ANALYSIS OF 1995

SURVEY DATA.

PHASE 2 POST-SURVEY

APPRAISAL

R&D Progress Report EMA 036/pr5
for the period from 1st February 1999
to 30th April 1999

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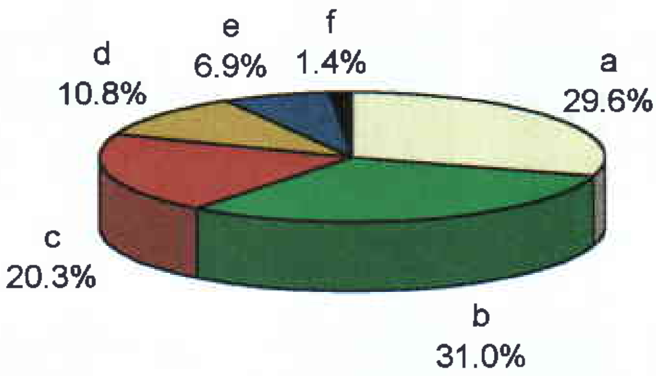
ENVIRONMENT AGENCY

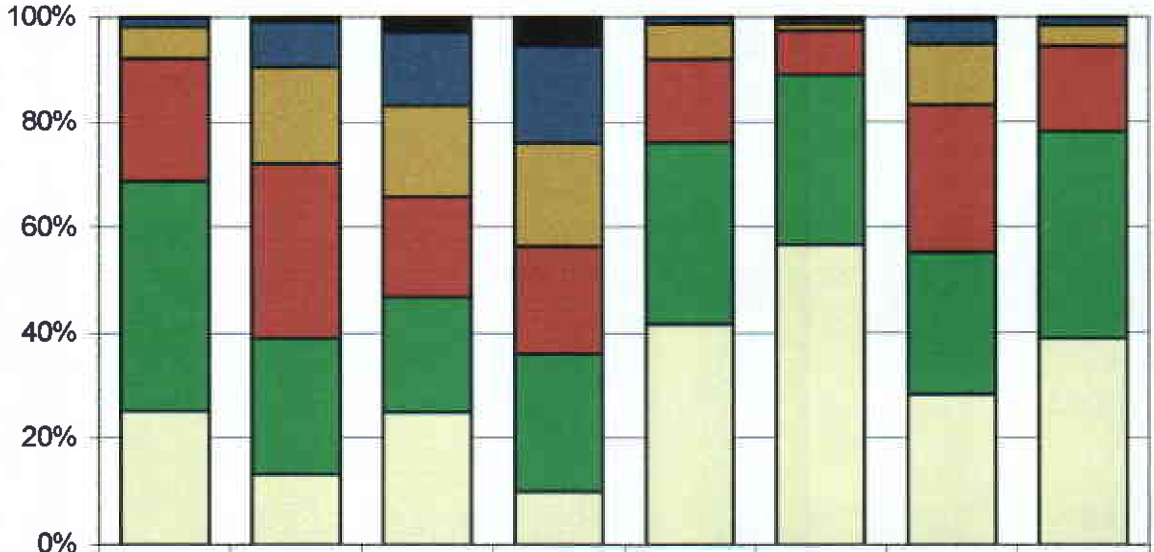
RESEARCH AND DEVELOPMENT
PROGRESS REPORT

Figure 1 **Percentage of sites in England and Wales in each (corrected) biological grade in 1995**



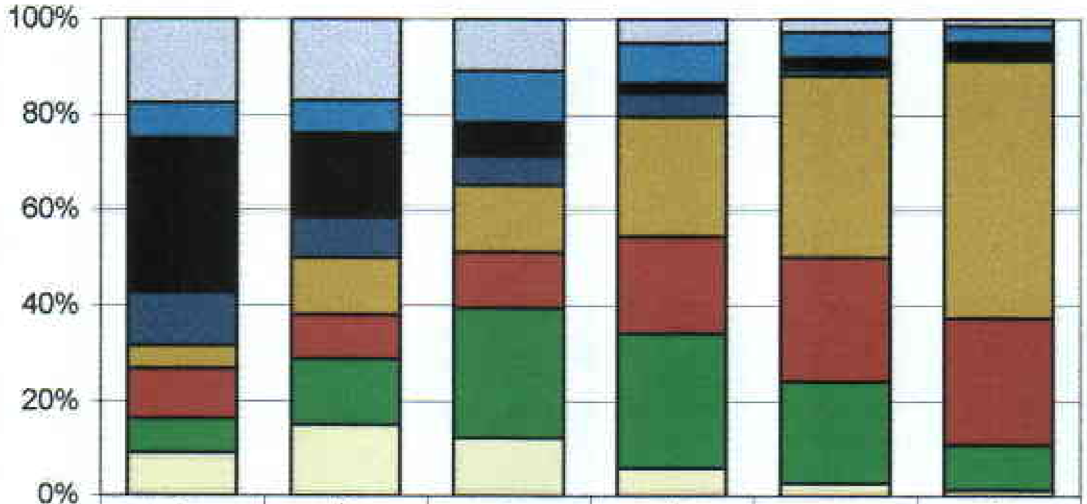
The proportions of sites in each biological grade were also calculated on a Region by Region basis (Figure 2), as was the distribution of sites in each grade between the different Regions (Figure 3).

Figure 3.2 **Percentage of sites in each (corrected) biological grade in 1995 within each of the eight Environment Agency regions**



	Anglian	Midlands	North-East	North-West	Southern	South-Western	Thames	Welsh
f	0.2%	0.8%	2.9%	5.3%	0.0%	0.3%	0.6%	0.1%
e	1.7%	8.8%	14.1%	18.7%	1.3%	1.0%	4.6%	1.4%
d	6.0%	18.3%	17.3%	19.4%	6.8%	1.3%	11.5%	4.0%
c	23.3%	33.1%	18.8%	20.5%	15.9%	8.4%	27.9%	16.5%
b	43.7%	25.9%	22.1%	26.2%	34.4%	32.4%	27.0%	39.2%
a	25.2%	13.1%	24.8%	9.8%	41.6%	56.7%	28.3%	38.8%

Figure 3 Regional distribution of sites for each (corrected) biological grade in 1995



	a	b	c	d	e	f
Welsh	17%	17%	11%	5%	3%	1%
Thames	8%	7%	11%	8%	5%	4%
South-Western	32%	18%	7%	2%	2%	4%
Southern	11%	9%	6%	5%	1%	0%
North-West	5%	12%	14%	25%	38%	54%
North-East	11%	9%	12%	20%	26%	27%
Midlands	7%	14%	27%	28%	21%	10%
Anglian	9%	15%	12%	6%	3%	1%

A series of analyses have been undertaken relating the distribution of biological grades to values of RIVPACS variables. For this purpose the environmental variables have been divided into four categories (Table 2).

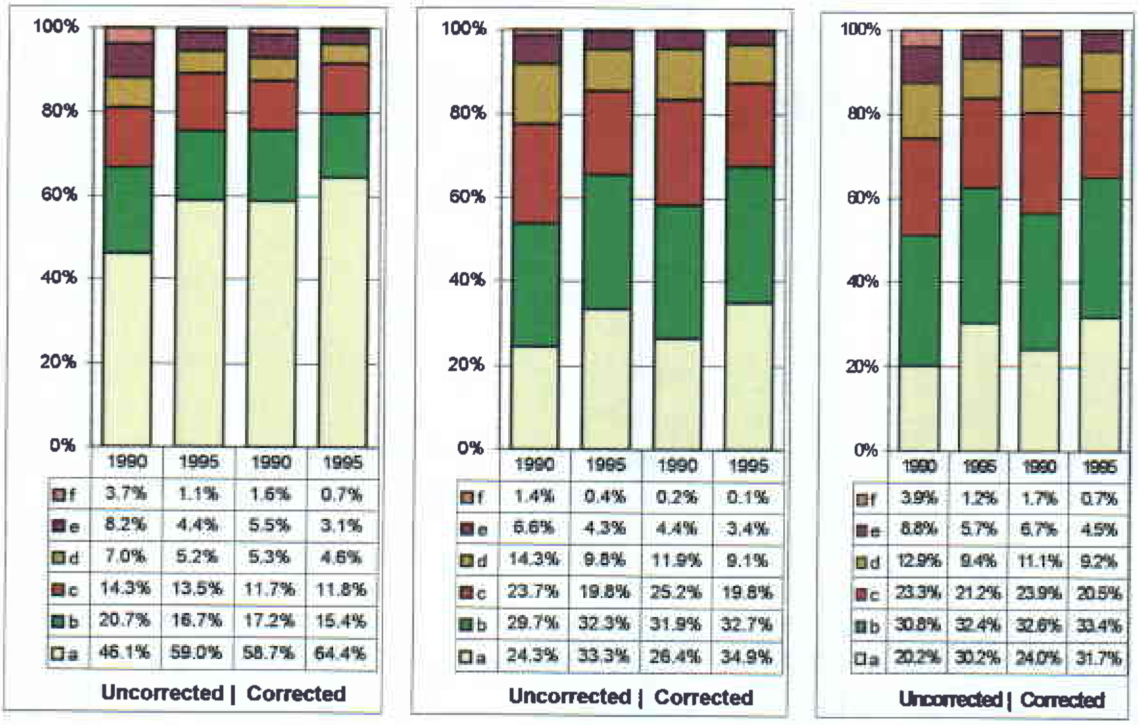
Table 2 A categorization of RIVPACS environmental variables

SIZE	GEOLOGY	LANDSCAPE	SUBSTRATUM
Distance from source (km)	Alkalinity (mg/l $CaCO_3$)	Altitude (m)	Mean substratum (phi units)
Discharge class		Slope (m/km)	%Boulders/Cobbles
Stream width (m)			%Pebbles/Gravel
Stream depth (cm)			%Sand
			%Silt/Clay

An example of the form of output of the analyses undertaken is given in Appendix 8. This example shows improving biological grades with increasing distance from source.

Figure 4 Percentage of all 3018 matched sites in England and Wales in each grade (a-f) in 1990 and 1995, uncorrected (left) and corrected (right) for sample processing biases. Grades based on (a) EQI_{TAXA} (b) EQI_{ASPT} and (c) the overall grade.

(a) grade using EQI_{TAXA} (b) grade using EQI_{ASPT} (c) overall grade



(a)

	1990	1995	1990	1995
f	3.7%	1.1%	1.6%	0.7%
e	8.2%	4.4%	5.5%	3.1%
d	7.0%	5.2%	5.3%	4.6%
c	14.3%	13.5%	11.7%	11.8%
b	20.7%	16.7%	17.2%	15.4%
a	46.1%	59.0%	58.7%	64.4%

(b)

	1990	1995	1990	1995
f	1.4%	0.4%	0.2%	0.1%
e	6.6%	4.3%	4.4%	3.4%
d	14.3%	9.8%	11.9%	9.1%
c	23.7%	19.8%	25.2%	19.8%
b	29.7%	32.3%	31.9%	32.7%
a	24.3%	33.3%	26.4%	34.9%

(c)

	1990	1995	1990	1995
f	3.9%	1.2%	1.7%	0.7%
e	8.8%	5.7%	6.7%	4.5%
d	12.9%	9.4%	11.1%	9.2%
c	23.3%	21.2%	23.9%	20.5%
b	30.8%	32.4%	32.6%	33.4%
a	20.2%	30.2%	24.0%	31.7%

Uncorrected | Corrected

There also appears to be a considerable improvement in the quality of matched sites when assessed using EQI_{ASPT} (Figure 4.1(b)). However, because of the way the separate grade limits for EQI for ASPT and number of taxa were set (Table 1.1), roughly twice as many sites were classed as grade a when assessed by their EQI_{TAXA} as when assessed by their EQI_{ASPT}. The effect of correcting for bias due to sample processing errors is much less for EQI_{ASPT} than for EQI_{TAXA}, especially for 1995. There is still however, a general tendency for estimated site quality based on EQI_{TAXA} to increase slightly when corrected for bias. In particular, the percentage of matched sites graded f on EQI_{ASPT} in 1990 decreased from 1.4% to only 0.4% when corrected for bias (Figure 4.1(b)).

When assessed by their overall grade (i.e. the lower of their grades based EQI_{TAXA} and EQI_{ASPT}), there is marked increase in the percentage of all matched sites grades a and a decrease in sites graded e or f between 1990 and 1995 (Figure 4.1(c)). After correcting for bias, 31.7% of matched sites were classified as grade a in 1995 compared to only 24.0% in 1990, whilst the percentage of sites graded e or worse fell from 8.4% in 1990 to 5.2% in 1995 – suggesting some improvement to an appreciable proportion of the poorest quality sites.

