NRA - WATER QUALITY 70

NRA

The 1990 River and Estuary 201

Classification Survey

of

England and Wales

National Rivers Authority

Anglian Region

THE 1990 RIVER AND ESTUARY

CLASSIFICATION SURVEY OF ENGLAND AND WALES

WATER QUALITY SURVEY GROUP

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THE 1990 RIVER AND ESTUARY CLASSIFICATION SURVEY OF ENGLAND AND WALES

SECTION 1. INTRODUCTION

General Introduction

1.1 In 1990 the newly created National Rivers Authority (NRA) will be responsible for undertaking the 5-yearly survey of river and estuary quality and reporting the resulting classification to the Department of the Environment (DoE). To prepare for this survey, the NRA set up a Water Quality Survey Group. This Group produced an interim report in June 1989[1] addressing what needed to be done to satisfy DoE's requirements for a classification having continuity with past surveys, establishing a base-line for the future and the need to consider adopting an use-related quality objective (EQO) scheme for the more effective management of groundwaters, rivers, estuaries and coastal waters.

1.2 This present report comprises comprehensive guidelines which NRA Regions must follow in order to achieve the requirements of the 1990 Survey of rivers and estuaries. Methods are specified for chemical and biological sampling, together with statistical methods, data handling, reporting and resource requirements.

1.3 The report does not address classification schemes or EQOs and EQSs; these will be the subjects of later reports. For the 1990 survey the previously-used means of assessing water quality and classification will be used, together with a concurrent programme designed to extend its scope and content.

Background

River Water Quality

1.4 The Water Act 1989 requires, in Sections 104 and 105, that all controlled waters may be subject to a system of classification and that Water Quality Objectives may be set in relation to such waters by the Secretary of State. The NRA is currently discussing with the DoE the means by which these Sections of the Act can be implemented. In the interim, it is essential for the NRA both to conduct a 1990 survey of rivers and estuaries that would be compatible with that of 1985, to provide an internally consistent baseline for future surveys which the NRA as a whole will conduct, and to work towards the setting of Water Quality Objectives and Standards using the information from the survey.

1.5 These facts mean that we must aim for:

- continuity with 1985;

at the same time as achieving:

- maximum objectivity and uniformity.

These are conflicting requirements. For example, the results of past Surveys showed differences between Regions in:

(a) the methods used to estimate 95-percentiles;

(b) the assumptions regarding statistical outliers;

(c) the sampling frequencies;

(d) the number of years' data used for the assessment;

(e) the inclusion of non-routine samples (like those for pollution incidents);

(f) the pooling of data for different sites;

(g) the use of judgements based on the effects of algae, biological data and visual pollution to qualify or overrule the classification suggested by the 95-percentiles;

(h) the interpretation of the EIFAC standards, especially for Unionised Ammonia;

(i) the status given to non-compliance with standards in EC Directives (especially metals).

1.6 Some of these differences stemmed from the fact that the summary statistics (like percentiles) are estimated with low precision in relation to the ranges of concentration which define the better quality Classes.

If left unconstrained, this low precision would lead to large numbers of spurious and random changes in Class. Faced with this, confirmation that small apparent changes were real was sought for by looking at extra data. Typical cases include:

- sites which 'failed' a chemical standard because of a single bad analytical result at a place where river quality was good according to all the other indicators, e.g. biological data;

- cases where a site 'complied' with all the standards but had no fishery or poor biology; in this case the site might be downgraded;

- sites which failed (or passed) marginally after several years of compliance (or failure) and where there was no obvious cause for the change.

1.7 By using this extra information, the damaging effects of low precision in the estimates of percentiles were damped out. Had they not done this, 20-40% of sites would have been placed in the wrong Class. This fact was established by the Groups of Tyson[2] and Mance[3], and confirmed by this group using the mathematical model, CLAM.

1.8 The twin objectives:

- continuity with 1985; and,
- uniformity and objectivity,

can be achieved only by reporting two sets of results:

[1] those obtained from a Survey based on the procedures used for 1985, including all the Regional differences. This will be called the DoE Survey;

[2] a Survey based on the universal use of a fixed set of procedures. This will be called the NRA Survey. To distinguish the results of the two surveys, the use of the term NRA Class for the NRA Survey is proposed.

Class X will be discontinued. Class X stretches will be treated like any other stretch and allocated a proper Class if they are important enough to be included in the Survey. Otherwise they will remain Unclassified.

1.9 The adjustments required for the DoE Survey produce inconsistency around the country, and are unacceptable for river quality standards which are to have statutory force. These adjustments also reduce the risk of misclassification and their removal will lead to volatile and misleading results in future surveys. In the NRA Survey, high risk of mis-classification will be reduced, using three developments, as follows.

1.10 First, as recommended by the Groups of Tyson[2] and Mance[3], the calculation of percentiles must be based on three years' data.

1.11 Second, it is noted that Biological data have the potential to improve precision in classification. The extra confidence could be worth the equivalent of a 100% increase in expenditure on chemical sampling. This benefit is in addition to any advantages of a second classification based solely on biology. With these developments the risk of mis-classification should be reduced from 20-40% to 5-10%.

1.12 Third, it is planned to use the 1990 NRA Survey to establish a baseline - a sound statement of river quality in 1990. After 1990, using this baseline, the problem of poor precision can be controlled by looking for statistically significant <u>changes</u> in Class using the method devised by the Tyson Group[2].

1.13 Section 2(a) of this report deals with the procedures for DoE Survey, Section 2(b) covers the NRA Survey, whilst Section 3 covers the biological aspects of the river survey.

<u>Biology</u>

1.14 The requirement for a biological component of the 1990 River Quality Survey is recognised. This will boost precision in the estimation of river Class (Paragraph 1.11), and provide a cost effective way of monitoring minor streams. The biological data will also augment the chemical data because it provides a fundamentally different estimate of water quality.

1.15 It also anticipates the EC Directive on the ecological quality of surface waters which is likely to be verified in 1992.

1.16 The NRA will use uniform and objective methods of sampling, processing and reporting biological results.

1.17 In 1985 there was no nationwide river biology survey, although some regions used biological information to help assign NWC chemical classes. Previously, biological results had been presented separately (in the 1980 survey).

1.18 In formulating these procedures the Water Quality Survey Group has sought the opinions of biologists from the Regions (Appendix 3) as well as external groups such as IFE (formerly FBA).

1.19 The procedures given in Section 3 are designed to monitor river water quality using biological information and to establish the ecological status to assess long-term changes. They also permit a quantitative assessment of the risk of mis-classification.

Estuary Quality

1.20 The estuary survey has traditionally been rather more subjective than that for rivers and has not involved a specific sampling programme.

1.21 Having considered the work of the Water Authorities Association Working Party on estuary quality, the Water Quality Survey Group has concluded that, in the absence of a formal EQO Scheme (See Section 1.3), the provision of major additional sampling resources for estuary classification is not warranted at this time. Instead, it is proposed that the 1990 survey be conducted in a similar way to that in 1985. Until the EQO Scheme is introduced, therefore, the estuary survey will lack a procedure for quantifying the risk of mis-classification.

1.22 As for rivers, two 'surveys' will be conducted, the first will repeat the procedures adopted in each Region in 1985, whilst the second will follow the procedures detailed in Section 4 of this report which offer more uniform guidance on the interpretation of the scheme.

