



ENVIRONMENT  
AGENCY

**ANALYSIS OF 1995  
SURVEY DATA.  
PHASE 2 POST-SURVEY  
APPRAISAL**

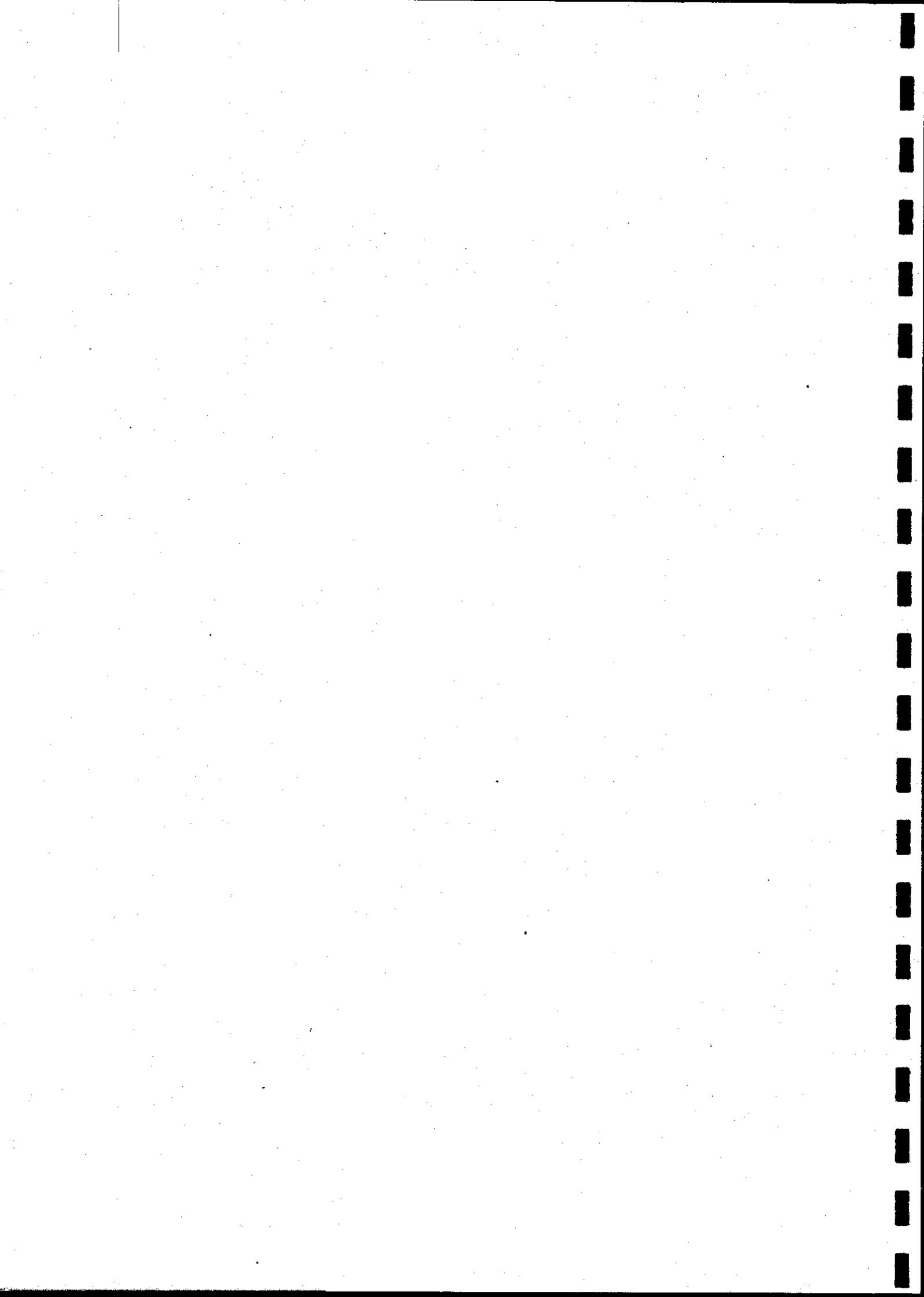
**R&D Progress Report EMA 036/pr4  
for the period from 1st November 1998  
to 31st January 1999**

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RESEARCH AND DEVELOPMENT  
PROGRESS REPORT



# 1 TECHNICAL PROGRESS

The current work programme is the second phase of the general project whose first phase comprised the development of an updated version of the River InVertebrate Classification and Prediction System (RIVPACS III+) (Clarke *et al.*, 1997), incorporating statistical procedures based on the findings of an earlier Agency project (Furse *et al.*, 1995), and a scoping study to determine the issues to be addressed in Phase 2 of the work (Furse and Clarke, 1997).