RIVPACS III+ (Clarke *et al.*, 1997) now provides the facility to make statistical comparisons of the significance of apparent changes in the biological grades of sites. Examples of the output of analyses of this kind are shown in Tables 10 and 11.

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 seventh quarter of the work programme from 1st February 1999 (month 19) to 30th April 1999 (month 21).

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
Stage 1: Database development	
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
Stage 2 Unit 1: Taxon distribution studies	
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
Stage 2 Unit 2: Changes in ecological quality	
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
Stage 2 Unit 3: Post-survey appraisal	
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_1 Production of a draft of R&D Technical Report 3	20
u_2 Production of the final copy of R&D Technical Report 3	24
Stage 2 General	
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 21 (April 1999) (Table1) and not previously completed by the beginning of the reporting period. These were:

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_1 To produce a draft of R&D Technical Report 3

2 INTERIM RESULTS

2.1 Data-base Development

2.1.1 Environmental stress data

All environmental stress data were received from all Environment Agency Areas by the end of the reporting period including the Agency's corrections to the first set of data supplied for the Ridings/Aire Area of the former Yorkshire NRA Region.

All data-sets received were first converted into Excel97 files with a standardised format. The data were then scrutinised for any additional errors that had not previously been detected by the Agency or Staffordshire University, or which had been detected by those organisations but not forwarded to IFE. The errors detected and some solutions adopted are shown in Appendix 1.

The original data request required intensity codes to be ascribed to most types of stress, with the exceptions of sampling difficulties associated with single bank access or the use of a dredge or airlift. No stress intensities were required for the codes NI (no information) or NP (no perceived problem). A list of individual site stresses requiring an intensity code, but supplied without it, is included in Appendix 1. All individual cases of stresses not requiring a stress intensity, but supplied with one, are given in Appendix 2.

The following general rules were applied in the stress editing procedure:

- All sites with no listed stress were assigned to the stress code NI

- All sites supplied with the stress code NP and with at least one more stress code had the NP code deleted.

- All sites with intensity codes assigned to stresses where no intensity code was required had the intensity value deleted.

- All sites where the stress qualifier format d/p or p/d was supplied had that format converted to pd, where p = point source stress and d = diffuse source stress

- All entries with the text "ford" in a numbered stress column had that text copied to the additional stresses column of the standard Excel spreadsheet and, where this was the only stress supplied for the site, the code NP was substituted.

- Two separate and differing versions of the stresses operating on the D/S Rostherne Mere site on the Blackburn Brook (NRA code NRA03LIGK) were received from the Northern and Southern Area Laboratories of the North West Environment Agency Region. The submission from the Southern Area was preferentially accepted because this geographic area better matched the National Grid Reference for the site.

New Agency stress codes AD, BM and EU were assigned to the individual categories "Acid deposition", "Boat Moorings" and "Eutrophication" respectively. However, a small number of stress codes remained unknown (Appendix 1) and these are subsequently excluded from analyses.

Once all corrections were made to the Excel files, the revised information was read into a single Minitab file for two further, major amendments:

- All cases of individual site stresses supplied without a stress intensity code had the intensity value 3 (light) ascribed. This was the minimum attainable level that must exist if the stress is definitely present).

- All cases where the symbol "?" was included in any part of the stress code and its intensity and qualifiers had the intensity code 4 (suspected) ascribed to it. This "blanket" approach was adopted because it was felt that a variable approach had been adopted by the different Agency laboratories to the use and positioning of the "?" symbol.

The amended Minitab file was then read into the main MSAccess97 data-base holding the biological and environmental results of the 1995 GQA and the 1990 RQS.

Both the Minitab file and the MSAccess97 database were used in the various subsequent analyses of the data.

In total, stress information was received for 6016 sites. Information was supplied on 154 individual stress types, of which 13 were unknown. The individual stresses were aggregated into 31 major, named categories that were similar but not identical to the major categories listed in the original data request. Details of the information supplied, including stress codes, the distribution of the original intensity values (prior to the amendments made in Minitab and listed above) and the major aggregation categories, are provided in Appendix 3.

Information on the allocation of stress qualifiers to individual stresses is given in Appendix 4.

Similar information to that included in Appendices 3 and 4 is also available by major stress categories and by individual Agency Regions and Areas. The presentation of data by individual areas is considered necessary because of the variable level of detail provided by different respondents.

Stress data, by area, are also being presented in relation to the GQA biological grades of sites and by changes of grade between 1990 and 1995. In the former case, the frequency of occurrence of each of the commonest individual stresses and major stress categories will be presented for sites in each biological grade. In addition, tabulated information will be provided on the most frequently occurring individual stress in each biological grade.

When changes in grade are considered, five categories of site are recognised: sites which have decreased in grade between 1990 and 1995 ($p>0.05$), sites which have decreased in grade between 1990 and 1995 ($p>0.5$), sites which have made no significant change in grade between 1990 and 1995 ($p<0.05$), sites which have increased in grade between 1990 and 1995 ($p>0.5$) and sites which have increased in grade between 1990 and 1995 ($p>0.05$). The frequency of occurrence of each common individual stress in each change of grade category will be plotted and will be sub-divided by individual intensity levels.

2.2 Taxon Distribution Studies

Distribution maps have been produced for each BMWP taxon for both 1990 and 1995. These have been complemented by charts showing the frequency of occurrence of each taxon in six distinct value ranges for eight of the most important RIVPACS variables. Examples are given, in Appendix 5, for two families with differing distribution patterns; Unionidae and Heptageniidae.

Currently, further maps are being produced for each taxon, that are based on approximately 3000 sites that were common to both the 1990 and 1995 surveys. Using separate symbols the distribution of the taxa will be shown in four different classes; taxon present in both 1990 and1995, taxon present in 1990 but not in 1995 ("taxon lost"), taxon absent in 1990 but present in 1995 ("taxon gained") and taxon absent in both years.

These maps will be complemented by tables showing the difference in the environmental characteristics of sites in each of the four categories for each taxon, the tendency for the taxon to be lost or gained as the sites change biological grade, regional differences in the loss and gain of taxa and landscape differences in the loss and gain of taxa. An example of the format of the tabular data is given in Appendix 6 and a map showing the distribution of the four landscape types (sensu Barr *et al.*, 1993) forms Appendix 7.

2.3 Changes in ecological quality

During the previous reporting period (Furse *et al.*, 1999), 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).

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.

In total, 4798 sites were considered from the 1990 RQS and 6016 from the 1995 GQA. All these sites were sampled in either three seasons in 1990 or in two seasons in 1995. Each had a complete set of both biological and environmental data and each appeared to be on a stream or river as opposed to a canal, ditch or drain.

Two sets of RIVPACS predictions were made for each site, one uncorrected for bias and the other corrected for bias. Bias values used were region-specific (Table 1) and were based on the results of IFE audits undertaken in 1990 and 1995.

Table 1 Estimates of average net under-estimation of the number of BMWP taxa (termed the bias) in single season samples taken from each Environment Agency region in the 1990 RQS and 1995 GQA.

Regions in 1990	Bias in 1990	Regions in 1995	Bias in 1995
Anglian	3.40	Anglian	1.98
Northumbrian	2.67	Northumbria & Yorkshire	1.45
Yorkshire	1.13		
North-West	3.13	North-West	2.18
Severn-Trent	3.77	Severn-Trent	1.64
Southern	1.57	Southern	1.02
South-West	1.13	South-West	1.42
Wessex	3.93		
Thames	1.97	Thames	1.78
Welsh	1.95	Welsh	1.73

In 1995, using bias-corrected data and overall band based on both ASPT and number of BMWP taxa indices, IFE analyses resulted in 61% of all sites in England and Wale being graded as "excellent" or "good" (grades a or b), 31% as "fair" or "moderate" (grades c or d), 7% or "poor" (grade e) and only just over 1% as "bad" (grade f) (Figure 1). These percentages agree within ±2% with those derived independently by Tony Warn of the Environment Agency using the an earlier version of the biological database for all sites sampled during the 1995 GQA survey (unpublished report dated August 1996).

Other analyses have considered the distribution of biological grades in relation to pairs of variables from different categories of RIVPACS environmental variables (as shown in Table 2). An example is shown for altitude and distance from source (Table 3).

Table 3 **Percentage of sites in each overall (corrected) biological grade (a-d, e/f) and total percentage of all 1995 sites for each combination of categories of distance from source (km) and altitude (m). Cells are shaded in deciles of percentages to aid interpretation of patterns. Total n = 6016 sites.**

%grade a

	Altitude					
Distance	<16	16-36	37-64	65-99	100-200	>200
<5	6	12	19	17	17	21
5-7.9	27	32	27	27	24	30
8-12.5	22	29	34	25	35	24
12.6-24	34	38	37	35	33	44
24.1-84	48	39	40	38	[illegible]	[illegible]
>84	29	47	45	[illegible]	---	---

%grade b

	Altitude					
Distance	<16	16-36	37-64	65-99	100-200	>200
<5	23	21	21	20	26	38
5-7.9	22	22	24	29	40	42
8-12.5	36	33	25	32	[illegible]	[illegible]
12.6-24	40	30	26	39	41	44
24.1-84	34	31	35	29	39	33
>84	40	37	35	25	---	---

%grade c

	Altitude					
Distance	<16	16-36	37-64	65-99	100-200	>200
<5	32	26	29	28	21	23
5-7.9	29	24	31	25	20	19
8-12.5	21	16	24	25	11	11
12.6-24	18	20	18	19	13	4
24.1-84	10	14	15	18	5	0
>84	12	16	13	0	---	---

%grade d

	Altitude					
Distance	<16	16-36	37-64	65-99	100-200	>200
<5	18	24	23	18	19	10
5-7.9	14	14	13	13	10	9
8-12.5	12	14	11	10	6	11
12.6-24	4	6	12	4	8	4
24.1-84	3	7	5	7	1	0
>84	3	0	6	0	---	---

%grade e/f

	Altitude					
Distance	<16	16-36	37-64	65-99	100-200	>200
<5	21	17	8	17	17	8
5-7.9	8	9	5	7	6	0
8-12.5	9	7	6	8	7	0
12.6-24	4	6	6	3	6	4
24.1-84	5	8	5	7	5	0
>84	16	0	0	0	---	---

number of sites

	Altitude					
Distance	<16	16-36	37-64	65-99	100-200	>200
<5	184	197	198	281	321	39
5-7.9	184	195	228	249	265	57
8-12.5	252	222	224	267	213	46
12.6-24	271	226	271	224	180	27
24.1-84	300	238	232	163	82	3
>84	104	38	31	4	0	0

The relationship between RIVPACS variables (Table 4) and between RIVPACS variables and biological grades (Table 5) has also been examined.

Table 4 Spearman correlations between the RIVPACS environmental variables for the GQA sites in 1995 (n=6016).

	Log Distance	Discharge class	Log Width	Log Depth	Alkalinity	Log Altitude	Log Slope
Discharge class	0.79						
Log Width	0.79	0.83					
Log Depth	0.58	0.53	0.57				
Alkalinity	-0.02	-0.18	-0.18	0.15			
Log Altitude	-0.23	-0.14	-0.14	-0.39	-0.21		
Log Slope	-0.50	-0.37	-0.37	-0.59	-0.35	0.57	
Mean Substratum	-0.04	-0.13	-0.15	0.46	0.42	-0.45	-0.50

The relationships between biological quality and environmental characteristics of sites will be summarized within the framework of the four categories of environmental variables, where appropriate.

Initial correlations and regression analyses relating EQI values to the environmental variables gave many statistically significant relationships because of the large number of sites involved (Table 5). For example, biological quality, as measured by either EQI_{TAXA} or EQI_{ASPT}, shows weak but statistically highly significant (all $p<0.001$) positive correlations with stream size as measured by any of discharge class, distance from source, stream width or depth. However, predictive equations developed from these relationships only forecast relatively small changes in the mean EQI values for different values of the environmental variables.

Table 5 Overall Spearman correlations between EQI values based on number of taxa and ASPT and the RIVPACS environmental variables for the GQA sites in 1995 (n=6016). *,,*** denote correlations significant at the p = 0.05, 0.01 and 0.001 probability level respectively.**

	EQI_{TAXA}	EQI_{ASPT}
Discharge class	0.188***	0.193***
Log Distance	0.240***	0.255***
Log Width	0.214***	0.247***
Log Depth	0.074***	0.136***
Alkalinity	-0.085***	-0.038**
Log Alkalinity	-0.104***	-0.107***
Log Altitude	0.031*	-0.002
Log Slope	-0.004	-0.056***
Mean Substratum	-0.161***	-0.086***
% Cover of boulders/cobbles	0.050***	0.009
% Cover of pebbles/gravel	0.225***	0.168***
% Cover of sand	-0.115***	-0.122***
% Cover of silt/clay	-0.163***	-0.080***

Another way of comparing environmental variable values with biological grades is shown in Table 6, which gives the median value of each of the environmental variables for sites in each of the overall biological grades. Although there are trends in the median values for several environmental variables across the grades, including a decreasing median distance from source (13.2km to 7.8km) with decreasing biological grade (a to f), the differences in the median values tend to be very small in relation to the full range of values obtained (as indicated by the maximum value given in Table 6)

Table 6 Median value of each of the RIVPACS environmental variables for sites in each overall (corrected) biological grade in 1995 (total n = 6016). The maximum value for all sites is included for reference.