1.23 Unlike the river survey, the difference between the 'DoE' and 'NRA' estuary survey methodologies is marginal except with respect to the DO Standards (see Section 4), where previous practice in the Regions seems to have differed.

Sampling Requirements for 1990

1.24 Regions should continue present practice for chemical sampling of river sites. For those classified river reaches for which the number of chemical programmed samples totals less than 12 (1988 - 1990 sampling years) a single biological sample should be taken during 1990. (See Paragraph 3.11).

SECTION 2. RIVER QUALITY SURVEY

Section 2(a) THE DoE SURVEY

2.1 This Survey will be done by the NRA for the DoE according to the timetable given in Table 1.

2.2 The DoE Survey must be compatible with that of 1985 and therefore must use the same rules and criteria followed for 1985, perpetuating the differences between the former Water Authorities.

2.3 The 1990 DoE Survey will use the classification scheme used in the 1985 Survey (as published by the National Water Council in River Water Quality: the Next Stage).

2.4 The classification will be done by NRA Regions but the report will be produced by the Chief Scientist's Department at Headquarters.

Responsibilities of Regions

2.5 In each Region, a Liaison Officer has been given responsibility for the Survey. A list of liaison Officers is given in Appendix 1.

2.6 Although the interpretation of the classification scheme may have varied over the years, Regions should use the interpretation used by their corresponding Water Authority for the 1985 Survey.

2.7 Every attempt should be made to assess water quality for all the reaches of river and canal surveyed in 1985.

2.8 The classifications will be based on 95-percentile values of quality parameters. The method of calculating the 95-percentiles should be the same as those used for other purposes by Regions.

2.9 The data used to calculate 95-percentiles should include all the pre-planned routine samples collected in the calendar year of 1990. Regions should attempt to copy the practice of their corresponding Water Authority in respect of the inclusion of samples from earlier years, from the investigation of pollution incidents, or from special surveys.

2.10 The upstream limits of rivers should be the same as those used for 1985. The downstream limits of rivers must be the same as the upstream limits for the estuary classification.

2.11 As for 1985, all lakes and reservoirs which form part of the river systems being surveyed (including the ends) should be included.

2.12 The results will be recorded on databases within Regions (and collated within each Region in the same way as was done by the previous Water Authorities. (See Section 5)). Liaison Officers will consult IT Managers on hardware and software.

2.13 An extract from the Regional databases will be sent on floppy-disc to the Headquarters Chief Scientist's Department and copied to Anglian Region in order for comparisons to be made between the DoE and NRA surveys. For each river length, the following information will be supplied:

(a) a name;

(b) the length of the reach (in km.);

(c) category of river flow;

(d) the NWC Class;

(e) the NWC Class in 1985;

(f) the upstream map reference;

(g) the downstream map reference.

2.14 Regions will also mark changes in NWC Class on copies of the maps produced from the 1985 Survey. These maps will also be sent to the Chief Scientist's Department at Headquarters.

2.15 Regions will provide a brief description of the methods used to estimate water quality. This will include:

(a) the criteria for including reaches;

(b) the method of calculating 95-percentiles;

(c) the method of assigning Class to sampling points;

(d) any allowance made for the effects of algae on the test for BOD;

(e) any concessions made for statistical Sampling Error;

(f) the treatment of outliers and qualified results;

(g) the method by which the results for sampling points were applied to reaches;

(h) parameters considered toxic to fish in EIFAC terms;

(i) any use of biological data to modify class;

(j) the status given to incidents;

(k) any other factors allowed to affect the classification.

About 1-3 sentences for each item should suffice.

2.16 The Region will supply a brief commentary (500 - 1000 words) giving reasons for changes since the 1985 Survey.

2.17 The Region should report any new factors likely to have a general effect on water quality over the next 5-10 years (up to 500 words).

Collating the Results

2.18 The Chief Scientist's Department at Headquarters will collate the results and summarise them for reporting to DoE (see Section 5).

Table 1: Timetable for DoE Survey

10/89:	Regions comment on draft Guidelines
10/89 to 12/89:	Chief Scientist's Department approves Guidelines
12/89:	Guidelines sent to Regions
10/89 to 12/89:	Regions plan sampling
1/90 to 12/90:	Regions collect data
1/90 to 12/90:	IT Managers set up facilities
10/89 to 10/90:	Settle any changes to data handling aspects of the Guidelines
in 11/90:	Chief Scientist's Department approves data handling aspects of the Guidelines
in 12/90:	Chief Scientist's Department dispatches final data handling aspects of the Guidelines to Regions
during 1/91:	Regions validate data
to 2/91:	Regions produce classifications
in 3/91:	Liaison Officers send results to Chief Scientist's Department and copied to Anglian Region
in 4/91:	Liaison Officers send maps to Chief Scientist's Department
in 6/91:	Chief Scientist's Department circulates draft report for checking by Regions
9/91:	Final draft ready
	Report published

2.19 In each Region, a Liaison Officer has been given responsibility for the Survey. The officers are the same as those used for the DoE Survey (Appendix 1). The Timetable is given in Table 2.

2.20 The NRA Survey will use the classification scheme given in Table 3. The Table includes only the BOD, Dissolved Oxygen and Ammonia though, as described later, biological data will be used in the final assessment. This should cover the instances where rivers are affected by pollutants excluded by the classification.

TABLE 3

Class	River Quality Standards		
	Dissolved Oxygen	Biochemical Oxygen Demand	Ammonia
	(% saturation)	(mg/l)	(mgN/l)
	5-percentile	——95-percentile——	
1a	80	3	0.3
1b	60	5	0.7
2	40	9	3.0
3	10	17	-
4	< 10	-	-

2.21 The Criteria in Table 3 will be called the NRA Classification.

2.22 The BOD criteria will not be applied to samples taken for rivers at times when the test for BOD is corrupted by algae. Before April 1990. Regions will provide the Chief Scientist's Department with a list of reaches where they may need to use this option for certain samples. For most Regions this list will be short.

Samples for these reaches will be said to have been given an <u>Exemption for BOD</u>. The list of Exemptions will be maintained by the Chief Scientist's Department which will ensure consistency. Changes to the list will be authorised only through that Department.

Note: The Exemptions are designed to remove the distortion caused by the effect of algae on the BOD test. If this is not done a lot of low-velocity clean rivers will be placed wrongly in Classes 2 and 3.

2.23 Water quality standards in the Directives do not figure in Table 3. Performance against individual Directives will be reported to the European Commission according to the timetables for each Directive. They will also be part of the full EQO Scheme. It remains an option to report compliance against Directives alongside the results of the 1990 NRA Survey.

2.24 Compliance with all other chemical and biological standards will be assessed separately making use of the system of Environmental Quality Objectives being developed by this Group.