This progress report covers the sixth quarter of the work programme from 1<sup>st</sup> November 1998 (month 16) to 31st January 1999 (month 18).

## 1.1 Objectives

The overall objective of this, the second phase of the full research programme is:

- To conduct a post survey appraisal of the 1995 General Quality Assessment (GQA) biological survey data.

The specific objectives of Phase 2 are as follows:

- To investigate the distribution of macro-invertebrate taxa in relation to the environmental features of watercourses and their catchments and the effects of particular pollutants.
- To investigate temporal and spatial trends in the ecological quality of watercourses through use of the updated version of RIVPACS (RIVPACS III+) developed during Phase 1 of this project.
- To review the effectiveness of the biological component of the survey in meeting its objective of assessing the ecological quality of the watercourses in the Environment Agency regions.
- To make recommendations that maximise the application of the biological data collected during the survey for other Agency operational purposes.
- To consider the implications of the preceding analyses for the refinement of the methodology for future surveys

The work programme comprises two component stages:

- Stage 1: Data-base development
- Stage 2: Data appraisal and analysis

Stage 2, in turn, is divided into three distinct units:

- Taxon distribution studies
- Changes in ecological quality
- Post survey appraisal

## 1.2 Work Programme and Timetable for the R&D Project

The targets and timescales for the R&D programme (Table 1) were originally defined in its Project Initiation Document (PID). Subsequent modifications were outlined by Furse *et al.* (1998a). In Table 1, which sets out the revised schedule, Month 1 is August 1997.

**Table 1** Targets and timescales for the R&D programme (month = month completed)

Work item	Month
<b>Stage 1: Database development</b>	
a. Data acquisition	2
b. Database construction and population	4
c. Data checking and correction	6
d. Identifying of matched pairs of sites from the 1995 GQA and 1990 RQS	8
e. Assignment of site codes	10
<b>Stage 2 Unit 1: Taxon distribution studies</b>	
f. Requesting of information on environmental stresses at 1995 GQA sites	10
g. Taxon distribution studies in relation to RIVPACS variables	13
h. Relating of environmental stress data to environmental variables	18
i. Production of the final copy of R&D Technical Report 1	24
<b>Stage 2 Unit 2: Changes in ecological quality</b>	
j. Determination of EQIs and quality classes for GQA and RQS sites	12
k. Relating of distribution of quality classes to environmental variables	15
l. Comparison of 1995 and 1990 site data for temporal changes in quality	17
m. Relating the distribution of faunal changes to environmental variables	18
n. Relating temporal quality changes to taxon information	19
o. Production of the final copy of R&D Technical Report 2	24
<b>Stage 2 Unit 3: Post-survey appraisal</b>	
p. Development and circulation of a user questionnaire	8
q. Collation of questionnaire replies	11
r. Analysis of the 1995 audit results for causes of poor performance	12
s. Investigation of analytical quality targets using RIVPACS III+	12
t. Consideration of the implications of this unit of study for future surveys	15
u <sub>1</sub> Production of a draft of R&D Technical Report 3	20
u <sub>2</sub> Production of the final copy of R&D Technical Report 3	24
<b>Stage 2 General</b>	
v. Production of the final copy of the R&D Project Record	24

### **1.3 Work Programme for the Reporting Period**

The work programme for the reporting period comprised the elements due to be completed by the end of Month 18 (January 1999) (Table1) and not previously completed by the beginning of the reporting period. These were:

#### **Stage 1: Database development**

- c To continue to check the data for accuracy and to correct where necessary
- f To fully integrate all environmental stress data into the database structure (links to Stage 2, Unit 1)

#### **Stage 2 Unit 1: Taxon distribution studies**

- g To continue taxon distribution studies in relation to RIVPACS variables
- h To relate environmental stress data to environmental variables

#### **Stage 2 Unit 2: Changes in ecological quality**

- j To determine EQIs and quality classes for those GQA and RQS sites subject to further changes in their environmental data
- k To relate the distribution of quality classes to environmental variables
- l To compare 1995 and 1990 site data for temporal changes in quality
- m To relate the distribution of faunal changes to environmental variables

#### **Stage 2 Unit 3: Post-survey appraisal**

- p-t To develop and circulate a user-questionnaire and to collate, analyse and interpret the replies.