	Max	Overall grade (corrected)					
		a	b	c	d	e	f
Distance from source (km)	287	13.2	11.1	7.9	6.4	6.9	7.8
Discharge class	10	3	2	1	1	1	1
Stream width (m)	86	5.6	5	3.2	2.7	3.3	4.4
Stream depth (cm)	1000	21.8	20.3	18.3	16.4	18.2	23.3
Alkalinity (mg/l CaCO3)	592	142	136	180	157	141	137
Altitude(m)	410	46	50	50	51	54	27
Slope (m/km)	200	2.8	3.3	2.9	3.8	3.7	2.0
Mean substrate (phi units)	8	-2.9	-2.7	-1.4	-1.6	-2.3	-0.7
% Boulders/Cobbles	98	22	24	16	20	25	23
%Pebbles/Gravel	97	44	39	35	34	33	20
%Sand	91	7	8	11	13	11	11
%Silt/Clay	100	6	7	15	13	10	16

The assessment of change in biological quality was based on all the Agency sites for which there was suitable data in both years taken from the same or adequately close sampling locations in both years. Such sites are referred to as matched sites.

In the 1990 RQS, the standard sampling protocol was to take a biological sample at each site in each of the three RIVPACS seasons (spring, summer and autumn). For the 1995 GQA survey, the plan was to take just two biological samples at each site, one in the spring and one in the autumn. These formed the standard sampling schemes for each survey. Therefore analyses of changes in biological quality were based on those 3018 matched sites which met these sampling standards.

Examples of the proportions of sites which showed improvement, deterioration or no change in the recorded biological grade between 1990 and 1995 are shown in Tables 7 – 9

Table 7 **Percentage of matched sites in each grade in 1995 (columns), shown separately for sites in each grade in 1990 (rows). Right-hand side columns show the percentages of sites upgraded and downgraded. All site grades are corrected for bias due to sample processing errors. (Total n = 3018 sites).**

(a) grades based on EQI_{TAXA}

		% of sites in grade in 1995								
		59.0	16.7	13.5	5.2	4.4	1.1		% of sites upgraded in 1995	% of sites downgraded in 1995
% of sites in grade in 1990		a	b	c	d	e	f	Total		
46.1	a	90	8	2	0	0	0	100	---	10
20.7	b	52	31	14	2	0	0	100	52	16
14.3	c	21	34	33	10	2	0	100	55	12
7.0	d	8	16	44	21	11	1	100	68	12
8.2	e	2	7	29	28	31	4	100	66	4
3.7	f	0	4	17	17	31	31	100	69	---
Total									24	11

(b) grades based on EQI_{ASPT}

		% of sites in grade in 1995								
		34.9	32.7	19.8	9.1	3.4	0.1		% of sites upgraded in 1995	% of sites downgraded in 1995
% of sites in grade in 1990		a	b	c	d	e	f	Total		
26.4	a	79	20	1	0	0	0	100	---	21
31.9	b	39	53	8	0	0	0	100	39	8
25.2	c	7	38	46	8	1	0	100	45	9
11.9	d	0	7	40	45	7	1	100	47	8
4.4	e	0	1	12	36	51	0	100	49	0
0.2	f	0	0	17	33	50	0	100	100	---
Total									38	10

(c) Based on overall grade

		% of sites in grade in 1995								
		31.7	33.4	20.5	9.2	4.5	0.7		% of sites upgraded in 1995	% of sites downgraded in 1995
% of sites in grade in 1990		a	b	c	d	e	f	Total		
24.0	a	75	23	2				100	---	25
32.6	b	37	54	9				100	37	9
23.9	c	7	39	46	8	1		100	46	9
11.1	d	1	7	44	40	7		100	52	7
6.7	e		1	16	37	42	3	100	54	3
1.7	f			12	19	40	29	100	71	---
Total									34	12

Table 8 **Percentage of matched sites in each region which were upgraded, stayed the same grade, or were downgraded between the 1990 RQS and 1995 GQA surveys based on their overall biological grade corrected for bias.**

Region in 1990	Matched sites	upgraded	same grade	downgraded
Anglian	428	38	51	12
Northumbrian	223	36	55	9
North-West	273	38	49	12
Midlands	576	32	54	14
Southern	280	36	54	10
South-West	279	22	65	13
Thames	221	36	56	8
Welsh	525	31	55	14
Wessex	34	44	47	9
Yorkshire	179	40	48	12
England and Wales	3018	34	54	12

Table 9 **Percentage of matched sites from each region in each overall grade, corrected for bias, in 1995 (columns), shown separately for sites in each grade in 1990 (rows). Right-hand side columns show the percentages of sites upgraded and downgraded.**

(a) Anglian region

		% of sites in grade in 1995							% of sites upgraded in 1995	% of sites downgraded in 1995
		27	44	22	5	1	0			
% of sites in grade in 1990		a	b	c	d	e	f	Total		
18	a	61	37	3	0	0	0	100	---	39
39	b	36	56	8	0	0	0	100	36	8
32	c	6	47	42	4	0	0	100	53	4
7	d	6	3	45	42	3	0	100	55	3
2	e	0	0	30	40	30	0	100	70	0
1	f	0	0	67	0	0	33	100	67	---
Total									38	12

Table 9 (continued)

(b) Northumbrian region

% of sites in grade in 1990		% of sites in grade in 1995						Total	% of sites upgraded in 1995	% of sites downgraded in 1995
		41	28	13	11	6	1			
		a	b	c	d	e	f			
	a	84	16	0	0	0	0	100	---	16
	b	47	48	5	0	0	0	100	47	5
	c	11	36	39	14	0	0	100	46	14
	d	0	8	38	42	12	0	100	46	12
	e	0	0	14	38	48	0	100	52	0
	f	0	0	17	33	17	33	100	67	---
Total									36	9

(c) North-West region

% of sites in grade in 1990		% of sites in grade in 1995						Total	% of sites upgraded in 1995	% of sites downgraded in 1995
		18	35	19	12	12	3			
		a	b	c	d	e	f			
14	a	69	31	0	0	0	0	100	---	31
36	b	27	52	20	1	0	0	100	27	21
13	c	5	27	55	11	1	0	100	32	13
12	d	0	3	41	50	7	0	100	44	7
19	e	2	0	13	33	46	6	100	48	6
6	f	0	0	0	20	60	20	100	80	---
Total									32	14

(d) Midlands region

% of sites in grade in 1990		% of sites in grade in 1995						Total	% of sites upgraded in 1995	% of sites downgraded in 1995
		15	24	35	18	7	1			
		a	b	c	d	e	f			
11	a	69	31	0	0	0	0	100	---	31
20	b	27	52	20	1	0	0	100	27	21
38	c	5	27	55	11	1	0	100	32	13
21	d	0	3	41	50	7	0	100	44	7
9	e	2	0	13	33	46	6	100	48	6
1	f	0	0	0	20	60	20	100	80	---
Total									32	14

Table 9 (continued)

(e) Southern region

		% of sites in grade in 1995								
		44	36	14	5	1	0			
% of sites in grade in 1990		a	b	c	d	e	f	Total	% of sites upgraded in 1995	% of sites downgraded in 1995
29	a	84	14	2	0	0	0	100	---	16
36	b	45	50	5	0	0	0	100	45	5
28	c	12	48	31	8	1	0	100	60	9
7	d	0	15	30	45	10	0	100	45	10
1	e	0	0	50	0	50	0	100	50	0
0	f							100	---	---
Total									36	10

(f) South-West region

		% of sites in grade in 1995								
		58	37	5	1	0	0			
% of sites in grade in 1990		a	b	c	d	e	f	Total	% of sites upgraded in 1995	% of sites downgraded in 1995
52	a	78	22	0	0	0	0	100	---	22
39	b	39	56	5	0	0	0	100	39	5
7	c	26	42	32	0	0	0	100	68	0
2	d	0	20	40	40	0	0	100	60	0
1	e	0	0	0	100	0	0	100	100	0
0	f							100		---
Total									22	13

(g) Thames region

		% of sites in grade in 1995								
		32	27	10	4	4	0			
% of sites in grade in 1990		a	b	c	d	e	f	Total	% of sites upgraded in 1995	% of sites downgraded in 1995
21	a	85	13	2	0	0	0	100	---	15
31	b	40	51	9	0	0	0	100	40	9
25	c	7	29	56	7	0	0	100	36	7
13	d	0	10	59	31	0	0	100	69	0
10	e	0	0	24	29	43	5	100	52	5
1	f	0	0	0	100	0	0	100	100	---
Total									36	8

Table 9 (continued)

(h) Welsh region

		% of sites in grade in 1995							% of sites upgraded in 1995	% of sites downgraded in 1995
		35	40	19	5	2	0			
% of sites in grade in 1990		a	b	c	d	e	f	Total		
30	a	72	25	3	0	0	0	100	---	28
36	b	35	55	9	1	1	0	100	35	10
23	c	4	44	46	6	0	0	100	48	6
8	d	0	24	40	29	5	2	100	64	7
3	e	0	7	27	33	33	0	100	67	0
0	f	0	0	100	0	0	0	100	100	---
Total									31	14

(i) Yorkshire region

		% of sites in grade in 1995							% of sites upgraded in 1995	% of sites downgraded in 1995
		27	22	18	16	13	3			
% of sites in grade in 1990		a	b	c	d	e	f	Total		
25	a	75	18	7	0	0	0	100	---	25
20	b	44	47	8	0	0	0	100	44	8
15	c	0	46	46	8	0	0	100	46	8
17	d	0	7	40	40	13	0	100	47	13
13	e	0	4	4	46	38	8	100	54	8
11	f	0	0	11	16	58	16	100	84	---
Total									40	12

Figure 4 shows overall percentage of the matched sites in England and Wales assigned to each grade in 1990 and 1995. When uncorrected for biases, there appears to be a substantial increase in quality between 1990 and 1995 based on EQI for number of taxa (Figure 4.1(a)). Only 46.1% of sites were graded a in 1990 compared to 59.0% in 1995; whilst 3.7% of matched sites were graded f in 1990, but this fell to only 1.1% in 1995. Correcting for biases always increases the estimated EQI based on number of taxa. However, because sample processing biases were generally greater in 1990 than 1995 (Table 1), the effect of correcting for biases is to increase the estimated EQI values for 1990 more than the values for 1995, so the size of the estimated inter-year differences are reduced. For example, once corrected for bias, 58.7% of sites for grade a in 1990 compared to 64.4% in 1995, an improvement of 5.7% compared to a corresponding estimated improvement of 12.9% if biases are ignored. Even after correcting for bias, there were less than half as many (0.7% versus 1.6%) sites graded f in 1995 compared to 1990 (Figure 4.a).

Table 10 Percentage of sites in each NRA region in 1990 which by 1995 were either a poorer graded (downgraded) or a better grade (upgraded) with >50%, >75% or >95% probability.

Region in 1990	Matched sites	downgraded			same grade	upgraded		
		>95%	>75%	>50%		>50%	>75%	>95%
Anglian	428	0.2	1.6	7.7	55.4	20.1	10.7	4.2
Northumbrian	223	0.0	2.7	5.4	57.4	16.6	13.0	4.9
North-West	273	1.1	2.9	6.6	54.6	13.2	16.1	5.5
Midlands	576	0.9	3.3	8.0	57.8	17.5	9.7	2.8
Southern	280	0.4	2.9	4.3	57.9	17.1	13.6	3.9
South-West	279	0.7	1.8	7.2	72.8	10.4	5.7	1.4
Thames	221	0.5	1.4	3.2	59.3	17.6	12.2	5.9
Welsh	525	1.0	3.6	6.7	60.8	12.6	11.0	4.4
Wessex	34	0.0	0.0	2.9	55.9	20.6	17.6	2.9
Yorkshire	179	1.1	2.8	6.1	55.3	15.1	11.7	7.8
England and Wales	3018	0.7	2.7	6.5	59.0	15.8	11.3	4.2

Table 11 Percentage of sites which were either a poorer graded (downgraded) or a better grade (upgraded) in 1995 with >50%, >75% or >95% probability, in relation to the 'face' change in overall grade (corrected for bias).