Table 2: Timetable for NRA Survey	
to 11/89:	Regions comment on draft Guidelines
to 12/89:	Working Group updates Guidelines
in 12/89:	Guidelines sent to Regions
10/89 to 12/89:	Regions plan sampling
1/90 to 12/90:	Regions collect data in accordance with Sampling Group Guidelines
3/90:	Regions send BOD Exemptions to Chief Scientist's Department
9/90:	Chief Scientist's Department Approves BOD Exemptions
1/90 to 12/90:	IT Managers arrange or approve database facilities (2.27-2.28)
1/90 to 10/90:	Settle any changes to data handling aspects of the Guidelines
in 11/90:	Chief Scientist's Department approves data handling aspects of the Guidelines
in 12/90:	Chief Scientist's Department dispatches final data handling aspects of the Guidelines to Regions
1/90 to 12/90:	Thames Region completes data handling system for Biological Classification)
1/90 to 12/90:	Anglian Region completes data handling system for NRA Survey
1/90 to 1/91:	Regions validate raw data
during 2/91:	Working Group tests procedures
in 3/91:	Working Group recommends final arrangements
during 3/91:	Working Group sends final Instructions to Regions

continued overleaf

Table 2: Timetable for NRA Survey (continued)	
in 4/91:	Liaison Officers send results to Anglian Region
in 5/91:	Evaluate Biological Override Establish relation with Biological Classification
in 6/91:	Anglian Region send results to Chief Scientist's Department and Liaison Officers
in 8/91:	Liaison Officers send maps to Chief Scientist's Department
in 10/91:	Chief Scientist's Department circulates draft report for checking by Regions
1/92:	Final draft ready
	Report published

Future	
to 12/91	Regions develop and test system for calculating change of Class
to 12/92	Establish Environmental Quality Objectives for rivers.
to 12/93	Review of Consents

Monitoring

2.25 Ultimately the level of routine chemical monitoring will be recommended by the Policy Group on Sampling. For 1990 Regions should continue present practice.

Procedure

2.26

a. For each site write down the length(s) of river(s) which the site will be assumed to characterise.

b. If the site falls into a Class,then the entire reach (or all the reaches) will be given that Class.

c. Use only the results from the routine, predetermined sampling programme;

d. Include the results collected over the three years 1988-90;

e. For sites with 20 or more results, use the Wiebull Method (a non-parametric procedure) to estimate percentiles.

f. Exclude no outliers (though their effect will be minimised because of the adoption of the Wiebull Method);

g. For sites having less than 20 results the Wiebull Method is inappropriate. Use a standard Parametric Method (Method of Moments) to estimate percentiles. Assume the Log-Normal Distribution for BOD and Ammonia and the Normal Distribution for Dissolved Oxygen.

h. Results qualified as "less-than" should be halved. Results given as "greater-than" should be taken as the value specified.

i. Compare the percentiles with the Class Limits in Table 3; assign the Class according to the worst determinand.

<u>Reporting the Results</u> (See Section 5).

2.27 The results will be recorded on databases within Regions. Liaison Officers will consult with IT Managers who will ensure each Region has the use of the required hardware and software.

2.28 The results from the Regions will be sent to the Anglian Region for collation. Anglian Region will advise on the format. IT Managers will ensure each Region has the use of the necessary facilities.

2.29 For every reach the Region will report:

(a) name of the reach;

(b) category of river flow (as defined for the DoE Survey);

(c) the length of the reach (km);

(d) the upstream map reference;

(e) the downstream map reference;

(f) the name of the chemical sampling point (if any);

(g) the Grid Reference for the chemical sampling point;

(h) the NWC Class for the reach in 1985;

(i) the NWC Class for the reach in 1990 (from the DoE Survey);

(j) the 1990 NRA Class for the reach resulting from the above procedure (the NRA Survey);

(k) whether the BOD is Exempted (see paragraph 2.22);

(l) the 95-percentile BOD;

(m) the 95-percentile Ammonia;

(n) the 5-percentile Dissolved Oxygen;

(o) the number of chemical samples used in the assessment;

(p) the name of the biological sampling point (if any);

(q) the BMWP Score and RIVPACS prediction;

(r) the ASPT Score and RIVPACS prediction;

(s) the number of biological samples used to compute Scores.

2.30 Anglian Region will process the results and assess the effect of allowing the Exemptions for BOD (Paragraph 2.22).

2.31 The use of biological data to improve precision will be evaluated by constructing a Biological Override. This may take the form:

Taking the Class resulting from applying the chemical data to Table 3, apply the Biological Override shown in Table 4.

TABLE 4: The Biological Override (illustrative)

Initial Class	Revised Class		
	BMWP Score divided by RIVPACS Prediction		
1a	1b if < 0.7;	2 if < 0.4;	3 if < 0.3
1b	1a if > 1.3;	2 if < 0.4;	3 if < 0.3
2	1a if > 1.3;	1b if > 1.0;	3 if < 0.3
3	-	-	2 if > 0.9

2.32 The form of the Biological Override will depend on a statistical analysis of the chemical and biological data collected in 1990. It may be that this work will show that no form of Override is suitable.

2.33 The biological data will also be used in their own right within a Biological Classification. The relation between the NRA Class and the Biological Class will be examined in April, 1991.

2.34 Anglian Region will provide summaries of results for the Working Group and Liaison Officers. Final decisions will then be made on any outstanding issues.

2.35 If necessary, Liaison Officers will then provide descriptive text. This will cover any special features which should be taken into account when interpreting the Survey. The text will be sent to the Chief Scientist's Department on floppy-disc suitable for that Department's word processors. IT Managers will advise on this.

Future Assessments

2.36 The 1990 NRA Survey will be a baseline - a statement of river quality in 1990. After 1990 the NRA will look for statistically significant changes in Class using:

(a) where there are chemical data, the methods devised by the Tyson Group[2] for the chemical data; and,

(b) where there are biological data, a version of the Biological Override.

This will be done each year, using the results, alongside compliance figures for effluents and Directives, to set priorities for action.

SECTION 3. THE BIOLOGICAL SURVEY OF RIVERS

3.1 The use of benthic macroinvertebrates utilising the BMWP scoring system is the most widely accepted system of biological river quality assessment. This was used in the 1980 national survey.

3.2 Since 1980 major advances have been made in the prediction of macroinvertebrate taxa that would exist in unpolluted waters. The system that enables this to be done is the River Invertebrate Prediction and Classification Model (RIVPACS) developed by IFE with DoE and NERC funding. Predicted and observed taxa can then be compared.

3.3 It is recommended that 3 seasons' data are collected and analysed for the national survey in 1990. The background for this is given in Appendix 3.

3.4 Biotic scores will be obtained from those sites using the 1980 survey sites as a basis (a total of 1955 for the ten regions). There will be some minor changes in site definitions and, in some regions, additional sites. Biological samples must be taken at sufficient additional sites to allow the application of a "biological override" to every river reach included in the NRA Survey (see Section 2b). This will not necessarily mean biological sampling in every reach.

3.5 Each site will be assumed to be representative of a (defined) length of river. Sites, should if possible, be no more than 30 Km apart.

3.6 For each biological sample a standard, 3-minute active kick/sweep sample using a minimum 400 mm deep, 1 mm mesh-size invertebrate sampling-net should be employed. A search to investigate those habitats not covered in the sweep, not exceeding one minute's duration, in the immediate area, should also be undertaken.

3.7 Exceptionally an airlift sampler or a medium naturalist's dredge may be used where the employment of an invertebrate net is impossible. Three to five throws of the dredge are recommended.

3.8 Sorting should be carried out in the laboratory.

3.9 All samples must be preserved after identification following which specimen samples will be selected for subsequent analytical quality control.

3.10 Three seasons' samples for each site are required (March to May, June to August, September to November). Minimum seasonal separation at any one site of two months is desirable.