## **2 INTERIM RESULTS**

### **2.1 Data-base Development**

#### **2.1.1 Biological and environmental data**

All the intended checking of the macro-invertebrate faunal data and RIVPACS environmental data from the 1995 GQA and 1990 RQS was completed during the reporting period.

Largely excluded from the checking process were environmental data from all sites believed to be artificial watercourses (i.e. drains, ditches and canals) and environmental data from most sites in the former Wessex National Rivers Authority (NRA) Region.

The list of artificial watercourses was that identified by Walley and Martin (1998) together with a small number of extra sites identified by IFE. The number of apparent errors in the Wessex dataset was, *pro-rata*, far greater than in any of the other NRA Regions. Additionally very few (4%) of the sites sampled in the Wessex Region during the 1995 GQA had previously been surveyed during the 1990 RQS. Most of the planned analyses in the current research programme will be based on sites sampled in both 1990 and 1995. Therefore, the only amendments made to the Wessex environmental data were those relevant to the small number of 1990 RQS sites re-sampled during the 1995 GQA.

All sites, including those excluded from other environmental data checks, were checked, using a Geographic Information System, to ensure that they lay within the boundaries of their known NRA Regions. Corrections were made, where necessary, by reference to Ordnance Survey (OS) 1:50,000 Landranger maps.

All but the excluded sites were also checked against the following criteria:

- 1) Their discharge and distance from source values were compatible (e.g. near source sites should have a small discharge and far from source sites should have a large discharge).
- 2) For a given watercourse, altitude of sites should not increase with increased distance from source.
- 3) For a given watercourse, discharge category should not decrease with increased distance from source.

Precise rules were developed for identifying sites which failed to meet criterion 1) and all sites which failed to meet it had both their discharge and distance from source checked on OS Landranger maps.

Data from all sites were scrutinised by eye in order to check their acceptability in relation to criteria 2) and 3). The number of data items that failed to meet these criteria was so great that an unacceptable amount of time would have been needed to check each of them by reference to maps. Data were amended subjectively by identifying which variable values seemed to be out of sequence in relation to values of the same variable (either altitude, distance from source or discharge category) at adjacent sites. The pattern of change in the easting and northing values in the National Grid Reference (NGR) of each watercourse was used as an aid in this process. Non-sequential values were amended subjectively, by best-guess substitution, in order to ensure that each river system flowed downhill and generally increased, but never decreased, in discharge as it flowed from source to mouth. Where estimation was particularly difficult, e.g. on watercourses with only two sites, or where NGR values appeared suspect, accurate checks were made by reference to the OS Landranger maps.

Whilst the accuracy of changes made, using the subjective approach adopted for criteria 2) and 3), has not been verified objectively, and may sometimes have led to correct data being altered, the overall result of this process will inevitably have been an improvement in the reliability and logical consistency of the data.

All problems related to the recording of alkalinity and hardness values in the dataset were resolved during the quarter.

Whilst it is evident that further checking would produce additional improvements in the accuracy of the data, the cost/benefits of doing so are not considered to be justified. It is recommended that all time invariant data for sites sampled in the 2000 GQA be re-measured in order to provide an additional check on the accuracy of data currently held in the IFE database for sites included in the 1990 and 1995 surveys. In the interim, the environmental data available at the end of the reporting period were considered adequate for the purposes of the current project.

### **2.1.2 Environmental stress data**

Environmental stress data were received from all Environment Agency Areas by the end of the reporting period. Most data supplied to IFE had been previously checked by Ray Martin of Staffordshire University, in connection with Environment Agency National R&D Project E1/i621 (Applications of Artificial Intelligence in River Quality Surveys), and subsequently corrected by Agency staff at the individual Area Laboratories. A list of the data received, with notes on the data format, is given in Table 2.

The only corrections not yet received from the Environment Agency are for the Ridings/Aire Area of the former Yorkshire NRA Region.

