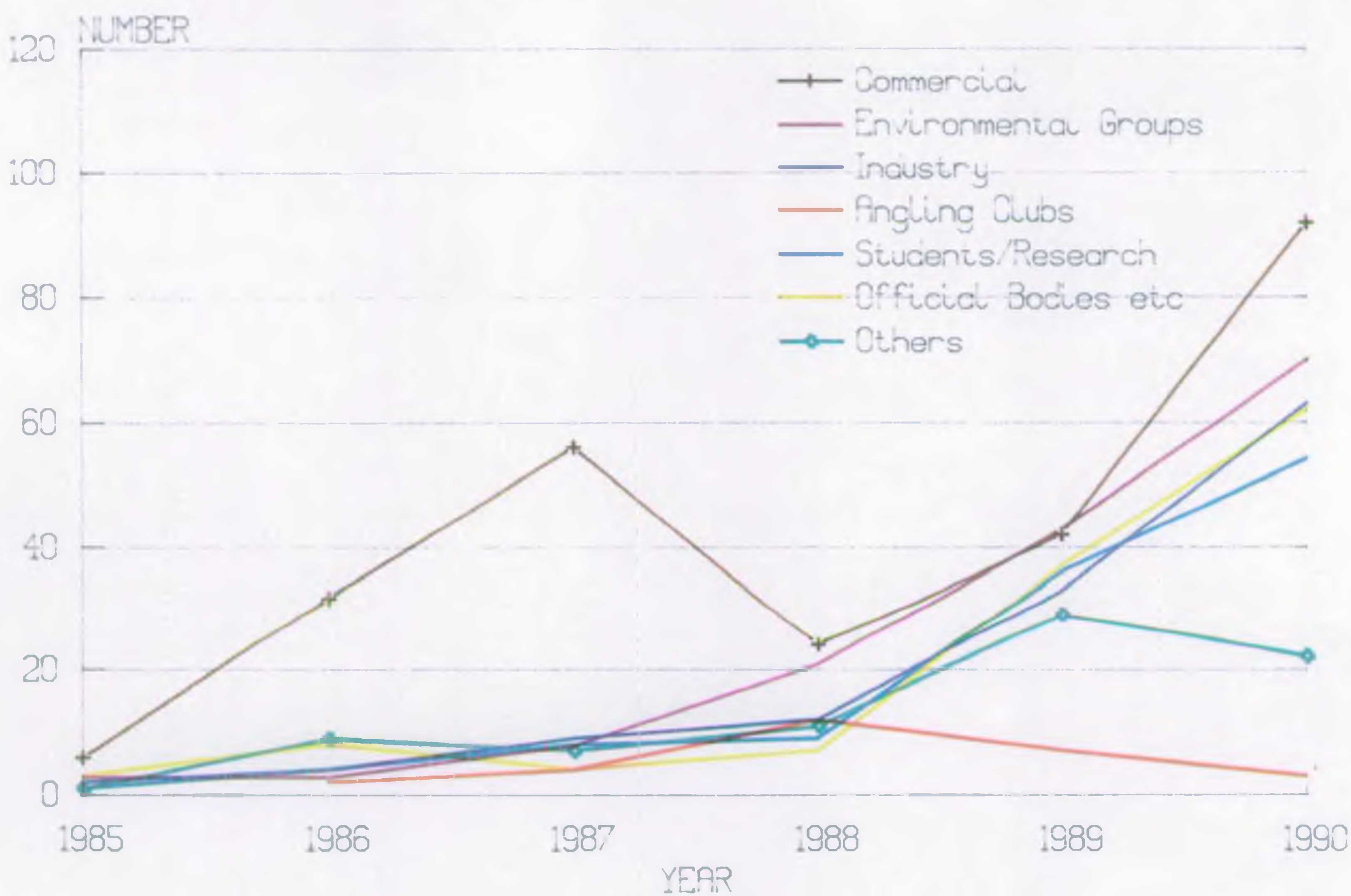
Immediate access is provided for sample results which are up to 3-4 years old. Data beyond this period and less than 6 years old are stored on magnetic tape and visitors may have to wait for an hour for this data to be provided. Results for samples obtained before August 1985 are not available from the Register.