3.11 As indicated in paragraph 1.24, for those classified river reaches for which the number of chemical programmed samples totals less than 12 (1988-1990 sampling years) a single biological sample should be taken during 1990 within the resources shown in Table 10. The result will be used with the RIVPACS prediction to provide an environmental quality index.

The available chemical data and the environmental quality index will then be used to determine the river class.

3.12 Taxa must be identified to BMWP family level.

3.13 For RIVPACS the following parameters are required for prediction:

(a) Mean width in metres (rounded up) should be taken at the time of sampling. The average of three seasons' measurements at the sampling site should be used. Where width varies in the sampling vicinity the mode should be used.

(b) Mean depth in cm is a mean of depth at 0.25, 0.5, 0.75 of the distance across the river. It should be taken at the time of sampling. For water depths greater than one metre an estimate to the nearest 100 cm is needed.

(c) Substrate composition. This is a % estimate of four size categories of substrates; Boulders and Cobbles (63+ mm), Pebbles (2 - 63 mm), Sand (0.06 - 2 mm) and Clay/Silt (<0.06 mm). Although substrates may not vary greatly with season, it is advisable to observe substrates over 3 seasons and combine seasonal data in order to obtain a better picture.

(D) Alkalinity determinations should be obtained from the routine chemical results for that reach and expressed as the annual mean in mg $CaCO_3$/l. If there are no chemical data for that reach, then an exceptional water sample series (seasonally-based) should be taken.

(e) Mean air temperature and temperature range can be obtained from the IFE programme (available on floppy disc).

(f) The remaining parameters can be obtained from the national water quality maps and the 1:50,000 Ordnance Survey maps. These are longitude, latitude, distance from source in kilometres, slope of river (meters/kilometres), discharge category.

(g) All the above data should be entered on the form and floppy disc provided to be returned to the nominated co-ordinating centre (Thames Region) (See Section 5).

Reporting and Analysis

3.14 From each site sampled, the following information will be derived:

(a) Site name

(b) Grid reference

(c) Reach(es) represented

(d) 1980 BMWP score (if available)

(e) Actual BMWP scores, Taxa number and ASPT for 1990 survey with sampling dates.

(f) RIVPACS parameters and predictions

(g) BMWP Taxa list

3.15 From the above, Environmental Quality Indices based on score, numbers of taxa and ASPT can be derived.

$$\text{Environmental Quality Index (EQI)} = \frac{\text{Observed value}}{\text{Predicted value}}$$

3.16 A strong feature of RIVPACS is that it permits the calculation of confidence limits on the estimates of the biological scores. This allows us to quantify the risk of mis-classification and will ensure that sound decisions are made on whether Class has changed.

Presentation of Data

3.17 A system of banding of BMWP score is suggested for the whole country. This will take the form of banding of EQI's. Precise delineation of bands will be derived during the course of the survey by IFE and WRc under the direction of the NRA to produce a biological quality classification for 1990.

This banding into biological water qualities lends itself to presentation in map form.

3.18 If biological information was used in 1985 to modify NWC chemical class, the same type of information should be made available on a regional basis for 1990 in order to satisfy requirements for the DoE Survey (see Section 2a).

3.19 From the biological results supplied, the co-ordinating centre (Thames Region) will provide environmental quality indices for the biological override to the chemical classification for the 1990 NRA Survey report (see Table 2).

Timetable

3.20 An outline of the proposed timetable is given in Table 5.

Table 5: Timetable for Biological Survey (and input to NRA Classification Survey)

10/89:	Regions to comment on draft Guidelines
10/89 to 12/89:	Chief Scientist's Department approves Guidelines
12/89:	Guidelines to Regions
to 3/89:	IFE Programme translation and amendment and preparation of Database
3/90 to 5/90:	Spring sampling
6/90 to 8/90:	Summer sampling
9/90 to 11/90:	Autumn sampling
4/90 to 3/91:	Collation of biological information
12/90:	Thames Region completes data handling system for biological classification
to 4/91:	Liaison Officers send results to Thames and Anglian Regions
in 5/91:	Evaluate Biological Override Establish relation with Biological Classification
in 6/91:	Thames Region sends results of biological classification to Liaison Officers
in 8/91:	Liaison Officers send maps to Chief Scientist's Department
in 10/91:	Chief Scientist's Department circulate draft Report for checking by Regions
1/92:	Final draft ready
	Report published.

SECTION 4. THE ESTUARY SURVEY

THE DoE ESTUARY SURVEY

4.1 The DoE estuary survey must be compatible with that of 1985 and the same rules and criteria adopted for 1985 must be followed, perpetuating any differences between regions.

4.2 The classification exercise must encompass those estuaries included in the 1985 survey.

4.3 The landward and seaward limits of estuaries should be the same as those adopted in 1985. The upstream limits for estuaries must be the same as the downstream limits for river classification. The limits of estuaries used for the 1985 survey were defined in accordance with the following guidelines:-

(a) Seaward limits should normally be identical with those laid down in the Clean Rivers (Estuaries and Tidal Waters) Act 1960. These limits may be adjusted where there are good local reasons, eg. to include waters with restricted circulation.

(b) Landward limits should wherever possible be that boundary at which the chloride level does not exceed 200 mg/l at high water of mean spring tides during low freshwater flow.

4.4 Estuaries should be divided at the discretion of the water authorities into zones having reasonably uniform characteristics, and classified separately. In large estuaries having different qualities across their width, two or three zones may be identified laterally. A reduction in water quality caused by a single discharge should be ignored, except where its effect is more than local.

4.5 For each zone identified, points should be allocated for biological quality, aesthetic quality and water quality as indicated in Table 6. Because of the lack of relevant quantative data for many estuaries, the scheme is primarily subjective. In this situation regions should score on the basis of the biological quality expected from knowledge of polluting inputs, including diffuse inputs where appropriate, and prevailing hydrographic conditions. Where firm data are not available within the NRA, it may be possible to use data held by other bodies to assist in classification and every effort should be made to do so.

4.6 The scoring of the characteristics describing estuarial quality must follow the numerical allocation given in Table 6; intermediate scores should not be used.

4.7 Biological quality is classified by the following features:

4.7.1 **Passage of migratory fish.** Except where other uses are deemed of greater importance, an estuary should allow the passage of all those species of migratory fish which can be supported by the freshwater reaches. The estuary would fail this criterion if the passage of one or more of the relevant species was seriously impeded by adverse water quality. Thus certain east coast estuaries, for instance, would not be failed because migratory salmonids do not pass through them, but would be failed if they did not allow the passage of elvers and eels. Similarly, an estuary would not be failed on this parameter if the only impediment to migration was a physical barrier. The main deterrent to migration is usually low dissolved oxygen, and this is reflected in the classification score under chemical quality. However, the scheme takes into account the possibility that fish might be able to migrate through an estuary with the lowest water quality classification if at the appropriate time there is sufficient dissolved oxygen present to allow migration to occur. For example, the lowest dissolved oxygen may occur during the third quarter of the year, whereas elvers and eels migrate during the second and fourth quarters respectively.

4.7.2 **Fish population.** To comply with this parameter, the classification scheme requires that each area of estuary contains a population of fish appropriate to the physical and hydrographic conditions for most of the time. It follows that where water quality criteria for recreational, commercial, or biological grounds are not met, fish population will also be reduced, either sporadically or permanently, in numbers or species and this will therefore also cause the area of estuary to fail in this respect.