## **2.2 Taxon Distribution Studies**

Procedures were successfully developed for linking macro-invertebrate data held in the IFE MSAccess97 data-base to the Geographic Information System (Arcview) to be used for displaying and reporting on the results of distribution studies. No final output maps or analyses linking taxon distributions with environmental data were produced during the reporting period.

## **2.3 Changes in ecological quality**

RIVPACS III+ was used to determine the Ecological Quality Index (EQI) values of all sites sampled during the 1995 GQA, other than those on artificial watercourses. RIVPACS III+ was also used to determine EQI values for all 1990 RQS sites also sampled in the 1995 GQA. Statistical tests and procedures in RIVPACS III+ were used to identify those sites that had undergone significant changes in biological condition between the two surveys and those with high probabilities of a change on biological grade (*sensu* the six grade, a-f, system used in the 1995 GQA).

Standard procedures were developed for relating the distribution of quality classes to environmental variables but the analyses have yet to be started.

In all RIVPACS analyses of sites common to the 1990 RQS and 1995 GQA the time variant data used were the means of the separate values obtained for each variable in each survey. This gave a common expected fauna for any given site in each survey year.

**Table 2 Progress with the receipt of environmental stress data from the Environment Agency. The Environment Agency file names are those used by Dr John Murray-Bligh, who supplied them to IFE by e-mail.**

Region	Area	Version	EA file name	IFE file name	Anomalies
Anglian	Eastern	19-Sep-98	Part.001	01an_east.xls	No asterisks in QA column. Blanks left in stress columns.
Anglian	Central	30-Sep-98	01an_cen.wk3	01an_cen.xls	NP used when other causes of stress exist. Two "additional stresses" in stress 2 column.
Anglian	Northern	06-Nov-98	01an_nor.wk4	01an_nor.xls	No site references. No values in QA column. Some stress columns after additional stress column.
Northumbrian	Wear	12-Aug-98	02ne_wea.wk3	02ne_wea.xls	None.
Northumbrian	Tyne	21-Aug-98	02ne_ty.wk3	02ne_ty.xls	None.
Northumbrian	Tweed	31-Oct-98	02ne_twe.wk	02ne_twe.xls	None. See explanatory notes at foot of spreadsheet - additional stress column.
Northumbrian	Tees	10-Dec-98	teescat.wk4	02ne_tee.xls	GQA grades removed by the Agency. GQA value includes additional stresses.
North West	Northern	06-Aug-98	Penrith.wk3	03_penrith.xls	Some mismatches between QA values and numbers of listed stresses.
North West	Central	24-Jul-98	stress95.wk4	03_stress95.xls	Asterisks before numbers in the QA column.
North West	Southern	24-Sep-98	03nw_so.wk3	03_nw_so.xls	Some sites without site reference codes. Are these GQA sites or not?
Midlands	Whole	11-Dec-98	Part.001	04_mids.xls	QA values missing for many sites. Confusing use of asterisks in stress columns. Asterisks before values in QA column.
Southern	Kent	02-Nov-98	05south2.wk3	05south2.xls	Additional stress asterisks in GQA class column. An extra (non-GQA?) site added?
Southern	Sussex	19-Sep-98	05south1.wk4	05south1.xls	None.
Southern	Hants	22-Sep-98	Part.001	05south3.xls	None.
South West	Cornwall	22-Sep-98	06sw_sw2.wk3	06sw_sw2.xls	None.
South West	Devon	06-Nov-98	06sw_dev.xlw	06sw_dev.xls	None. Very detailed extra stresses.
Thames	Whole	03-Nov-98	Part.001	07_thms.xls	None.
Welsh	Northern	20-Aug-98	08wel_n.wk4	08wel_n.xls	None.
Welsh	South West	24-Jul-98	08wel_sw.wk3	08wel_sw.xls	None.
Welsh	South East	31-Oct-98	Part.001	08wel_se.xls	None. Key to some stresses given at foot of additional stresses column in EXCEL spreadsheet.
Wessex	Whole	22-Dec-98	Part.001	09sw_reg.xls	None.
Yorkshire	Ridings-Aire	12-Aug-98	210ne_yo.wk3	210ne_yo.xls	Many stress intensities missing. "CHECK" typed in QA column of some sites. No QA values given. Corrected file awaited from the Environment Agency.
Yorkshire	Dales-Derwent	22-Sep-98	10ne_yo2.wk3	10ne_yo2.xls	None. QA values of 0 for NP converted to 1. Several sites with no QA value.
Yorkshire	Ridings-Hull	12-Aug-98	310ne_yo.wk3	310ne_yo.xls	Extra (non-GQA?) sites added. GQA band for site NR10.2511 deleted in error by the Agency.