'Face' change in overall grade	Matched sites	downgraded			same grade	upgraded		
		>95%	>75%	>50%		>50%	>75%	>95%
Down 3 grades	1	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Down 2 grades	23	56.5	43.5	0.0	0.0	0.0	0.0	0.0
Down 1 grade	342	1.8	20.5	50.3	27.5	0.0	0.0	0.0
same grade	1635	0.0	0.0	1.4	94.4	4.2	0.0	0.0
Up 1 grade	888	0.0	0.0	0.0	16.1	45.8	32.5	5.5
Up 2 grades	117	0.0	0.0	0.0	0.0	0.0	44.4	55.6
Up 3 grades	11	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Up 4 grades	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0
England and Wales	3018	0.7	2.7	6.5	59.0	15.8	11.3	4.2

On-going analyses include the relationship between RIVPACS variables and the occurrence of environmental stresses and these outputs will resemble the bar chart outputs for individual taxa shown in Appendix 5.

2.4 Post-survey Questionnaire

A post-survey, user-questionnaire on the 1995 GQA, developed during the previous reporting period, was the subject of a meeting between Dr R A Dines (Environment Agency Project Manager) and Dr J A D Murray-Bligh (Environment Agency Project Board Member) and the authors of this Progress Report.

Following these discussions, the original document was shortened and divided into two parts, the main questionnaire (Appendix 9) and an optional supplementary questionnaire (Appendix 10). Copies were circulated to a person in each Environment Agency Region nominated by Dr Dines. Copies of each part of the questionnaire were also sent to the Scottish Environment Protection Agency (SEPA) and the Department of the Environment (Northern Ireland), primarily for their information but with the option that they could complete and return them if they wished.

Copies were circulated by post and by e-mail on 1st April, with a request that they should be returned to IFE by the 3rd May if possible. By that date, which is three days after the end of the current reporting period, the only replies received were from North East Region of the Agency and from Northern Ireland. The latter reply was received electronically less than 24hrs after circulation.

3 PLANS FOR THE NEXT REPORTING PERIOD

The next reporting period is the last for the project and runs from 1st May 1999 (Month 22) to 31st July 1999 (Month 24).

During this period it is intended to complete all those tasks listed in Table 1.

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

Most elements of the project are still running behind schedule but a considerable amount of time has been made up over the past quarter.

It is intended to deliver the contract on time but this will require a rapid turn around in comments on the draft reports that form the major outputs of the project. It also assumes that the customer is largely satisfied with the products and that no major revisions or additions to the text are required.

It is now certain 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 financial position of the project needs to be checked in order to ensure that full note has been taken of the implications of the delay in the project start date. When this occurred it was agreed by IFE and the Agency 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, should have been paid by the end of March 1999 (Furse *et al.* 1997). This is possible because of the collaborative nature of the project.

The financial summary for the previous quarter is normally obtainable from the IFE Finance Office approximately two months after the end of the period/financial year in question. This will provide confirmation of whether all payments to IFE have been paid by the Agency, except the 10% retainer that the Agency withholds until delivery, by the customer, of all outputs

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

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Furse, M T, Symes, K L and Clarke, R T (1997) *Analysis of 1995 biological survey data and RIVPACS update. Phase 2. Post-survey appraisal. Progress report EMA 036/pr1 for the period from 22nd July to 31st October 1997.* A Progress Report to the Environment Agency.

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Appendix I Problems in the stress data-sets provided by the Environment Agency via John Murray-Bligh and Staffordshire University.

PROBLEMS IN THE STRESS DATA-SETS PROVIDED BY JOHN MURRAY-BLIGH AND THE SOLUTIONS ADOPTED

UNKNOWN STRESS CODES

SITE_REF	OLD_CODE	WATERCOURSE	LOCATION	NGR	GRADE	QA	STRESS PROBLEM 1	CORRECTION 1	STRESS PROBLEM 2	CORRECTION 2	STRESS PROBLEM 3	CORRECTION 3
100009700	NRA030794	WHIT BECK	AT NY156249	NY15602490	B	2	AF3					
100011052	NR09.6707	WYLYE	HENSFORD MARSH (93**)	ST878 437	B	4	AF3					
100006440	NRA0307PS	ST JOHNS BECK	20M U.S. THRELKELD BRIDGE	NY31502450	B	3	BL3					
100006400	NRA030438	STONEHWAITE BECK	70M D.S. BRIDGE ON TRACK	NY25801500	B	3	BL2					
1000102	NRA011209	LARK	TOLLGATE BRIDGE	TL852066	C	2	CR2					
1000102	NRA011222	NAR	B1145 RD BR AT MILEHAM	TF906018	C	6	EIA3					
100001174	NRA044043	COTGRAVE BROOK	U/S POLSER BROOK	SK62503720	D		JT1					
100007492	NRA03RJQS	ENGLESEA BK	U/S CREWE HALL (WELLCOM	SJ74305376	C	5	LM?3					
100007487	NRA03RGYS	ROF STREAM	PTC VALLEY BROOK RADWA	SJ77845449	F	4	MR?3					
100002055	NRA051027	EDEN (05)	CATERFIELD BRIDGE	TQ40234782	B	3	PG?3					
100000609	NRA045939	PAUPERS DRAIN	LEAM HOUSE EASTOFT	SE80501440	C		SO2					
1000103	NRA011292	COLNE	GREAT YELDHAM RD BR	TL760038	C	1	UK3sd					
100001169	NRA044507	BAKER LANE BROOK	LEEN CONFLUENCE	SK54904830	B		VR2		VS2			
100001109	NRA044134	MELTON BROOK	BELGRAVE	SK60100740	D		VR1					
100011831	NRA045321	R.EREWASH	ILKESTON	SK47304240	E		VR2		VS2			
100011834	NRA045324	R.EREWASH	NEW INLET ATTENBOROUGH	SK50803350	D		VR2		VS2			
100011828	NRA045318	R.EREWASH	PINXTON STATION	SK45605440	D		VR2		VS2			
100011829	NRA045319	R.EREWASH	PYE BRIDGE	SK44305280	E		VR2		VS2			
100011832	NRA045322	R.EREWASH	STANTON GATE	SK48403830	D		VR2		VS2			
100011833	NRA045323	R.EREWASH	TOTON	SK50303410	D		VR2		VS2			
100011830	NRA045320	R.EREWASH	U/S MILNHAY WRW	SK45304720	D		VR2		VS2			
100001128	NRA044319	SCALFORD BROOK	MELTON	SK75701890	C		VS2					
100010699	NR09.5406	BISS	U/S TROWBRIDGE STW	ST85755835	B	4	VS3					

PROBLEMS IN THE STRESS DATA-SETS PROVIDED BY JOHN MURRAY-BLIGH AND THE SOLUTIONS ADOPTED

SITES WITH ILLEGAL CODES

SITE_REF	OLD_CODE	WATERCOURSE	LOCATION	NGR	GRADE	QA	STRESS PROBLEM 1	CORRECTION 1	STRESS PROBLEM 2	CORRECTION 2	STRESS PROBLEM 3	CORRECTION 3
1000103	NRA011305	ALDE	BRUISYARD CHURCH LANE F	TM250066	C	3	TSIP	TS1p	SESP/D			
1000104	NRA011152	DEBEN	BARLEY FARM	TM201061	B	2	AR1/AG1	AR1 & AG1 both used				
1000103	NRA011246	DOVE	COLLINGSFORD BRIDGE	TM123067	C	2	PI3 d	PI3d				
1000102	NRA011213	THET	FORD @ SOUTH END	TL984090	C	1*	Watton produce Ltd	Move to extra stress				
1000032	NRA010642	WATTON BROOK	LT CRESSINGHAM RB (PILGRI	TF872000	B	1	1	NI				
1000098	NRA011103	SHARNBROOK (YELNOE B	YELNOE BRK RUSHTON RD B	SP997059	C	2	Unilever Research Farm	Move to extra stress				
1000033	NRA010712	MIDDLETON STOP DRN	MIDDLETON TOWERS BR	TF668017	B	3	IS2(sand)	(sand) to extra stress				
1000034	NRA010472	BARTON BROOK	IRON BRIDGE HANSCOMBE E	TL110033	D	2?	P/DI?	Delete				
100006477	NRA030ASW	CRUMMOCK BECK	15M U.S. BRIDGE AT ABBEYT	NY17605020	C	5	1S2	IS2				
100006831	NRA0314L4	KENT	25M U/S KENDAL STW OUTFA	SD51309010	C	3	*AC	AC				
100006832	NRA0314TG	KENT	AT SEDGWICK	SD50808720	B	3	*AC	AC				
100006482	NRA030B6S	WAMPOOL	5M D.S. BRIDGE AT LAYTHES	NY24305560	C	6	,	Delete				
100009638	NRA03QNN8	BEAL	PTC PIETHORNE BROOK	SD93691138	E	6	SH3pUR2	SH3p & UR2 both used				
100007238	NRA03MNTG	LOACH BK	SOMERFORD PARK			4	L13	LI3				
100009650	NRA03T5M4	RIVACRE BROOK	D/S A41	SJ37907485	D	6	UR?p	Delete but keep UR3				
100010803	NRA03QH8O	ROCH	PTC RIVER BEAL	SD91361464	E	6	uR3d	UR3d				
100002706	NRA043713	ARROW (04)	SPERNAL LANE	SP08506220	D	3*	1*	Delete				
100011724	NRA043734	ARROW RIVER	SALFORD PRIORS	SP08305130	B	1*	1*	Delete				
100002734	NRA042302	CAREYS BROOK	CONFLUENCE SEVERN	SO84805070	B	3	CL£	CL3				
100011621	NRA041905	COUND BROOK	STAPLETON BRIDGE US CON	SJ47700430	B		ST2-autumn only	"autumn only" to extra stress				
100003579	NRA043908	ITCHEN (04)	FORD FARM	SP40406270	C		?	NI				
100011816	NRA045110	R.WYE	KINGSTERNDALE	SK09307240	D		QBI	QB1				
100003596	NRA043936	RADFORD BROOK	A425 ROAD BR RADFORD SE	SP33806500	C	2	2*2	Delete				
100002681	NRA041406	SOULTON BROOK	SOULTON B5065 BRIDGE	SJ54603030	C		brook ditch	Move to extra stress				
100011744	NRA043971	STOWE RIVER	DOWNSTREAM NAPTON WR	SP45906070	C	3*	2*2	Delete				
100000460	NRA045208	WESTWOOD BK	U/S MORTON MINEWATER	SK41906030	C		?FA2	FA?2				
100002041	NRA051013	WEST HOATHLY STREAM	BLACKLAND WOOD	TQ37623371	C	2	FE1d?3	FE1d?				
100009554	NR06.2972	WEST OKEMENT	30M U/S MELDON QUARRY B	SX56649331	B	4*	R2?	RE2				
100004724	NRA08W219	TEIFI	PONT EYNON TREGARON	SN67108140	B	*	see note last col	Delete text				
100010432	NR09.3503	WASHFORD RIVER	ROADBRIDGE (D/S ROADWAT	ST03013820	A	2	FF£	FF3				
	NR10.2223	MILLSHAW BECK	NR. TIP	SE28702790	D	4	T12?	TI2?				
	NR10.2352	HUNSWORTH BECK	U/S NORTH BIERLEY STW	SE17802780	E	3	2CS3	CS3				
100001462	NR10.0166	GYPSEY RACE	BRIDLINGTON	TA16606760	F	1*	LF1s/c	LF1sc				