4.7.3 **Benthic community.** To comply with this parameter the benthic community of each area would have a diversity and biomass which is consistent with the physical and hydrographic conditions. This parameter is included because the sedentary characteristics of benthic organisms reflect the conditions at a given location, in contrast to the fish population which is mobile. It is often not easy to determine whether the benthos is healthy or otherwise, although the extremes are readily recognisable. Thus the benthic community may need to show a substantial deterioration before its failure to comply can be stated with any certainty.

4.7.4 **Persistent toxic or tainting substances.** The accumulation of toxic or tainting substances by estuarine organisms may affect their subsequent acceptability for human consumption, or the viability of populations of sensitive species. The presence of higher-than-background concentrations of persistent chemicals in the biota would not constitute grounds for failing an area of estuary on this parameter, unless the substances approach concentrations which could cause harm to the organisms or render edible species unacceptable for human consumption. Clearly where, from a knowledge of the nature of inputs to an estuary, there is no reason to expect the accumulation of such substances in the biota, parts of estuaries would be given the highest rating.

4.8 When deciding on the aesthetic quality of an estuary, the following should be taken into account: colour, smell, debris, oil, recognisable sewage solids and effects from discharge of domestic or industrial effluent. The assessment should take into account the natural turbidity of the water in the area, algal growth, and the frequency that floating oil and other debris enters the area.

4.9 The chemical quality is classified in terms of the dissolved oxygen levels which refer to those obtained under the worst conditions, where necessary averaged with depth, and over a tidal cycle. It is expected that water having a mean dissolved oxygen value of 60% will exceed this value for a substantial portion of the time.

4.10 In order to produce the overall classification and description of each estuary, or part of an estuary, the points awarded to each area under the headings of biological, aesthetic and water quality, as indicated in Table 6, should be summed. The estuaries or parts of estuaries should then be classified according to the following scale:-

Classification	Number of Points	Description
Class A	30 - 24	Good Quality
Class B	23 - 16	Fair Quality
Class C	15 - 9	Poor Quality
Class D	8 - 0	Bad Quality

4.11 Classification of an estuary is summarised according to the length in each class. The length of an estuary should normally be measured along its centre line from the landward limit to the seaward limit of the survey. Where the classification is different from one side to the other, the length of estuary affected should be allocated proportionally between the different classes.

4.12 Regions will provide the information listed below; the Chief Scientist's Department at Headquarters will collate the returns and write the report.

(a) Name of estuary or zone (where necessary use descriptions such as upper, middle, lower etc.).

(b) Length of estuary or zone (km).

(c) Individual points allocated for the various criteria identified in Table 6 to indicate how the classification was arrived at.

(d) Classification for estuary or zone in 1990.

(e) 1985 classification.

(f) Brief description of any significant water quality problems in the estuary which affect the classification.

4.13 The region should supply a brief commentary (500-1000 words) summarising any changes in classification since the 1985 survey.

4.14 Information should be supplied to the Chief Scientist's Department on a floppy disc; they will advise on detailed arrangements.

TABLE 6. Allocation of points for the Estuarial Quality Classification Scheme

Description	Points awarded if the estuary meets this description
Biological Quality (Scores under a, b,c & d to be summed)	
(a) Allows the passage to and from freshwater of all migratory fish, when this is not prevented by physical barriers. Relevant species include salmonids, eels, flounders and cucumber smelts etc.	2
(b) Supports a residential fish population which is broadly consistent with the physical and hydrographical conditions	2
(c) Supports a benthic community which is broadly consistent with the physical and hydrographical conditions	2
(d) Absence of substantially elevated levels in the biota of persistent toxic or tainting substances from whatever source	4
Maximum number of points	10
Aesthetic Quality (Choose one description only)	
(a) Estuaries or zones of estuaries that either do not receive a significant polluting input or receive inputs that do not cause significant aesthetic pollution	10
(b) Estuaries or zones of estuaries which receive inputs which cause a certain amount of aesthetic pollution but do not seriously interfere with estuary usage	6
(c) Estuaries or zones of estuaries which receive inputs which result in aesthetic pollution sufficiently serious to affect estuary usage	3
(d) Estuaries or zones of estuaries which receive inputs which cause widespread public nuisance	0
Water Quality (Score according to quality)	
Dissolved oxygen exceeds the following saturation values: 60%	10
40%	6
30%	5
20%	4
10%	3
below 10%	0

THE NRA ESTUARY SURVEY

4.15 The NRA Estuary Survey should only encompass those estuaries included in the 1985 survey.

4.16 The procedures given in Sections 4.2 to 4.7.2 should be followed. However, the guidelines for assessing the benthic community, persistent toxic or tainting substances, aesthetic quality and chemical quality are different from those in the DoE Survey and have been standardised in the following way:

4.16.1 **Benthic community.** To comply with this parameter the benthic community of each zone would have a diversity and biomass which is consistent with the physical and hydrographic conditions. This parameter is included because the sedentary characteristics of benthic organisms reflect the conditions at a given location, in contrast to a fish population which is mobile. It is often not easy to determine whether the benthos is healthy or otherwise, although the extremes are readily recognisable. Thus the benthic community may need to show a major deterioration before its failure to comply can be stated with any certainty.

The following variables will influence fundamentally the composition of benthic communities.

(i) tidal ranges
(ii) salinity regime
(iii) level on shore
(iv) sediment characteristics
(v) prevailing currents
(vi) water quality

and should be taken into account, when using field data to assess the health of benthic communities.

The following species lists include some commonly occurring British estuarine species which are found intertidally (i) and/or subtidally (s) : where salinity and other physical conditions allow.

(A) <u>Indicative of normal conditions</u> - suggest that estuary of zone should score 2 points.

<u>Polychaeta</u>

Nereis diversicolor	(i,s)
Nephtys hombergii	(i)
Scoloplos armiger	(i,s)
Eteone longa	(i,s)
Arenicola marina	(i)
Ampharete balthica	(s)
Neanthes virens	(s)
Pholoe inornata	(s)
Anaitides mucosa	(s)
Anaitides maculata	(s)

Mollusca

Hydrobia ulvae	(i)
Macoma balthica	(i) *1
Scrobicularia plana	(i) *2
Cerastoderma edule	(i)
Mya arenaria	(i)
Abra alba	(s)

*1 Rare in the South
*2 Rare in the North

Crustacea

Corophium volutator	(i)
Carcinus maenas	(i,s)
Marinogammarus sp.	(i)
Diastylis rathkei	(s)
Crangon crangon	(s)

(B) Indicative of Organic Enrichment - Where there is substantial organic enrichment, more than 50% of the annelid and nematode biomass of the biota in a representative sample will be of species indicative of organic enrichment.

Polychaeta

Streblospio shrubsolii	(i,s)	
Polydora ligni/ciliata	(i,s)	
Malacoceros fuliginosus	(i,s)	organic carbon levels
Pygospio elegans	(i,s)	in sediments likely
Capitella capitata	(i,s)	to be 2-4% although
Mediomastus fragilis	(i,s)	these may be modified
		in areas where there are
Nematodes		substantial coal solids.
Pontonema sp	(s)	
Oligochaetes		
Tubificidae	(i,s)	
Naididae	(i)	
Enchytraeidae	(i)	

N.B. These species lists are intended to be indicative rather than exhaustive.