## **2.4 Post-survey Questionnaire**

A post-survey, user-questionnaire on the 1995 GQA was developed during the reporting period and distributed to Dr R A Dines (Environment Agency Project Manager) and Dr J A D Murray-Bligh (Environment Agency Project Board Member) for comment.

## **3 PLANS FOR THE NEXT REPORTING PERIOD**

The next reporting period is from 1st February 1999 (Month 19) to 30th April 1999 (Month 21).

The following tasks, as listed in Table 1, are due for completion by the end of the reporting period, including those outstanding from work planned for completion in the first 18 months of the project.

### **Stage 1: Database development**

- f To fully integrate all environmental stress data into the database structure (links to Stage 2, Unit 1)

### **Stage 2 Unit 1: Taxon distribution studies**

- g To continue taxon distribution studies in relation to RIVPACS variables
- h To relate environmental stress data to environmental variables

### **Stage 2 Unit 2: Changes in ecological quality**

- k To relate the distribution of quality classes to environmental variables
- m To relate the distribution of faunal changes to environmental variables
- n To relate temporal quality changes to taxon information

### **Stage 2 Unit 3: Post-survey appraisal**

- p-t To develop and circulate a user-questionnaire and to collate, analyse and interpret the replies
- u<sub>1</sub> To produce a draft of R&D Technical Report 3

## **4 FACTORS WHICH MAY AFFECT THE ATTAINMENT OF ANY TARGETS OR TIMESCALES**

Most elements of the project are still running behind schedule. The principal reasons were detailed in the previous progress report (Furse *et al.*, 1998b) and arise from conflict with other Agency R&D projects with more pressing deadlines and from difficulty in obtaining reliable biological and environmental data from the Agency.

The other project deadlines have now been met and the dataset held by IFE is now considered adequate for the purposes of this study. The environmental stress data are also largely accurate and incorporating them in the IFE database is expected to be relatively straightforward. The authors are grateful for the contributions made to improving the accuracy and reliability of these data by Ray Martin (Staffordshire University) and John Murray-Bligh (Environment Agency).

It is anticipated that most elements of the work can be returned to schedule over the remaining six months of the project. However, it is likely that completion of the draft of R&D Technical Report 3 will not be achieved until the final quarter of the project.

## **5 FINANCE**

The work conducted to date has been within the agreed budget. The detailed attention that the project is currently receiving means that spending rates will soon be back in line with projections.

When the start date of the project was delayed by four months it was agreed that the completion date be put back by a similar period but that the schedule of payment be unaltered. This means that all payments from the Agency to IFE, with the exception of the retained sum payable on completion of the project, be paid by the end of March 1999 (Furse *et al.* 1997). This is possible because of the collaborative nature of the project.

A financial summary for the reporting period may be obtained from the IFE Finance Office approximately two months after the end of the period/financial year in question.

## **6 REASONS FOR ANY LIKELY UNDER OR OVERSPEND OF BUDGET**

No overall under or overspend of the budget is currently anticipated.

## **7 OTHER MATTERS**

None.

## 8 REFERENCES

Clarke, R T, Cox, R, Furse, M T, Wright, J F and Moss, D (1997) *RIVPACS III+. River InVertebrate Prediction and Classification System with error assessments*. R&D Technical Report E26. Bristol: Environment Agency.

Furse, M T, Bowker, J, Symes, K L and Clarke, R T (1998a) *Analysis of 1995 biological survey data and RIVPACS update. Phase 2. Post-survey appraisal. Progress report EMA 036/pr2 for the period from 1st November 1997 to 31st March 1998*. A Progress Report to the Environment Agency.