PROBLEMS IN THE STRESS DATA-SETS PROVIDED BY JOHN MURRAY-BLIGH AND THE SOLUTIONS ADOPTED

SITES WITH MISSING INTENSITIES

SITE_REF	OLD_CODE	WATERCOURSE	LOCATION	NGR	GRADE	QA	STRESS PROBLEM 1	CORRECTION 1	STRESS PROBLEM 2	CORRECTION 2	STRESS PROBLEM 3	CORRECTION 3
1000030	NRA010907	CHAD BROOK	BRIDGE ST A134 RD BR	TL878049	B	1	WI					
1000102	NRA011153	CHELMER	LANGLEYS BRIDGE	TL637020	B	1	TS					
1000102	NRA011169	COLNE	MIDDLE MILL	TL997025	B	2	UR		CL4			
1000029	NRA010946	COLNE (01)	EARLS COLNE RD BR	TL866528	B	1	CS					
1000028	NRA010943	COLNE (01)	DOES CORNER	TL806032	B	2	CL		CS			
1000029	NRA010942	COLNE (01)	HOVIS MILL	TL792533	B	2	CL		AG			
1000030	NRA010940	COLNE (01)	NUNNERY BRIDGE	TL777035	B	3	CL		IR		AG	
1000030	NRA010941	TOPPESFIELD BK	A604 RD BR	TL762037	C	2	WI		IA			
1000029	NRA010939	HOLLAND BROOK	MAIN DRAIN RD BR	TM210017	C	1	RF					
1000029	NRA010960	ROMAN	BOUNSTEAD BRIDGE	TL985220	B	1	WE					
1000102	NRA011179	ROMAN R	STANWAY BRIDGE	TL934024	C	1	HY					
1000029	NRA010917	STOUR (01)	FT BR D/S STRATFORD INTAK	TM042034	B	2	IA		WE			
1000029	NRA010915	STOUR (01)	BOXTED MILL	TM012534	B	1	IA					
1000102	NRA011181	STOUR	BURES MILL	TL912033	B	1	IA					
1000029	NRA010910	STOUR (01)	PITMIRE RAILWAY BRIDGE	TL890936	A	1	IA					
1000102	NRA011182	STOUR	BAKERS MILL	TL882039	B	2	LI		UR			
1000028	NRA010903	STOUR (01)	LISTON WEIR	TL856745	B	2	IA		WE			
1000030	NRA010901	CHILTON BK	FOLLY RD BR CHILTON ST	TL757046	C	1	IA					
1000102	NRA011184	STOUR	ASHEN RD BR CLARE	TL767044	B	1	IA					
1000030	NRA010896	STOUR (01)	R STOUR BAYTHORNE END B	TL723043	B	1	IA					
1000030	NRA010900	BUMPSTEAD BROOK	WATSOE BRIDGE	TL707042	C	1	IA					
1000102	NRA011185	STOUR	NEAR HILLE ENGINEERING LT	TL678044	C	2	WI		SS			
1000029	NRA010893	STOUR (01)	LT THURLOW CHURCH BRIDG	TL680051	B	1	WE					
1000103	NRA011305	ALDE	BRUISYARD CHURCH LANE F	TM250066	C	1	SESP/D					
1000044	NRA010739	GUNTHORPE STRM	GUNTHORPE STR THORNAG	TG048036	A	1	TSP					
1000103	NRA011262	BUTLEY CREEK	LOWER CORNER BUTLEY	TM368051	B	1	LP					
1000044	NRA010862	BUTLEY	BUTLEY MILL	TM385051	B	1	RO					
1000032	NRA010534	CAM (01)	DERNFORD LOCK GAUGING S	TL467050	B	1	RN					
1000103	NRA011225	GRAND UNION CANAL	BOWLERS BRIDGE SIMPSON	SP880036	B	1	CN					
1000033	NRA010721	BABINGLEY RIVER	ESTUARY FARM RD N WOOT	TF625024	B	2	AT					
1000033	NRA010698	CUT OFF CHANNEL	ERISWELL HALL FARM BR	TL718080	B	4	RF					
1000033	NRA010696	CUT OFF CHANNEL	HILGAY BR A10	TL622099	B	3	RF					
1000102	NRA011221	CUT OFF CHANNEL	STOKE FERRY WTW INTAKE	TL698098	A	3	RF					
1000033	NRA010695	FLOOD RELEIF CHANNEL	SADDLEBOW BRIDGE	TF609015	D	4	IS		SP			
1000033	NRA010693	FLOOD RELIEF CHANNEL	DOWNHAM BRIDGE	TF601003	D	4	IS		SP			
100000849	NR02.2200	WEAR	EASTGATE	NY95703840	B	5*	BG					
100000858	NR02.2290	MOORS BURN	RAINTON BRIDGE	NZ33604880	C	3	BG					
100000868	NR02.2390	PITTINGTON BURN	PITTINGTON	NZ32404470	E	2*	NF					
100000874	NR02.2450	BOWBURN BECK	TURSDALE HOUSE	NZ29703680	E	6*	DN					
100000891	NR02.2620	BRANLEPETH BURN	PAGEBANK	NZ23603590	C	3*	LF					
100000916	NR02.2870	CASTLEEDEN BURN	HORDEN	NZ44704040	E	4*	NF					
100011456	NR02.2875	CASTLE EDEN BURN	U/S A19 ROAD BRIDGE	NZ40803880	E	5	LF					
100009688	NRA0303H0	DERWENT	10M U.S. OUSE BRIDGE	NY20003210	C	4	LP*					
100009772	NRA031EUK	GOLDMIRE BECK	PTC POAKA BECK	SD21807300	D	2*	NFs					
100006828	NRA0314CS	KENT	15M PTC R.SPRINT	SD50709540	B	3	CL					

PROBLEMS IN THE STRESS DATA-SETS PROVIDED BY JOHN MURRAY-BLIGH AND THE SOLUTIONS ADOPTED

SITES WITH MISSING INTENSITIES

SITE_REF	OLD_CODE	WATERCOURSE	LOCATION	NGR	GRADE	QA	STRESS PROBLEM 1	CORRECTION 1	STRESS PROBLEM 2	CORRECTION 2	STRESS PROBLEM 3	CORRECTION 3
100006900	NRA031E2S	KIRKBY POOL	D/S WREAKS CAUSEWAY EN	SD23208620	B	5	CL					
100006436	NRA0307EO	PARK BECK (03)	AT NY144205	NY14402050	A	2	LP*					
100006821	NRA031318	PEASEY BECK	PTC FARLETON BECK	SD52908260	B	3	WDs					
100006907	NRA031EP0	POAKA BECK	PTC GOLDMIRE BECK	SD21907300	E	3*	NFs					
100006440	NRA0307PS	ST JOHNS BECK	20M U.S. THRELKELD BRIDGE	NY31502450	B	3	RE*					
100006458	NRA03093S	TRIBUTARY FROM OVERWAT	AT NY255354	NY25503540	B	4	LP*					
100007147	NRA033SYK	BACK DRAIN	CROSSENS P.S.	SD37702060	C	10	IA					
100007132	NRA033Q6K	DOWNHOLLAND BROOK	PTC RIVER ALT	SD30800580	E	5	WDs					
100007129	NRA033PKC	MAGHULL BROOK	MAGHULL U/S RIVER ALT	SD36200280	E	7	IA					
100006739	NRA030VV8	RAIS BECK	PTC RIVER LUNE	NY63600590	B	*5	AI*					
100002018	NRA041112	AFON TWRCH	PONT TWRCH	SH99001150	B	2	CFd					
100000469	NRA045021	BOTTLE BROOK	LUMB FARM	SK40004850	D		IA					
100000470	NRA045022	BOTTLE BROOK	U/S DENBY POTTERY	SK39204750	E		MI					
100000507	NRA045721	BROAD BRIDGE DYKE	CONFLUENCE	SK50608230	F		SH					
100000506	NRA045720	BROAD BRIDGE DYKE	U/S KIVETON PARK WRW	SK49208210	D		SH					
100000456	NRA045204	HEAGE BK	AMBERGATE	SK35705170	E		OH					
100002009	NRA041054	REA BROOK	MALEHURST	SJ38300640	B	1	CA					
100000563	NRA045807	ST CATHERINES WELL STRE	MILL BRIDGE LOVERSALL	SK57309850	D		IAZ					
100000461	NRA045209	WESTWOOD BK	WESTHOUSES	SK42005740	C		OH*					
100002349	NRA054130	POLES LANE STREAM	OTTERBOURNE	SU46192338	B	5	LFs					
100006173	NR06.1922	FAL	KERNICK BRIDGE	SW93215462	D	4	DEpa					
100006072	NR06.2702	STRAT	HELE BRIDGE	SS21820377	A	2	SLp					
100003505	NR06.3203	EAST LYN	LYNMOUTH OAKLEIGH U/S FT	SS72584933	B	2*	SB					
100005472	NR06.0902	ERME	10M U/S BR LOWER KEATON	SX64035449	B	3*	SB					
100005206	NR06.0501	EXETER CANAL	30M U/S A379 BR COUNTESS	SX93958940	C	2	SB					
100005162	NR06.0101	LIM	25M U/S BRIDGE MILL GREEN	SY34009253	B	4*	US		SB			
100005262	NR06.0526	MADFORD	25M U/S CULM BRIDGE HEMY	ST14351352	A	4*	FA					
100010641	NR09.4938	CONGYRE/NEWTON BROOK	U/S CONFL. WITH BRISTOL A	ST71806560	A	3	BG					
100010506	NR09.4010	FIVEHEAD RIVER	FIVEHEAD BRIDGE (43M D/S B	ST35842188	A	2*	NFs					
100010451	NR09.3708	HAYWARDS WATER	BRADFORD-ON-TONE (45M U/	ST16952268	B	2	PRs					
100010779	NR09.6102	LITTLE AVON	WICKWAR D/S STW	ST72708970	A	4	SF					
100010778	NR09.6101	LITTLE AVON	WICKWAR U/S STW AT HORS	ST72758893	A	2	LF		SF			
100010741	NR09.5613	SNAILS BROOK	10 M U/S RADSTCK BRIDGE	ST68905460	A	3	CL					
100010745	NR09.5617	SOMER	D/S CHILCOMPTON STW	ST65605330	B	3	OH					
100010449	NR09.3706	TONE RIVER	BELOW FOX BROS. OUTFALL,	ST12902206	B	2	LV					
100010651	NR09.4948	WARMLEY BROOK	WARMLEY U/S ROAD BRIDGE	ST67207360	B	4	PRs					
100010435	NR09.3506	WASHFORD RIVER	WHITEHALL BRIDGE (20M U/S	ST06964330	A	6	PRs					
100010731	NR09.5603	WELLOW BROOK	D/S WELLOW STW	ST75105820	A	2	CL					
	NR10.2436	OULTON BECK	D/S LEMON ROYD STW	SE38202770	E	1*	CA*					
100001404	NR10.0108	DERWENT (10)	LOFTSOME BRIDGE	SE70503010	A	3*	RF					
100001406	NR10.0110	DIBB	HARTLINGTON BRIDGE	SE04006090	A	2*	RF		RE			
100012014	NR10.0939	POCKLINGTON CANAL	CHURCH BRIDGE	SE78504520	A	3*	CN					
100007580	NR10.0582	POCKLINGTON CANAL	HAGG BRIDGE	SE71704510	B	3*	CN					
100001821	NR10.0525	SELBY CANAL	BRAYTON	SE61003030	C	3*	CN					
100012027	NR10-0952	SKERNE	AYCLIFFE	NZ28602260	E	3*	WDS					

Appendix 2 **Sites with individual stress categories with unwanted intensity values in the data-sets provided by the Environment Agency via John Murray-Bligh and Staffordshire University.**

SITES WITH UNWANTED INTENSITIES IN THE STRESS DATA-SETS PROVIDED BY JOHN MURRAY-BLIGH

OLD NRA SITE CODE	RIVER NAME	SITE NAME	NGR
STRESS DR (Dredge) Stress = ?			
NR09.4321	BRUE	30M D/S BRIDGE, ABBOTS FISH HOUSE, MEARE	ST45854180
NRA010492	KYM	STONELY FOOTBRIDGE	TL105066
NRA08E054	HOW CAPLE BROOK	AT TOTNOR	SO59683110
NRA08E407	TARRINGTON BROOK	NR TARRINGTON	SO61304210
NR09.4408	CHEDDAR YEO	10M U/S BOW BRIDGE, CROSS	ST41155454
NR09.4406	CHEDDAR YEO	10M U/S FOOTBRIDGE, D/S HYTHE STW	ST43805220
NR09.4405	CHEDDAR YEO	240M D/S B3151 BRIDGE, HYTHE	ST44565217
NR10.2196	STOCKLEY BROOK	D/S GLAPWELL COLLIERY	SK46306760
STRESS DR (Dredge) Stress = 3			
NRA010073	LYMN / STEEPING	PARTNEY	TF402067
NRA010279	BRAMPTON BRANCH	R NENE BOUGHTON CROSSING	SP735065
NRA010244	GLEN (01)	KATE'S BRIDGE A15	TF105014
NRA010298	ISE	GEDDINGTON A43 ROAD BRIDGE	SP894082
NRA010597	KENNET (01)	RED LODGE BRIDGE A11	TL693069
NRA010700	NAR	LITCHAM RD BR	TF888017
NRA051349	BROOK FARM STREAM	HOLIDAY CAMP ROAD	TR23006900
NRA051105	LITTLE STOUR	BLUE BRIDGE	TR24226203
NRA051318	TEISE	GOUDHURST INTAKE	TQ70743713
NR09.4941	BRISTOL AVON	BITTON	ST68306890
NR09.4944	BRISTOL AVON	COWHAM HANHAM GREEN	ST64706980
NR09.4940	BRISTOL AVON	SALTFORD	ST69206790
NR09.4929	BRISTOL AVON	U/S BRADFORD ON AVON STW BARTON FM COUNTRY PK	ST81606050
NR09.4918	BRISTOL AVON	U/S LACKHAM COLLEGE STW D/S CHIPPENHAM STW	ST92107030
NR09.4908	BRISTOL AVON	U/S MALMESBURY STW D/S A429 ROAD BRIDGE	ST94158690
NR09.4933	BRISTOL AVON	WARLEIGH	ST79206445
NR09.4937	CONGYRE BROOK	NEW BRIDGE D/S TWERTON	ST71706570
NR10.2337	CUDWORTH DIKE	D/S CUDWORTH STW	SE38900740
NR10.2512	SCURF DYKE	SCURF DYKE FARM	TA04905070