4.16.2 **Persistent toxic or tainting substances.** The accumulation of toxic or tainting substances by estuarine organisms may affect their subsequent acceptability for human consumption, or the viability of populations of sensitive species. The presence of higher-than-background concentrations of persistent chemicals in the biota would not constitute grounds for failing an area of estuary on this parameter, unless the substances approach concentrations which could cause harm to the organisms or render edible species unacceptable for human consumption. For the purposes of monitoring, particular attention should be paid to the number of specimens required to smooth out variation between individuals, and the influence of size/weight/age, and time of year, all of which affect the variability in growth and the reproductive state of the organism. The adoption of uniform national guidelines for bioaccumulation studies is essential to ensure comparability of classification. Numerical thresholds, can be defined for widely analysed indicator species.

Table 7 indicates some provisional numerical standards for the most widely used estuarine indicator organism, Mytilus edulis. Account is taken of the fact that this organism has a limited ability to control its uptake of the metabolically useful metals, copper and zinc. Fucus spp are better indicators for these metals, and also penetrate to lower salinities. However, at even lower mean salinities perhaps only Enteromorpha spp, which take up and lose metals relatively rapidly, will be sufficiently widely distributed to be a useful indicator. Suggested numerical standards for Fucus are given in Table 8.

TABLE 7

'Substantially Elevated' Contaminant Levels in Mussels, Mytilus edulis, Analysed in accordance with ICES Guidelines

Substance		National background	Substantially elevated
Mercury	mg/kg dry	0.15	1.5
Cadmium	"	1	10
Arsenic	"	7	70
Chromium	"	2	20
Copper	"	6	30
Lead	"	2.5	25
Nickel	"	1.5	15
Zinc	"	90	400
HCH	µg/kg	-	20
DDT	"	-	100
HCB	"	-	50
Dieldrin	"	-	50
PCB	"	-	200*

* Determination of individual PCB congeners will be better, but data not yet available.

Principal sources of data for this table are the MAFF Aquatic Environment Monitoring Reports, DAFs, CRPB, and FRPB reports.

TABLE 8

'Substantially Elevated' Contaminant Levels in the thallus of Fucus vesiculosus/spiralis Concentrations as mg/kg dry weight.

Substance	National background	Substantially elevated
Mercury	0.02	0.2
Cadmium	0.8	8
Arsenic	10	100

Chromium	0.6	6
Copper	3.5	35
Lead	1	10
Nickel	4	40
Zinc	35	350

The effects attributable to discrete discharges of persistent toxic or tainting substances should not be differentiated from those attributable to natural processes such as mineralization further up a catchment for the purposes of classification.

Aesthetic quality

4.16.3 (i) When deciding on the aesthetic quality of an estuary, the following should be taken into account: colour, smell, debris, oil, recognisable sewage solids and effects from discharge of domestic or industrial effluent. The assessment should take into account the natural turbidity of the water in the area, algal growth, and the frequency with which floating oil and other debris enters the area.

(ii) Any estuary or zone receiving significant untreated sewage discharges (i.e. no appropriate preliminary treatment as a minimum) cannot score >6 points in this category. This limitation can be waived for very minor discharges from individual or small groups of premises provided that they do not give rise to substantial complaint. This limitation should not be waived simply on the grounds of highly turbid waters obscuring the effects of such untreated discharges.

(iii) Where discharges cause aesthetic pollution sufficiently serious to affect adversely the amenity value and usage of the estuary there will have been at some time frequent complaints substantiated by the Regulatory Authority. Complaints do not need to have been sustained if the likely origin of the problem remains.

(iv) Inputs which cause widespread public nuisance will result in sustained gross contamination with faecal solids, oils or other sewage derived debris including foam. This will include discharges which give rise to offensive smell problems.

Chemical quality

4.16.4 The chemical quality is classified in terms of the 95-percentile exceedence dissolved oxygen levels which refer to those values obtained under the worst anticipated conditions (eg. tidal state, height of tide, time of year etc), where necessary averaged for depth (i.e. in estuaries exhibiting significant stratification).

Class estimation and reporting

4.17 The procedures for determining the class of each estuarial zone and reporting the results are identical to those of the DoE Survey (Section 4.10 to 4.14).

SECTION 5. DATA HANDLING AND REPORTING

River Quality Surveys

Compilation of Basic Data Sets

5.1 All regions will collect data in accordance with the instructions provided in Section 2-4. The format of the basic data sets will be agreed by Water Quality Survey Group. The data fall into two basic categories, chemical and biological.

5.2 Chemical data will be archived initially to a standard Water Quality Archive and then transferred by Water Quality staff into a PC based Water Quality Survey Chemical database set up by each regional IT Group. This database may comprise two sub-sets of chemical data, one associated with the DoE classification requirements and another (very similar) associated with the NRA proposed classification requirements. Water Quality Staff will be responsible for ensuring the accuracy of the data compiled on the PC database and for its regular updating as the survey progresses.

5.3 Biological data will be archived by biologists onto a PC based Water Quality Survey biological database set up by each regional IT Group. Specific PC equipment will need to be purchased in some regions, provision of hardware and software being the responsibility of the local IT Group. Biological staff will be responsible for ensuring the accuracy of the data compiled on the PC database and for its regular updating as the survey progresses.

Classification Process for DoE Survey

Regional Responsibilities

5.4 Water Quality Staff in regions will be responsible for carrying out the 1990 Chemical Classification in the same manner as for the 1985 Survey. The regional report should comprise the text and draft map information using word processing facilities to be defined by the local IT group. Hence the DoE results should be made up of two sets of data:

(i) Report text and draft maps.

(ii) PC based chemical database from which (i) has been derived.

5.5 The final approval of the report and data at regional level will be the responsibility of the senior Environmental Quality Manager in each region.

5.6 Once approved the information will be transferred to Headquarters by floppy disk in accordance with a specification defined by Headquarters and controlled by the local IT Group.

Headquarters Responsibilities

5.7 The submissions from all ten regions will be centrally collated within the Chief Scientist Department. The Data Processing Manager at Headquarters will arrange with local IT Groups for files to be sent in an appropriate format. Any corrections/ modifications required for collation at Headquarters will be notified back to the relevant region for local amendment of their own copy of the results.

5.8 The provision of Water Quality Survey Maps (final copies) will be co-ordinated by the Chief Scientist's Department using the service of the DoE Cartographic Division or appropriate alternative cartographer.

Classification Process for NRA

Regional Responsibilities

Biological Data

5.9 The derivation of the Environmental Quality Indices (EQI) for all regions data will be carried out by biologists in the Thames Region. The ten PC based Water Quality Survey biological databases will be collated in Thames Region once regional biologists are satisfied with the accuracy of their own data. EQIs will then be derived for all data and the data stored with the PC biological database. Once derived and checked to the satisfaction of Thames Region biologists, all data will be transferred to the Anglian Region for subsequent classification analysis.

Classification Method

5.10 Water Quality staff in the Anglian region will collate all ten sets of PC based chemical data and biological data.

5.11 The algorithm relating chemical and biological data to the proposed NRA classification system will be derived under the control of Dr A Warn and once agreed by the Water Quality Survey Group all NRA rivers will be classified at Anglian region.

5.12 Once classified, a copy of the chemical data, biological data (including EQIs) and classified river stretch data will be returned on floppy disk to each region, another copy of all ten regions data being sent to the Chief Scientist's Department at Headquarters.