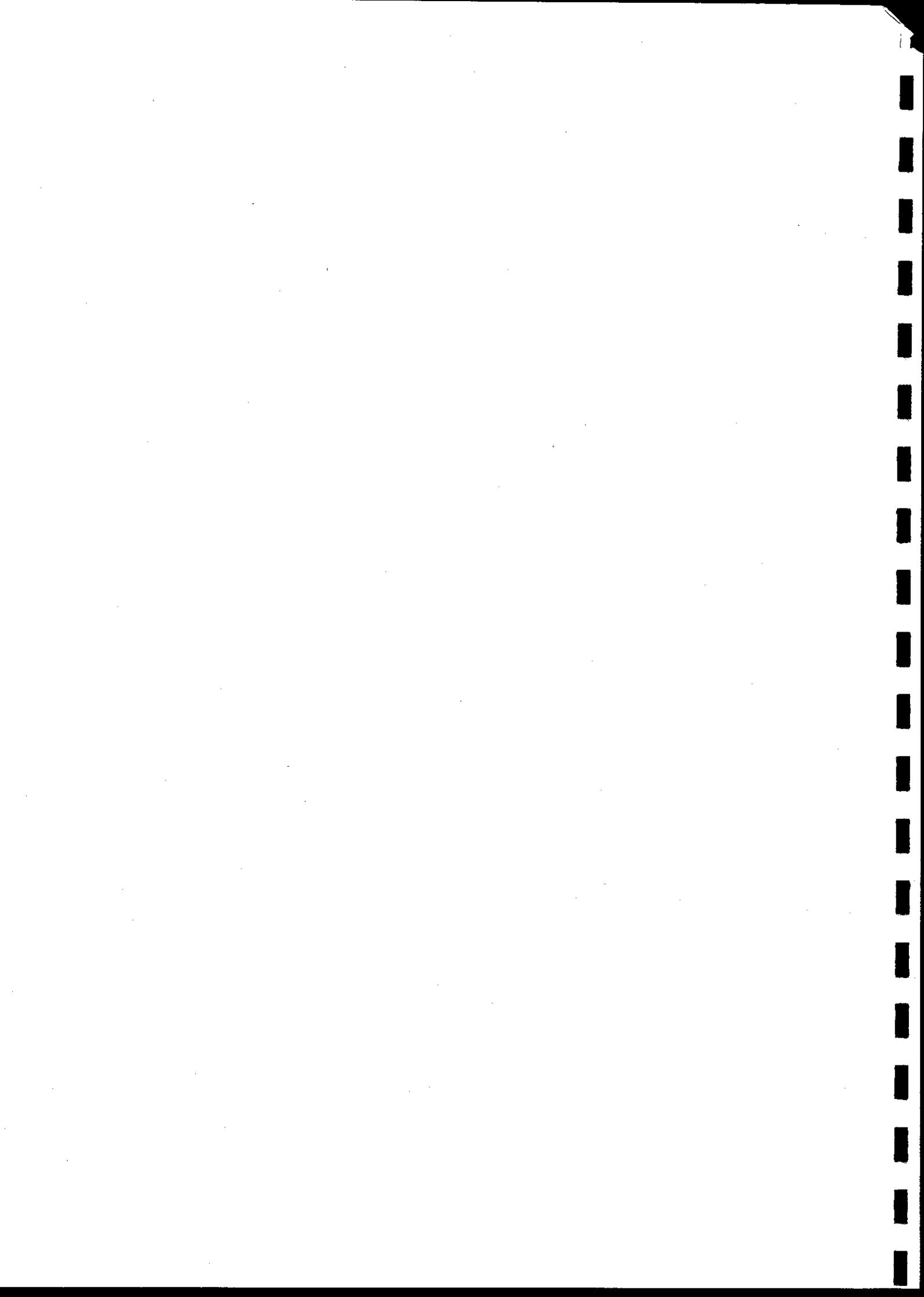
Furse, M T and Clarke, R T (1997) *Analysis of the 1995 Survey data and RIVPACS update*. R&D Project Record E1/008/1. Bristol: Environment Agency

Furse M T, Clarke R T, Winder, J M, Symes, K L, Blackburn, J H, Grieve, N J and Gunn, R J M (1995) *Biological assessment methods: controlling the quality of biological data. Package 1: The variability of data used for assessing the biological condition of rivers*. R&D Note 412. Bristol: National Rivers Authority.

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Walley, W.J and Martin, R.W. (1998) *Applications of artificial intelligence in river quality surveys*. R&D Project Record E1/i621/6. Bristol: Environment Agency.



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