SITES WITH UNWANTED INTENSITIES IN THE STRESS DATA-SETS PROVIDED BY JOHN MURRAY-BLIGH

OLD NRA SITE CODE	RIVER NAME	SITE NAME	NGR
STRESS DR (Dredge) Stress = 2			
NRA010040	WAITHE BECK	A1031	TA313000
NRA010041	WAITHE BECK	D/S TETNEY	TA324001
NRA010001	WINTERTON BECK	WEST HALTON	SE911020
NRA010238	WEST GLEN	LITTLE BYTHAM BRIDGE	TF019017
NRA010240	WEST GLEN	BANTHORPE LODGE	TF068011
NRA011079	NENE	NEWMHAM	SP579059
NRA010297	ISE	RUSHTON ROAD BRIDGE	SP840082
NRA011078	ISE	BARFORD BR, (D/S RUSHTON STW)	SP860083
NRA010608	LITTLE OUSE /B'DALE	BLO NORTON FORD	TM012079
NR02.0030	WHITEADDER (02)	NEWMILLS	NT95802600
NRA042319	LEADON	WEDDERBURN BRIDGE	SO77602340
NRA051161	BREDE	FERRY BRIDGE	TQ90361797
NRA051347	FROGNALL DRAIN	D/S TEYNHAM STW O/F	TQ95706398
NRA051095	GREAT STOUR	BRETTS	TR18766019
NRA051302	MEDWAY	TESTON BRIDGE	TQ70955340
NRA051011	MEDWAY	EAST FARLEIGH	TQ73465351
NRA051300	MEDWAY	U/S SPRINGFIELD INTAKE	TQ75255698
NRA051301	MEDWAY	U/S TREBOR SHARPS LTD	TQ75755582
NRA051107	NORTH STREAM (LYDDEN)	OLD DOWNS FARM	TR35125700
NRA051053	TEISE	LADDINGFORD	TQ69094882
NRA08E082	LITTLE LUGG	U/S WITHINGTON MARSH BROOK	SO55304437
NRA08E083	WITHINGTON MARSH BROOK	AT WITHINGTON MARSH	SO55354440
NR09.4942	BRSITOL AVON	KEYNSHAM D/S WIER U/S ROAD BRIDGE	ST66006890
NR09.7103	STOUR	BLACKWATER JUNCTION (91**)	SZ136 958
NR09.7112	STOUR	HAMMOON (95**)	ST820 147
NR09.7113	STOUR (09)	STURMINSTER NEWTON (90**)	ST782 135
NR09.4206	WRIGGLE	TRILL HOUSE DAIRY	ST59001240
NRA010035	LACEBY BECK	R FRESHNEY BOULEVARD AVE	TA260010
NRA010031	LACEBY BECK	TRACK TO MANOR TOP FARM	TA223005

SITES WITH UNWANTED INTENSITIES IN THE STRESS DATA-SETS PROVIDED BY JOHN MURRAY-BLIGH

OLD NRA SITE CODE	RIVER NAME	SITE NAME	NGR
STRESS DR (Dredge) Stress = 1			
NRA010035	LACEBY BECK	R FRESHNEY BOULEVARD AVE	TA260010
NRA010031	LACEBY BECK	TRACK TO MANOR TOP FARM	TA223005
NRA010032	LACEBY BECK	LACEBY	TA217006
NRA010033	LACEBY BECK	STUD FARM	TA223007
NRA010034	LACEBY BECK	LITTLECOATES	TA240009
NRA011233	SKITTER BECK	BROCKELSBY STATION	TA119013
NRA010039	WAITHE BECK	BRIGSLEY	TA253001
NRA010268	BRAMPTON BRANCH	R NENE BRIXWORTH - CREATON	SP736071
NRA010243	EAST GLEN	BRACEBOROUGH	TF082013
NRA010772	ANT	IRSTEAD CHURCH	TG366020
NRA010758	BURE	BELAUGH	TG288018
NRA011242	BURE RIVER	WROXHAM RAIL BRIDGE	TG302018
NRA010760	BURE	HORNING FERRY	TG344016
NRA011314	WAVENEY	LOCKS LANE INN	TM390090
NRA010831	WAVENEY	GELDESTON LOCK	TM390090
NRA010835	WAVENEY	BECCLES YACHT STATION	TM421091
NRA011275	WENSUM	NEW MILLS	TG225009
NRA010789	WENSUM	FYE BRIDGE	TG232009
NRA010807	YARE	CROWN POINT	TG269007
NRA010808	YARE	BRAMERTON WOODS END	TG291006
NRA011277	YARE	COLDHAM HALL	TG325007
NRA010810	YARE	STRUMPSHAW	TG332006
NRA010598	KENNETT (01)	BECK BR	TL662073
NRA010648	TRINGSIDE STRM	WHITE BR OXBOROUGH	TF719001
NRA010580	LARK	SOUTHGATE BR BURY ST EDMUNDS	TL865063
NRA011132	WISSEY	HOME HALE NECTON BRIDGE	TF888008
NRA010634	WISSEY	N PICKENHAM BR (HOUGHTON LANE	TF866006
NRA010462	PIX BROOK	RESERVOIR OUTLET LETCHWORTH	TL208034
NRA030M2G	STONY BECK	D.S. A6 ROUNDABOUT AT STONYBECK INN	NY50103450

SITES WITH UNWANTED INTENSITIES IN THE STRESS DATA-SETS PROVIDED BY JOHN MURRAY-BLIGH

OLD NRA SITE CODE	RIVER NAME	SITE NAME	NGR
STRESS DR (Dredge) Stress = 1			
NRA043001	AVON (04)	BIDFORD	SP09905170
NRA043957	AVON (04)	CASTLE BRIDGE WARWICK	SP28806470
NRA043002	AVON (04)	ECKINGTON	SO92204230
NRA043938	AVON DS RIVER SOWE	STONELEIGH PARK	SP31407150
NRA043649	AVON DS RIVER SOWE	STRATFORD UPON AVON	SP20605480
NRA043006	AVON-ARROW TO SEVERN	200 M DS TEWKESBURY WRW	SO88003170
NRA043004	AVON-ARROW TO SEVERN	EVESHAM	SP03404310
NRA043005	AVON-ARROW TO SEVERN	TEWKESBURY	SO89303320
NRA043609	BADSEY BROOK	B4035 ALDINGTON	SP06504370
NRA042501	SEVERN	KEMPSEY (MID)	SO84604950
NRA042503	SEVERN	TEWKESBURY	SO88803370
NRA042502	SEVERN	UPTON ON SEVERN	SO85104070
NRA042505	SEVERN-AVON TO TIDAL	ASHLEWORTH	SO81902500
NRA042504	SEVERN-AVON TO TIDAL	HAW BRIDGE	SO84502780
NRA051012	MEDWAY	U/S ALLINGTON SLUICES	TQ74905815
NRA08E117	LETTON LAKE BROOK	AT LETTON	SO33744649
NRA08E119	WILLERSLEY BROOK	AT WILLERSLEY	SO31254734
NRA08E421	WILLERSLEY BROOK	U/S STW	SO31204870
NR09.4930	BRISTOL AVON	D/S AVONCLIFF WEIR	ST80205985
NR09.4916	BRISTOL AVON	MALFORD CHURCH D/S SUTTON BENGER STW	ST95907835
NR09.4907	BRISTOL AVON	MALMESBURY D/S BRIDGE	ST92908725
NR09.4923	BRISTOL AVON	MELKSHAM ABOVE ROAD BRIDGE	ST89956883
NR09.4922	BRISTOL AVON	MELKSHAM AT SCOTLAND ROAD	ST90606470
NR09.4926	BRISTOL AVON	MONKTON HOUSE	ST88506230
NR09.4936	BRISTOL AVON	PULTENEY WEIR	ST75306480
NR09.4928	BRISTOL AVON	STAVERTON U/S OF WEIR AT NESTLES FACTORY	ST86106105
NR09.4934	BRISTOL AVON	U/S BATHAMPTON WEIR	ST77556725
NR09.4915	BRISTOL AVON	U/S SUTTON BENGER STW MALFORD	ST95807875
NR09.4327	BRUE	150M U/S BASON BRIDGE	ST34744574
NR09.4322	BRUE	20M D/S WESTHAY BRIDGE	ST43774265
NR09.7102	STOUR	CARAVAN PARK (91**)	SZ135 947

SITES WITH UNWANTED INTENSITIES IN THE STRESS DATA-SETS PROVIDED BY JOHN MURRAY-BLIGH

OLD NRA SITE CODE	RIVER NAME	SITE NAME	NGR
STRESS AL (Airlift) Stress = 3			
NR10.2098	DON (10)	D/S ALDWARKE STW	SK45309480
NR10.2198	DON (10)	AT BRAMWITH	SE62101150
STRESS AL (Airlift) Stress = 2			
NR10.2112	DON (10)	U/S RIVER DEARNE	SK49109990
NR10.2104	DON (10)	RAWCLIFFE BRIDGE	SE70102110
STRESS AC (Access to one bank only) Stress = 3			
NRA011043	MARDYKE	CAUSEWAY BRIDGE	TQ571579
NRA010936	RAMSEY	PARKESTON RD BR	TM239031
NRA011184	STOUR	ASHEN RD BR CLARE	TL767044
NRA030EW4	EDEN (03)	100M U.S. EDEN BRIDGE,CARLISLE	NY40205660
NRA045955	HATFIED WASTE DRAIN	GOODCOP FARM	SE73500830
NRA054356	ITCHEN	OTTERBOURNE WATERWORKS	SU47062324
NR06.2940	TORRIDGE	100M U/S BEAM BRIDGE	SS47312089
NR10.2472	DON	AT MEADOWHALL CENTRE	SK39209120
NR10.2100	DON (10)	ELDON ROAD FOOTBRIDGE	SK43509400
NR10.2002	GREAT COMMON DRAIN	U/S RIVER WENT	SE57601660
STRESS AC (Access to one bank only) Stress = 2			
NRA011180	ROMAN R	U/S ABBERTON RESERVOIR	TL940016
NRA011273	WENSUM	GREAT RYEBURGH BRIDGE	TF964027
NRA033RHS	BLACK BROOK (03)	D/S DRUMMERSDALE DRAIN	SD37501560
NRA033SCC	BOATHOUSE SLUICE	AT FORD BRIDGE	SD42201570
NRA051005	MEDWAY	WHILLETS BRIDGE	TQ37883452
STRESS AC (Access to one bank only) Stress = 1			

SITES WITH UNWANTED INTENSITIES IN THE STRESS DATA-SETS PROVIDED BY JOHN MURRAY-BLIGH

OLD NRA SITE CODE	RIVER NAME	SITE NAME	NGR
NRA010939	HOLLAND BROOK	MAIN DRAIN RD BR	TM210017
NRA011042	MARDYKE	STIFFORD GAUGING STATION	TQ597080
NRA011023	CHELMER	LONG POND CB CANAL HEYBRIDGE	TL872006
NRA011182	STOUR	BAKERS MILL	TL882039
NRA010954	SALARY BK (W TRIB)	WEST TRIB PLAINS FARM	TM021028
NRA011236	ANT	HONING LOCK	TG328027
NRA010768	ANT	TONNAGE BRIDGE	TG348026
NRA010728	BURN (01)	ROYS MILL, BURNHAM OVERY	TF842042
NRA011258	GIPPING	CLAYDON BRIDGE	TM128050
NRA010885	GIPPING	POUGHTON MILL	TM125045
NRA010741	GLAVEN	WIVETON BRIDGE	TG044042
NRA010840	LOTHINGLAND HUNDRED	KESSINGLAND DAM	TM510086
NRA010863	TANG	DOCK FARM BRIDGE	TM381047
NRA011060	WAVENEY	NEEDHAM MILL	TM230081
NRA010825	WAVENEY	MENDHAM MILL	TM269083
NRA011314	WAVENEY	LOCKS LANE INN	TM390090
NRA010835	WAVENEY	BECCLES YACHT STATION	TM421091
NRA010782	WENSUM	SWANTON MORLEY BRIDGE	TG021018
NRA010789	WENSUM	FYE BRIDGE	TG232009
NRA033R9G	BOUNDARY BROOK	A570	SD36101540
NRA030VK4	LUNE (03)	D/S FORGE WEIR	SD51206460
NRA033S9K	THE SLUICE	CROSSENS P.S.	SD37802050
NRA033R14	THREE POOLS WATERWAY	CROSSENS P.S.	SD37702050
NRA042208	CAM RIVER	CONFLUENCE CANAL	SO74300500
NRA051009	MEDWAY	ENSFIELD BRIDGE LEIGH	TQ54724527
NRA051010	MEDWAY	HARTLAKE BRIDGE	TQ62974725
STRESS NP (No perceived problem) Stress = 3			
NR10.2332	DEARNE	BARNSLEY ROAD	SE22000830
STRESS NP (No perceived problem) Stress = 1			
NRA03OOYS	WASH BROOK (03)	PTC BLACK BROOK	SK05738172

Appendix 3 Overall frequency of occurrence of each of the individual stress types identified amongst the GQA sites in 1995 (n=6016), together with frequency of each severity code (1 = severe, 2 = moderate, 3 = light, 4 = severity not given, 5 = stress only suspected).