Headquarters Responsibilities

5.14 Headquarters will arrange for the collation of the ten regions' reports into one report and for the production of the final river quality maps via the DoE Cartographic Division or appropriate alternative cartographer.

Estuarine Surveys

Compilation of Data. Classification Process and Presentation of Results

5.15 The classification process is rather more subjective for estuaries than for rivers and does not rely explicitly on a simple list of chemical or biological data. Hence the compilation of basic raw data sets is inappropriate.

Regional Responsibilities

5.16 The classification process will be carried out within the regions according to the instructions provided in Section 4.

5.17 Each region will be responsible for classifying its own estuaries and producing a report and list of data comprising the "quality scores" upon which the final classification is based. The appropriate software and format for producing the report and lists in each region will be defined by the local IT Group. When complete, a copy will be sent to the Chief Scientist's Department at Headquarters where collation of the 10 classification reports will take place.

Headquarters Responsibilities

5.18 After collation of the reports the presentation of the Estuary Classification in map form will be carried out in the same way as for the River Quality Survey either using the DoE Cartographic Division or an appropriate alternative cartographer.

SECTION 6. SAMPLING RESOURCES AND COSTS

Introduction

6.1 The report describes the present chemical and biological sampling resources and identifies where there may be a shortfall with regard to the 1990 River Quality Survey. The information on the sampling was obtained from the returns to a questionnaire sent out by the River Sampling Group. The report concludes with the estimated total costs of carrying out the 1990 Survey.

Chemical Sampling

6.2 The proposal for assessing the chemical classification of rivers and canals is to use data collected over a three year period from 1988 to 1990 and it is assumed that most sites will be sampled at a frequency of 12 samples per year. A breakdown for each region of the current sampling frequencies by river reach is given in Table 9. Of the sites sampled at least 12 times a year, 11% are sampled either weekly or fortnightly.

6.3 In some regions there are relatively high numbers of river reaches that are not sampled. This may be a reflection of the way the original classification was carried out as each water authority used different criteria in designating river reaches. Where a number of successive river reaches have similar chemical quality, data from just one sampling point may be sufficient to classify all the reaches.

6.4 Before the recommendation of the River Sampling Group to have at least one monitoring point on all classified reaches is implemented it may be necessary to establish a common approach to river classification across all Regions. In 1990 Regions should continue existing practices.

6.5 The number of samples taken per kilometre of classified river reach is considered a more appropriate measure for assessing the additional sampling resources that may be required for the 1990 Survey. Table 9 shows a six fold difference between the highest (Southern) and lowest (Yorkshire). The differences in the numbers will reflect the type of river catchments in the region, for example the length of rivers, the proportion of upland catchments, river uses and the number of large industrial conurbations.

6.6 Pending the implementation of the Sampling Group Proposals the present routine chemical sampling programme for the 1990 Survey will be used, and where there is a shortfall of data, biological sampling will help to assess river quality. No increase in chemical sampling resources will be required assuming that the routine programme can be achieved.

Biological Sampling

6.7 Table 10 gives the proposed biological sampling programme for the regions for the 1990 Survey with a comparison to the number of sites sampled for the 1980 Survey. Three seasons samples will be taken at the 4872 sites identified by the biologists for the 1990 Survey. The extra sites are on river reaches where currently there are no chemical data and the quality of the reach will be assessed on data from a biological sample using RIVPACS.

6.8 The table identifies the biologists available and needed for carrying out the Survey in each region. The total shortfall in staff is 26.5 FTEs (full time equivalents), and the regions requiring the major part of this additional resource are Welsh (6 FTEs), North West (4 FTEs), South West (4 FTEs) and Wessex (4 FTEs).

Costs

6.9 These are estimates of the total costs based on providing data in 1990 for the DoE Survey. The estimates of sampling and analytical costs for the chemical data are from 1988 to 1990. Costs for sampling analysis and processing estuary data have not been included. No additional sampling is envisaged for the estuary survey and, as the scheme is essentially subjective, there is a minimal requirement for data processing.

6.10 Chemical sampling - The total number of river and canal samples per annum is 64000. At a cost of £8 per sample = £0.50m.

6.11 Chemical analysis - With DO generally being measured in the field, the cost of the BOD and ammonia analysis per sample is £2.85 based on the proposed NRA laboratory analytical costs. Total cost = £0.18m.

6.12 Biological sampling and analysis - The total cost of sampling and analysing 19425 biological samples at £40 per sample is £0.777m. If only the 1980 sites are sampled the cost is £0.235m and the cost of sampling the extra sites identified in Table 10 is £0.193m.

6.13 For the DoE survey the estimated costs for NRA Headquarters for data handling and presentation are £86,000. This includes setting up systems, salaries, data transfer and map and report productions.

6.14 For the regions, data production and presentation is estimated as 3 man months per region at a total cost of £75,000. In addition, Thames and Anglian Regions will incur costs in computing the biological and chemical results on behalf of the other eight Regions, estimated at £24,000 and £20,000 respectively. Of these, £24,000 and £8,000 respectively require additional funding, reflecting costs which cannot be absorbed by the region in question.

6.15 A summary of the costs for the 1990 Survey is given in Table 11. The estimated total cost is £2.90m which includes a large element of current costs. The additional cost of sampling the extra biological sites and providing data for the 1990 Survey is £0.37m.

TABLE 9 - CHEMICAL SAMPLING

REGION	ROUTINE RIVER SAMPLING SAMPLING BY RIVER REACH				LENGTH OF CLASSIFIED W'COURSE (RIVERS & CANALS)	LENGTH PER REACH (km)	LENGTH PER SAMPLING SITE (km)	SAMPLES PER km
	Monthly or Greater	Quarterly	None	Total				
Anglian	897	3	0	900	4453	4.95	4.95	2.42
Northumbria	112	304	55	471	2784	5.90	6.70	1.44**
North West	175	325	924	1424	5323	3.74	10.60	.64
Severn-Trent	344	352	118	814	6192	7.61	8.90	.89
Southern	607	305	9	921	2542	2.76	2.79	3.34
South West	851	22	0	873	3459	3.96	3.96	2.98
Thames	236	25	116	427	3824	8.95	9.10*	1.75**
Welsh	494	255	575	1324	4802	3.63	6.42	1.45
Wessex	384	75	24	483	2466	5.11	5.37	1.99
Yorkshire	188	252	1300	1740	6034	3.47	13.70	.54
TOTAL	4288	1918	3171	9377	41879			
AVERAGE						4.47	6.58	1.53

* Includes additional sites to the routine monthly and quarterly sites
** Includes additional samples to the routine monthly and quarterly samples

TABLE 10 - BIOLOGICAL SAMPLING

REGION	1980 SURVEY SITES	1990 MAJOR SURVEY SITES	ADDIT-IONAL SITES	SAMPLE NUMBERS SAMPLES (FTE's)	BIOLOGISTS AVAILABLE FOR 1990 SURVEY WORK (FTE's)	BIOLOGISTS NEEDED FOR MAJOR SITES IN 1990	SHORTFALL (FTEs) IDENTIFIED PRIOR TO CORPORATE PLAN
Anglian	179	900	700	2700 (+700)	8	8	0
Northumbria	(a) 87 (b) 87	240	200	720 (+200)	1	2	1 (+1 contract)
North West	389	434	741	1302 (+741)	4	8	4
Severn-Trent	268	716	105	2148 (+105)	4	6	2
Southern	(a) 104 (b) 99	409	40	1277 (+40)	1	4.5	3.5
South West	(a) 174 (b) 164	504	526	1512 (+526)	2	6	4
Thames	167	262	332	786 (332)	2	4	2
Welsh	(a) 471 (b) 288	800	524	2400 (+524)	1.5	7.5	6
Wessex	(a) 190 (b) 134	357	251	1071 (+251)	0	4	4
Yorkshire	(a) 173 (b) 168	350	1390	1050 (+1390)	2.5	3	(0.5 contract)
TOTAL	1955	4872	4809	14616 (+4809)	26	54	26.5 (1.5)

(a) Reported to DoE (b) Reported by DoE

The figures given for biologists refer only to Biologists performing routine freshwater monitoring work.