In 1990 we introduced a geographical mapping system. This makes it easier for the enquirer to find out what is available for a particular location. As well as enhancing the display of data, the system assists with data retrieval.

The year saw another large increase of interest in the Register. 370 requests for information were made. In particular, there was a big increase in the number of inquiries from Environmental Consultants. Trends are shown in Figure 6.1.

FIGURE 6.1

WATER ACT REGISTER ENQUIRIES



Part 7: CAPITAL DEVELOPMENT PROGRAMME

We started 1990 with a total budget of £738,000. This was subsequently augmented with internally-generated funds, transfers from revenue to capital and funds from National Head Office.

The number of schemes funded by the Department of the Environment increased from 19 to 74. The assets developed under these schemes are:

TABLE 7.1

Type of Asset	Number	Cost (£ 000's)
Water Quality Monitoring Stations	13	252
Water Quality Models	3	118
Pollution Control	3	40
Marine Survey Facilities	9	444
Scientific Equipment	21	660
Laboratories	6	333
Minor Capital Projects	6	29
Fisheries	13	193
Totals	74	2,069

The total for 1990 compares with £820,000 (at September 1990 prices) for 1989, reflecting our expanding responsibilities. The greatest increases were associated with the future monitoring of saline waters.

Part 8: RESEARCH AND DEVELOPMENT

In 1990, research was organised into two areas, the National Research and Development Programme and Regional Operational Investigations.

The National Programme was set up to address the research requirements of the NRA as a whole and is funded through National Head Office. The Programme is subdivided into Commissions, one for each of the main areas of work covered by the NRA. Within each Commission are Topic Areas. These cover specific areas of interest, each Topic containing a portfolio of Projects. Projects are directed by a Project Leader, who typically is based in one of the ten NRA Regions.

In this first year of the National Programme, 18 Anglian staff lead 22 Projects. The associated budget, £616,000, is the largest devolved to a Region for R & D.

Regional Operational Investigations cover research on a specific site or geographical area. These projects remain under the control and finance of the Region. In the fiscal year 1990/91, £716,000 was spent on Regional Operational Investigations. Of this £122,000 was spent on NRA staff and NRA plant and equipment. £646,000 was spent on contracted services.

£52,000 of the expenditure on Regional Operational Investigation was met by contributions from other environmental organisations.

In 1990/91, a reduction was made on expenditure on Operational Investigations. This was because some projects passed into the National Programme.

8.1 Benefits

Benefits of R & D include:

- the identification and evaluation of new methods of working;
- a better understanding of responses to pollution of the aquatic environment;
- assistance in identifying and responding to changing environmental concerns and in implementing new legislation.

Part 9: LABORATORY SERVICES

The new laboratory at Kingfisher House became fully operational. Very little work is now performed by external contract. A support service for the analysis of organic chemicals has been provided to Southern Region.

All analyses are performed using strict methods of control on precision. In addition, the laboratory takes part in schemes organised by the Water Research Centre. These have been extended to cover a wider range of determinands. Our performance has generally been good.

The increase in Tripartite Sampling (see Part 5.4) has had a significant impact on resources because the need for rigorous procedures requires a lot of staff time.

The laboratory has continued to provide an emergency and out-of-hours service, and has dealt with a number of pollution incidents, particularly those involving organic chemicals.

The Regulations on the Control of Substances Hazardous to Health (COSHH) have continued to have an impact. Our stock of 1400 substances has, by careful disposal, been reduced to 1000. A system has been established for handling the requirements of the Regulations. This has been introduced to staff by pamphlets, discussions and training sessions.

The Laboratory Information Management System (LIMS), was introduced, and has gradually been developed so that the analytical results from most instruments are captured automatically (See Part 10). The introduction of this system has reduced errors. It has also enabled better planning, thereby by reducing over-sampling.