Table 5.1	Individual stresses		Overall occurrences		Severity code				
Major stress name	Code	Full name	No. of sites	% of sites	1	2	3	4	5
Farming	FA	Farming	967	16.1	91	449	318	1	108
Farming	EU	Eutrophication	9	0.2	6	0	3	0	0
Farming	FE	Fertilisers	660	11.0	15	244	205	0	196
Farming	WC	Water cress beds	10	0.2	1	3	6	0	0
Farming	FF	Fish farm	81	1.4	5	27	45	0	4
Pesticides	PE	Pesticides	161	2.7	9	12	120	0	20
Pesticides	HE	Herbicides	177	3.0	3	7	150	0	17
Pesticides	IN	Insecticides	197	3.3	12	17	152	0	16
Pesticides	SD	Sheep-dip	34	0.6	1	6	8	0	19
Waste	WA	Waste	5	0.1	0	2	1	0	2
Waste	PI	Piggery waste	31	0.6	2	15	8	0	6
Waste	PO	Poultry waste	13	0.3	3	4	3	0	3
Waste	SL	Slurry	187	3.2	5	14	36	1	131
Waste	SI	Silage	14	0.3	1	3	6	0	4
Waste	SR	Sludge applied to land	5	0.1	0	1	4	0	0
Agri-industry	AI	Agri-industry	24	0.4	4	6	10	1	3
Agri-industry	AB	Abattoir	21	0.4	5	5	6	0	5
Agri-industry	DA	Dairy	173	2.9	12	73	79	0	9
Agri-industry	VE	Vegetable processing	21	0.4	6	8	3	0	4
Agri-industry	TA	Tanning/leather	5	0.1	0	0	2	0	3
Agri-industry	WO	Wool	1	0.1	0	0	1	0	0
Agri-industry	FL	Flour mill	2	0.1	1	1	0	0	0
Agri-industry	BR	Brewery	17	0.3	0	7	8	0	2
Agri-industry	SU	Sugar refinery	6	0.1	1	4	0	0	1
Industrial discharge	ID	Industrial discharge	81	1.4	16	30	27	0	8
Industrial discharge	HI	Heavy industry	98	1.7	45	18	11	0	24
Industrial discharge	PL	Plating industry	4	0.1	1	2	1	0	0
Industrial discharge	LI	Light industry/commercial	152	2.6	26	46	53	1	26
Industrial discharge	DE	Detergent	4	0.1	0	2	2	0	0
Industrial discharge	PM	Paper mill	26	0.5	4	8	12	0	2
Industrial discharge	BW	Brick works	2	0.1	0	1	0	0	1
Industrial discharge	CE	Cement works	8	0.2	3	1	4	0	0
Industrial discharge	CW	Cooling water (warm)	22	0.4	2	11	5	0	4
Industrial discharge	DY	Colouration (dye)	31	0.6	6	18	6	0	1
Sediment at the site	SX	Sediment at the site	36	0.6	6	20	10	0	0
Sediment at the site	TX	Contaminated sediment	197	3.3	26	25	14	0	132
Sediment at the site	IS	Inert siltation	475	7.9	59	248	159	0	9
Sediment at the site	GS	Eroded gravel/boulders in channel	25	0.5	6	6	13	0	0
Oils, petrochemicals	OI	Oils, petrochemicals	52	0.9	10	20	17	0	5
Oils, petrochemicals	CO	Crude oil	0	0.0	0	0	0	0	0
Oils, petrochemicals	TO	Tar/bitumen	1	0.1	1	0	0	0	0
Oils, petrochemicals	VO	Vegetable oil	4	0.1	1	0	3	0	0
Oils, petrochemicals	LO	Lubricating oil	1	0.1	1	0	0	0	0
Oils, petrochemicals	FO	Fuel (diesel/petrol)	37	0.7	4	7	18	0	8
Construction	CT	Construction	2	0.1	1	0	1	0	0
Construction	BU	Building and road site	20	0.4	2	14	3	0	1
Leachate	LE	Leachate	17	0.3	1	6	6	0	4
Leachate	SY	Scrap yard	3	0.1	0	1	1	0	1
Leachate	SH	Slag heap	21	0.4	3	4	11	0	3
Leachate	DL	Domestic landfill	58	1.0	11	14	17	0	16
Leachate	TI	Toxic/industrial landfill	63	1.1	15	15	8	0	25
Sewage Treatment Works (STW)	ST	Sewage Treatment Works (STW)	279	4.7	85	121	66	0	7
Sewage Treatment Works (STW)	TS	Treated STW effluent	1477	24.6	339	518	573	2	45

Table 5.1	Individual stresses		Overall occurrences		Severity code				
Major stress name	Code	Full name	No. of sites	% of sites	1	2	3	4	5
Sewage Treatment Works (STW)	SE	Septic tank	207	3.5	11	33	140	1	22
Sewage Treatment Works (STW)	SS	Storm sewer overflow	221	3.7	64	82	54	1	20
Sewage Treatment Works (STW)	CS	Combined sewer overflow	586	9.8	79	259	194	2	52
Water Treatment Works (WTW)	WT	Water Treatment Works (WTW)	33	0.6	4	7	12	0	10
Water Treatment Works (WTW)	FS	Iron sulphate from WTW	2	0.1	1	0	1	0	0
Water Treatment Works (WTW)	AS	Aluminium sulphate from WTW	6	0.1	0	3	2	0	1
Water Treatment Works (WTW)	SW	Swimming pool	3	0.1	0	0	0	0	3
Run-off	RO	Run-off	108	1.8	1	2	16	1	88
Run-off	UR	Urban run-off	892	14.9	220	370	235	2	65
Run-off	HY	Highway run-off (including salt)	299	5.0	19	77	103	1	99
Run-off	RR	Railway run-off	40	0.7	2	2	14	0	22
Run-off	HR	Heavy industry run-off	60	1.0	15	22	8	0	15
Run-off	LR	Light industry/commercial run-off	214	3.6	46	87	61	0	20
Acid deposition	AD	Acid deposition	80	1.4	17	23	20	0	20
Mining, quarries and extraction	MI	Mining, quarries and extraction	61	1.1	10	18	22	1	10
Mining, quarries and extraction	MM	Metal mine drainage	105	1.8	12	31	54	0	8
Mining, quarries and extraction	CM	Coal mine drainage	122	2.1	19	49	46	0	8
Mining, quarries and extraction	CC	China clay extraction	25	0.5	9	9	7	0	0
Mining, quarries and extraction	QA	Quarry (acid rock)	9	0.2	1	2	4	0	2
Mining, quarries and extraction	QB	Quarry (limestone/chalk)	13	0.3	2	4	4	0	3
Mining, quarries and extraction	SG	Sand and gravel extraction	23	0.4	1	9	12	0	1
Channel at the site	AN	Channel at the site	11	0.2	2	4	5	0	0
Channel at the site	CA	Channelisation	441	7.4	108	224	102	1	6
Channel at the site	CU	Culvert	31	0.6	8	14	8	0	1
Channel at the site	CV	Cave	1	0.1	0	1	0	0	0
Channel at the site	BE	Bedrock	70	1.2	14	31	21	0	4
Channel at the site	BD	Concrete stream bed	19	0.4	10	3	6	0	0
Channel at the site	BG	Bridge	274	4.6	10	60	188	2	14
Man-made watercourse	CN	Canal	6	0.1	1	4	1	0	0
Man-made watercourse	RN	River navigation (locks etc)	57	1.0	17	34	5	1	0
Man-made watercourse	DI	Artificial ditch of dyke	17	0.3	9	6	2	0	0
Channel Management	DN	Dredging	92	1.6	13	27	39	1	12
Channel Management	WD	Weed cutting	68	1.2	7	25	24	3	9
Choked channel (>33% plant)	CH	Choked channel (>33% plant)	175	3.0	37	79	58	0	1
Artificial bank at the site	AT	Artificial bank at the site	29	0.5	7	16	4	1	1
Artificial bank at the site	UC	Unconsolidated (Rip-rap/boulder)	47	0.8	7	27	11	0	2
Artificial bank at the site	SB	Consolidated (stone/brick/concrete)	179	3.0	40	60	70	3	6
Artificial bank at the site	SP	Sheet piling	22	0.4	7	7	8	0	0
Bank practices at the site	BP	Bank practices at the site	3	0.1	0	1	2	0	0
Bank practices at the site	LV	Livestock poaching, trampling	217	3.7	9	54	102	1	51
Bank practices at the site	MO	Mown/managed riparian zone	61	1.1	9	19	32	0	1
Bank practices at the site	OG	Over grazing	22	0.4	1	6	13	0	2
Impoundments	RF	Regulated flow	149	2.5	26	48	69	3	3
Impoundments	WE	Weirs	154	2.6	18	55	71	4	6
Impoundments	RE	Reservoir u/s catchment	135	2.3	25	44	57	2	7
Impoundments	PF	Ponded flow (lake or reservoir d/s)	56	1.0	16	26	13	0	1
Impoundments	LP	Lake or pond close u/s	164	2.8	32	67	54	4	7
Impoundments	HW	Hypolimnic water	8	0.2	2	3	2	0	1
Impoundments	RT	River transfer	33	0.6	14	10	9	0	0
Impoundments	FT	Freshwater but tidal	61	1.1	14	29	14	0	4
Low flow	LF	Low flow	220	3.7	39	90	71	4	16
Low flow	AP	Abstraction for public supply	33	0.6	5	13	13	0	2
Low flow	AG	Abstraction from groundwater	62	1.1	10	16	28	2	6
Low flow	AR	Abstraction from river	36	0.6	8	13	13	0	2
Low flow	IR	Abstraction for irrigation	56	1.0	12	21	21	1	1
Low flow	CD	Cessation of STW discharge	3	0.1	1	2	0	0	0
Low flow	DT	Drought	132	2.2	7	52	58	0	15
No flow	NF	No flow	8	0.2	4	4	0	0	0
No flow	WI	Winterbourne (natural)	11	0.2	4	2	3	2	0