TABLE 11 - COSTS (£m)

	1988	1989	1990	Extra Costs
Chemical Sampling	0.5	0.5	0.5	-
Chemical Analysis	0.18	0.18	0.18	-
Biological Sampling & Analysis	-	-	0.777	0.193
Data Handling - NRA Head Office	-	-	0.086	0.086
Data Handling - Regions	-	-	0.075	0.075
Data Handling - Thames and Anglian	-	-	0.048	0.048

Total cost of 1990 Survey - £3.124m

Extra cost of 1990 Survey - £0.402m

REFERENCES

1. Water Quality Survey Group reporting to the National Rivers Authority Advisory Committee. Interim Report, June 1989. Group membership as for this present report.

2. Working Group on Environmental Quality Objectives and Standards reporting to the Water Authorities Association's Privatisation Environment/Regulation Group. Final Report, January, 1988. Group chaired by J M Tyson (North West Water). Membership K Bowden (Thames Water), P K Estwood (Northumbrian Water), J C Ellis (Water Research Centre), G M Woodward (Severn Trent Water) and A E Warn (Anglian Water).

3. Working Group on Statutory River Quality Objectives reporting to the Water Authorities Association's Privatisation Sub-Group on Pollution Control. Progress Report, April 1988. Group chaired by G Mance (Severn Trent Water). Membership: J C Ellis (Water Research Centre), J Landroc (HMIP), J Martin (Severn Trent Water), J Tyson (North West Water).

Appendix 1

Liaison Officers (DoE and NRA Surveys).

Region	Officer	Telephone	Fax
Anglian	Barrie Harbott	0733 371811	0733 231840
Northumbria	Howard Taylor	091-213 0266	091-284 5069
North-West	Peter Osbaldeston	0925 53999	0925 415961
Severn Trent	Peter Whalley	021-711 2324	021-722 5824
Southern	Bob Edmunds	0903 820692	0903 821832
South-West	Barry Milford	0392 444000	0392 444238
Thames	Martin Morgan-Jones	0734 535000	0734 535100
Welsh	Colin Strange	0222 770088	0222 798555
Wessex	Peter McGillivray	0278 457333	0278 452985
Yorkshire	Colin Urquhart	0532 440191	0532 461889

Chief Scientist's Department	Peter Chave	01-820 0101	01-820 1603

Scottish River Purification Boards	Andrew Haig	035-52 38181/6	035-52 64323

Appendix 2

REGIONAL UNITS

BIOLOGISTS RESPONSIBLE FOR 1990 SURVEY BIOLOGICAL COLLATION

Region	Biologist	Address
Anglian	Dr Alastair Ferguson	NRA Anglian Region Kingfisher House, Orton Goldhay Peterborough PE2 0ZR Tel: (0733) 371811 Fax: (0733) 231840
Thames	Dr Roger Sweeting	NRA Thames Region Fobney Mead, Rose Kiln Lane Reading Berkshire RG2 0SF Tel: (0734) 311422 Fax: (0734) 311438
Severn-Trent	Shelley Howard	NRA Severn-Trent Region Sapphire East 550 Streetsbrook Road Solihull B91 1QT Tel: (021) 7112324 Fax: (021) 7225824
Northumbrian	John Orr	NRA Northumbrian Region Washington Laboratory Barraston Lane Washington D15 Tyne and Wear Tel: (091) 4171928 Fax: (091) 4171972
North West	Dick Chambers (Janet Foster)	NRA North West Region Chertsey Hill London Road Carlisle CA1 2QX Tel: (0228) 25151 Fax: (0228) 49734
Yorkshire	Brian Hemsley-Flint	NRA Yorkshire Region Olympia House Gelderd Road Leeds LS12 6DD Tel: (0532) 440191 Fax: (0532) 795034

Wessex	Dr George Green	NRA Wessex Region 2 Nuffield Road Poole Dorset BH17 7RL Tel: (0202) 671144 Fax: (0202) 681857
Southern	Dr Bob Dines	NRA Southern Region Guildbourne House Chatsworth Road Worthing BN11 1LD Tel: (0903) 820692 Fax: (0903) 507326
South West	Dr John Murray-Bligh	NRA South West Region Manley House Kestrel Way Sowton Exeter EX2 7LQ Tel: (0392) 444000 Fax: (0392) 444238
Welsh	Frank Jones	NRA Welsh Region Regional Laboratory Penyfai House 19 Penyfai Lane Furnace Llanelli SA15 4EL Tel: (0554) 757031 Fax: (0554) 752686

Appendix 3

In its assessment of the issues on the 1990 River Quality Survey produced in March 1989, DoE concluded that "a biological survey should be carried out in 1990 and that using the FBA method, one year's results (three samples per site) will provide adequate data for an assessment of quality to be made.".

It is also recognised that biological results can increase the precision of the chemical classification. However, it is important that the measure of the river quality, based on biological information alone, is available as an individual result. This is because it is fundamentally different from the NWC chemical class. The chemical quality of a site may be satisfactory but the biological quality may indicate an environmental stress, undetected by chemical analysis. Hence the two systems should not be expected to provide similar results in all cases and an important stage in the analysis is to look for major discrepancies between them. The use of macroinvertebrate fauna for this purpose is now accepted, and the ability of the fauna to reflect the impact of environmental stress over previous weeks and months is widely recognised. However, some families of macroinvertebrates are only available for capture in certain seasons and many others vary in the abundance and hence accessibility for capture with season. Interpretation of the significance of particular absentees will become an increasingly powerful tool as knowledge grows concerning the response of the biota to particular environmental stresses.

The principle of regular sampling is fundamental to the chemical survey. (Overall NWC class is determined by 95-percentile values over a minimum of a twelve month period.) Because macroinvertebrates integrate environmental perturbation over extended periods of time, biological sampling need not be as frequent as chemical, but the same underlying principle should still be applied to biological sampling. The frequency should be sufficient to ensure that important indicator taxa are not excluded as a consequence of their life cycle. Neither is it desirable that taxa are excluded because of environmental extremes, when these are unrepresentative of the year as a whole.

Previous work has indicated that 3 seasons' sampling is adequate to overcome these difficulties and provide scientifically supportable conclusions on water quality. Single season sampling is prone to provide an unreliable estimate of prevailing quality and is more likely to underestimate true quality. Two seasons' sampling reduces this estimate, but allows only limited comparison between sites sampled across different seasons. Three seasons' sampling has the capacity of detecting all taxa that contribute to the BWMP score.