Staff numbers have increased to 46, and are planned to increase further in 1991/92 to cope with the anticipated workload. Numbers of samples handled are given in Table 9.1. New equipment was purchased to replace ageing technology and to improve capacity and efficiency.

Additional accommodation has been planned and work commenced on Phase 1, the shell of the extension. This accommodation should be complete by late 1991.

All NRA laboratories have established a timetable for achieving the standard recognised by the National Measurement Accreditation Service. This Region will apply in late 1991 for accreditation early in 1992.

TABLE 9.1

CHEMICAL SAMPLING PROGRAMME: PLANNED AND ACTUAL

Type of Sample	SITES Planned	SITES Actual	SAMPLES Planned	SAMPLES Actual
Controlled Waters:				
Rivers	1053	1435	11604	13348
Groundwaters	496	502	2093	2121
Freshwater sediments	67	101	126	190
Estuaries	171	171	640	2150
Coastal waters	50	16	892	1421
Saline sediments	113	113	330	908
All Discharges:	1502	1317	16922	17200
Total	3452	3655	32605	37338

Part 10: Information Technology

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

The Laboratory Information Management System (LIMS) helps manage our resources of sampling and analysis. It is operated on a network of Personal Computers (PCs).

According to an overall plan, LIMS generates routes of sites which are to be sampled and sets up the worksheets which will be used in the laboratory. LIMS checks that all the samples arrive at the laboratory, that each sample receives the correct analyses, and that the results contain no obvious errors.

Laboratory equipment is linked in LIMS by a network of computers that co-ordinate the analytical requirements of each sample. The results of analysis are stored and are available to any computer connected to the network. LIMS has increased the ease and speed of access to data.

Data from LIMS are transferred to the Region's Honeywell Computer for long-term storage and security and for the Water Act Register (Part 6).

The Sampling Information Management System (SIMS) is another system based on the use of PCs. A single site may require monitoring for 5 or 6 different purposes and each of these may involve different sampling frequencies and different types of analysis. SIMS brings together all the monitoring requirements for each site and confirms that LIMS is set up to analyse for all the requirements.

Every site has been given its National Grid Reference. This specifies the location of the site. The Grid Reference allows us to overlay maps (Figure 10.1), on the computer screen, which show and collate all the sampling sites, discharges and other data. In this way, SIMS provides easy access to 20 databases containing 25,000 records representing 22,000 individual sites.

FIGURE 10.1

EasyMap

NRA Anglian

EasyMap
Digitised River
Network

DATE: 12-07-91

SCREEN/MAP AREA: -
SU3000070000 to
TB900030000
260.0 km square
(Anglian)

SEARCH AREA: -
SU3000070000 to
TB900030000
260.0 km square

No. of Sites=0

Last Data Update
27-06-91

52.0 km

Appendix I: Biological Sampling April 1990-March 1991

Sample Category	
1. Freshwater - Rivers	
a. Macroinvertebrates	
Routine	3169
Pollution	273
Special investigation	136
Others	7
Quantitative	144
b. Macrophytes	34
c. Microbes	455
d. Phytoplankton	207
e. Zooplankton	82
f. Others	159
2. Freshwater - Lakes	
a. Macroinvertebrates	688
b. Macrophytes	0
c. Microbes	41
d. Phytoplankton	1560
e. Zooplankton	625
3. Estuary and Coastal waters	
a. Macroinvertebrates	
Intertidal	667
Subtidal	940
b. Macrophytes (algae)	38
c. Microbes	2238
d. Phytoplankton	120
e. Zooplankton	120
f. Beam trawl	80
4. Boreholes	
a. Microbes	4

Appendix II: Prosecutions brought to Court

Incident	Defendant	Fine (£)	Costs
Molasses; Ingham Brook & River Till Ingham, Lincolnshire	Lincs Mill 'N' Mix	1000	150
Chicken Processing Waste; Starton Beck Harleston, Norfolk	Crooks Ltd	500	425
Maltings Effluent; Tributary of River Waveney Norfolk	Simpson & Co Ltd	500 500 500	-
Sand & Gravel Waste Water; Maxey Cut Maxey Springs	Tarmac Roadstone Ltd	1500	650
Piggery Effluent; Hordon on the Hill	A J Smith	1200	400
Untreated Sewage; Marham, Norfolk	S S Mondair / Plumtree Caravans	400	1400
Poultry Waste; River Wang Norwich	Bernard Matthews	3500	972
Surface Water; Tributary of River Tas Wymondham, Norfolk	Lotus Cars Ltd	2000	877
Oil; Grand Union Canal Wolverton, Buckinghamshire	Bibby Distribution Services	1000	1922
Maltings Effluent; Low Level Drain Norfolk	Anglian Maltings Ltd	1000	783
Duck Farm Effluent; Watton Brook Norfolk	Buxted Poultry Ltd	1200	802
Trade Effluent; Stone Brook Sandy, Bedfordshire	Lorien Laboratories	1000	761

Appendix II: Prosecutions brought to Court - continued

Incident	Defendant	Fine (£)	Costs
Chicken Processing Waste; River Wensum Great Witchingham, Norfolk	Bernard Matthews	1200	944
Trade Effluent; Skellingthorpe Catchwater Drain Skellingthorpe, Lincoln	Hughes & Son	1500 1500	1500
Dairy Effluent; Wendling Brook Norfolk	Farnham Farms	250	730
Ammonia Fertiliser; Wendling Brook Wendling, Norfolk	Howell & Son	1000	1000
Trade Effluent; Tributary of River Nene Thrapston, Northamptonshire	Tilleys Sweets	1000	766
Oil & Urea; Tributary of Hobhole Drain Langrick, Lincolnshire	Messrs. Tinsleys	1500	1270
Poultry Effluent; Attleborough, Norfolk	Banham Poultry	1000	574
Piggery Effluent; River Sapiston Bardwell, Suffolk	Messrs. Clements	750	554
Mud & Silt; Melton Water Treatment Works Norfolk	Anglian Water Services Ltd	200	578
Fungicide; River Fynn Witnesham, Suffolk	Messrs. Buchanan	200	523
Piggery Effluent; Froghall Drain & Kettleby Beck, Lincolnshire	Cotswold Pig Development Ltd	300	250

Appendix II: Prosecutions brought to Court - continued

Incident	Defendant	Fine (£)	Costs
Diesel & Urea; Tributary Hobhole Drain Langrick, Boston	Messrs. Tinsleys	1000	1270 500
Sewage Effluent; Bentley Brook Great. Bentley, Essex	Anglian Water Services Ltd	700	358
Oil; River Waveney Wilby, Norfolk	Messrs. Askew	Conditional Discharge	250

GLOSSARY

Aquifer	*Layers of underground gravels or 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.*
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).*
Carbon tetrachloride	*An organic solvent commonly used as a dry-cleaning agent.*
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.*
Drins	*The abbreviated name for a group of persistent Organophosphorous insecticides, including Aldrin, Dieldrin and Isodrin.*
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 Assessment:	*A procedure by which a developer 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.*
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* <u>Escherichia coli</u> (<u>E.coli</u>). *These are coliform (ibid) bacteria characteristic of faecal pollution of mammalian origin. These bacteria are relatively harmless but their absence indicates the absence of harmful micro-organisms.*
Groundwater	*Underground water especially in or from aquifers (ibid).*
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, i.e. 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).*
Median Values	*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.*
Multiple Regression	*A mathematical technique for identifying an association between sets of data, for example, river flow and river quality.*
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.*

Property Services Agency	*The organisation that administers and maintains Crown Property.*
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.*
SIMS	*Sampling Information Management System. This is based on micro-computers and brings together all the monitoring requirements for each site. It also confirms that LIMS (ibid) is set up to analyse for all the requirements.*
Surface Water	*Rivers, canals, lakes or impoundments.*
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.*
Water Act Register	*Formerly the COPA Register (see Part 6).*
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 will be carried out by the NRA in 1990 and published in 1991.*