Table 5.1	Individual stresses		Overall occurrences		Severity code				
Major stress name	Code	Full name	No. of sites	% of sites	1	2	3	4	5
No flow	DC	Dry channel (caused by man)	3	0.1	1	0	1	0	1
Saline	SA	Saline	13	0.3	2	5	3	0	3
Saline	MA	Marine origin	22	0.4	4	7	7	0	4
Saline	IG	Inland geological	3	0.1	1	0	1	0	1
Saline	IL	Industrial discharge	5	0.1	1	2	2	0	0
Land use	LU	Land use	5	0.1	0	3	2	0	0
Land use	CF	Afforestation (conifer)	96	1.6	13	26	28	1	28
Land use	IA	Intensive arablisation	397	6.6	121	205	44	12	15
Land use	US	Urban/suburban	344	5.8	64	166	111	1	2
Land use	MD	Moorland drainage	101	1.7	5	41	39	0	16
Land use	UO	Upland overgrazing	5	0.1	1	3	0	0	1
Land use	RB	Reedbed at the site	6	0.1	1	1	4	0	0
Reclaimed land	RL	Reclaimed land	4	0.1	1	2	1	0	0
Reclaimed land	RI	Industrial reclaimed land	17	0.3	2	5	9	0	1
Reclaimed land	OC	Open/cast reclaimed land	7	0.2	0	2	2	0	3
Bank erosion	EC	Clay bank erosion	42	0.7	0	15	14	0	13
Bank erosion	ES	Sand bank erosion	44	0.8	5	14	13	0	12
Bank erosion	EG	Gravel, boulder bank erosion	18	0.3	3	11	4	0	0
Sorting problem	PR	Poorly preserved sample	8	0.2	0	0	5	3	0
Sampling difficulty	DR	Dredge used to sample	193	3.3	0	0	0	187	6
Sampling difficulty	AL	Air-lift used to sample	16	0.3	0	0	0	16	0
Sampling difficulty	AC	Access to one bank only	168	2.8	0	0	0	168	0
Sampling difficulty	BO	Bouldery site sampling difficult	141	2.4	32	58	51	0	0
No perceived problem	NP	No perceived problem	669	11.2	1	0	1	667	0
No information	NI	No information	168	2.8	0	0	0	168	0
Other	BM	Boat mooring	1	0.1	0	1	0	0	0
Other	SF	Sewage fungus	92	1.6	5	17	58	2	10
Other	OH	Ochre	125	2.1	34	41	42	3	5
Other	CL	Cladophora	431	7.2	58	254	109	8	2
Other	MY	Stress is a mystery	80	1.4	4	30	17	25	4
Other	AF	Unknown	2	0.1	0	0	2	0	0
Other	BL	Unknown	2	0.1	0	1	1	0	0
Other	CR	Unknown	1	0.1	0	1	0	0	0
Other	EI	Unknown	1	0.1	0	0	1	0	0
Other	JT	Unknown	1	0.1	1	0	0	0	0
Other	LM	Unknown	1	0.1	0	0	0	0	1
Other	MR	Unknown	1	0.1	0	0	0	0	1
Other	PG	Unknown	1	0.1	0	0	0	0	1
Other	SO	Unknown	0	0.0	0	0	0	0	0
Other	UK	Unknown	1	0.1	0	0	1	0	0
Other	VR	Unknown	9	0.2	1	8	0	0	0
Other	VS	Unknown	10	0.2	0	9	1	0	0
		Total	15543		2304	5278	4995	1311	1655

Appendix 4 Frequency of occurrence of each of the individual stress types identified amongst the GQA sites in 1995 (n=6016), classified according to the spatial (p=point, d=diffuse) and temporal (a=acute, s=seasonal, c=chronic) occurrence of the stress. Total = total number of sites identified as having the stress.

Table 5.2	Individual stresses		Total	spatial		temporal			point (p)			diffuse (d)		
Major stress name	Code	Full name		p	d	a	s	c	a	s	c	a	s	c
Farming	FA	Farming	967	5	141	1	6	30	0	0	0	0	0	17
Farming	EU	Eutrophication	9	0	0	0	0	0	0	0	0	0	0	0
Farming	FE	Fertilisers	660	3	397	0	111	167	0	0	0	0	110	158
Farming	WC	Water cress beds	10	5	0	0	0	4	0	0	4	0	0	0
Farming	FF	Fish farm	81	28	2	1	0	21	1	0	19	0	0	0
Pesticides	PE	Pesticides	161	1	113	0	110	8	0	1	0	0	109	0
Pesticides	HE	Herbicides	177	2	152	0	5	154	0	0	2	0	0	151
Pesticides	IN	Insecticides	197	16	152	5	5	154	5	0	6	0	2	145
Pesticides	SD	Sheep-dip	34	2	0	2	1	2	0	0	2	0	0	0
Waste	WA	Waste	5	0	1	0	0	0	0	0	0	0	0	0
Waste	PI	Piggery waste	31	3	16	0	0	0	0	0	0	0	0	0
Waste	PO	Poultry waste	13	2	4	0	0	1	0	0	1	0	0	0
Waste	SL	Slurry	187	15	134	8	13	3	6	0	1	0	4	0
Waste	SI	Silage	14	0	0	1	5	1	0	0	0	0	0	0
Waste	SR	Sludge applied to land	5	0	0	0	0	0	0	0	0	0	0	0
Agri-industry	AI	Agri-industry	24	3	0	0	1	1	0	0	0	0	0	0
Agri-industry	AB	Abattoir	21	7	3	0	0	2	0	0	1	0	0	0
Agri-industry	DA	Dairy	173	7	21	3	3	1	0	0	0	0	0	0
Agri-industry	VE	Vegetable processing	21	8	0	1	3	5	1	0	3	0	0	0
Agri-industry	TA	Tanning/leather	5	1	0	0	0	1	0	0	1	0	0	0
Agri-industry	WO	Wool	1	0	0	0	0	0	0	0	0	0	0	0
Agri-industry	FL	Flour mill	2	2	0	0	0	2	0	0	2	0	0	0
Agri-industry	BR	Brewery	17	7	1	0	0	0	0	0	0	0	0	0
Agri-industry	SU	Sugar refinery	6	1	0	0	1	1	0	1	0	0	0	0
Industrial discharge	ID	Industrial discharge	81	9	1	2	0	0	0	0	0	0	0	0
Industrial discharge	HI	Heavy industry	98	18	0	3	1	50	1	1	18	0	0	0
Industrial discharge	PL	Plating Industry	4	0	0	0	0	1	0	0	0	0	0	0
Industrial discharge	LI	Light industry/commercial	152	34	4	3	2	29	3	0	19	0	0	0
Industrial discharge	DE	Detergent	4	0	0	1	0	0	0	0	0	0	0	0
Industrial discharge	PM	Paper mill	26	6	0	2	0	8	0	0	3	0	0	0
Industrial discharge	BW	Brick works	2	0	0	0	0	0	0	0	0	0	0	0
Industrial discharge	CE	Cement works	8	2	1	0	0	3	0	0	2	0	0	0
Industrial discharge	CW	Cooling water (warm)	22	2	1	0	0	1	0	0	0	0	0	0
Industrial discharge	DY	Colouration (dye)	31	1	0	0	0	0	0	0	0	0	0	0
Sediment at the site	SX	Sediment at the site	36	1	0	0	0	1	0	0	0	0	0	0
Sediment at the site	TX	Contaminated sediment	197	35	119	1	0	156	0	0	35	0	0	117
Sediment at the site	IS	Inert siltation	475	5	7	1	2	46	0	1	4	0	0	2
Sediment at the site	GS	Eroded gravel/boulders in channel	25	0	0	0	0	0	0	0	0	0	0	0

Table 5.2

Major stress name	Code	Full name	Total	spatial		temporal			point (p)			diffuse (d)		
				p	d	a	s	c	a	s	c	a	s	c
Oils, petrochemicals	OI	Oils, petrochemicals	52	21	0	2	1	26	1	1	16	0	0	0
Oils, petrochemicals	CO	Crude oil	0	0	0	0	0	0	0	0	0	0	0	0
Oils, petrochemicals	TO	Tar/bitumen	1	0	0	0	0	0	0	0	0	0	0	0
Oils, petrochemicals	VO	Vegetable oil	4	3	0	2	0	1	2	0	0	0	0	0
Oils, petrochemicals	LO	Lubricating oil	1	0	0	0	0	0	0	0	0	0	0	0
Oils, petrochemicals	FO	Fuel (diesel/petrol)	37	4	6	3	0	1	0	0	1	0	0	0
Construction	CT	Construction	2	0	0	0	0	0	0	0	0	0	0	0
Construction	BU	Building and road site	20	0	1	0	0	0	0	0	0	0	0	0
Leachate	LE	Leachate	17	3	2	0	0	5	0	0	2	0	0	1
Leachate	SY	Scrap yard	3	0	0	0	0	1	0	0	0	0	0	0
Leachate	SH	Slag heap	21	2	8	0	0	1	0	0	0	0	0	0
Leachate	DL	Domestic landfill	58	7	3	0	0	8	0	0	1	0	0	0
Leachate	TI	Toxic/industrial landfill	63	3	8	3	0	11	0	0	0	1	0	3
Sewage Treatment Works (STW)	ST	Sewage Treatment Works (STW)	279	22	0	0	1	25	0	0	22	0	0	0
Sewage Treatment Works (STW)	TS	Treated STW effluent	1477	675	4	3	4	157	3	3	80	0	0	0
Sewage Treatment Works (STW)	SE	Septic tank	207	38	42	0	1	11	0	1	6	0	1	1
Sewage Treatment Works (STW)	SS	Storm sewer overflow	221	39	0	27	6	21	26	0	4	0	0	0
Sewage Treatment Works (STW)	CS	Combined sewer overflow	586	50	10	2	21	21	0	0	1	0	0	0
Water Treatment Works (WTW)	WT	Water Treatment Works (WTW)	33	3	0	0	0	2	0	0	2	0	0	0
Water Treatment Works (WTW)	FS	Iron sulphate from WTW	2	1	0	0	0	2	0	0	1	0	0	0
Water Treatment Works (WTW)	AS	Aluminium sulphate from WTW	6	0	0	0	0	1	0	0	0	0	0	0
Water Treatment Works (WTW)	SW	Swimming pool	3	1	0	0	0	1	0	0	1	0	0	0
Run-off	RO	Run-off	108	3	2	0	2	0	0	0	0	0	0	0
Run-off	UR	Urban run-off	892	48	127	2	27	79	1	0	28	0	0	0
Run-off	HY	Highway run-off (including salt)	299	16	9	1	19	17	1	0	10	0	0	0
Run-off	RR	Railway run-off	40	0	1	1	0	2	0	0	0	0	0	0
Run-off	HR	Heavy industry run-off	60	18	0	1	3	15	0	0	13	0	0	0
Run-off	LR	Light industry/commercial run-off	214	34	20	3	0	27	2	0	21	0	0	1
Acid deposition	AD	Acid deposition	80	0	8	1	13	2	0	0	0	1	6	0
Mining, quarries and extraction	MI	Mining, quarries and extraction	61	3	5	0	0	0	0	0	0	0	0	0
Mining, quarries and extraction	MM	Metal mine drainage	105	3	1	0	0	2	0	0	0	0	0	0
Mining, quarries and extraction	CM	Coal mine drainage	122	15	2	1	1	10	0	1	3	0	0	0
Mining, quarries and extraction	CC	China clay extraction	25	0	0	0	0	0	0	0	0	0	0	0
Mining, quarries and extraction	QA	Quarry (acid rock)	9	0	0	1	0	0	0	0	0	0	0	0
Mining, quarries and extraction	QB	Quarry (limestone/chalk)	13	1	0	0	0	1	0	0	1	0	0	0
Mining, quarries and extraction	SG	Sand and gravel extraction	23	3	1	1	0	2	1	0	1	0	0	0
Channel at the site	AN	Channel at the site	11	0	0	0	0	0	0	0	0	0	0	0
Channel at the site	CA	Channelisation	441	0	1	0	0	68	0	0	0	0	0	0
Channel at the site	CU	Culvert	31	0	0	0	0	0	0	0	0	0	0	0
Channel at the site	CV	Cave	1	0	0	0	0	0	0	0	0	0	0	0
Channel at the site	BE	Bedrock	70	0	0	0	0	0	0	0	0	0	0	0
Channel at the site	BD	Concrete stream bed	19	0	0	0	0	1	0	0	0	0	0	0
Channel at the site	BG	Bridge	274	2	0	0	0	2	0	0	0	0	0	0

Table 5.2

Major stress name	Code	Full name	Total	spatial p	spatial d	temporal a	temporal s	temporal c	point (p) a	point (p) s	point (p) c	diffuse (d) a	diffuse (d) s	diffuse (d) c
Man-made watercourse	CN	Canal	6	0	0	0	0	0	0	0	0	0	0	0
Man-made watercourse	RN	River navigation (locks etc)	57	0	0	0	0	14	0	0	0	0	0	0
Man-made watercourse	DI	Artificial ditch of dyke	17	0	0	0	0	1	0	0	0	0	0	0
Channel Management	DN	Dredging	92	0	0	7	3	2	0	0	0	0	0	0
Channel Management	WD	Weed cutting	68	0	1	10	16	3	0	0	0	0	0	0
Choked channel (>33% plant)	CH	Choked channel (>33% plant)	175	0	0	0	32	24	0	0	0	0	0	0
Artificial bank at the site	AT	Artificial bank at the site	29	0	0	0	0	0	0	0	0	0	0	0
Artificial bank at the site	UC	Unconsolidated (Rip-rap/boulder)	47	0	0	0	0	2	0	0	0	0	0	0
Artificial bank at the site	SB	Consolidated (stone/brick/concrete)	179	0	0	0	0	13	0	0	0	0	0	0
Artificial bank at the site	SP	Sheet piling	22	0	0	0	0	1	0	0	0	0	0	0
Bank practices at the site	BP	Bank practices at the site	3	0	0	0	0	0	0	0	0	0	0	0
Bank practices at the site	LV	Livestock poaching, trampling	217	2	0	0	1	8	0	0	0	0	0	0
Bank practices at the site	MO	Mown/managed riparian zone	61	1	0	1	1	1	0	0	0	0	0	0
Bank practices at the site	OG	Over grazing	22	0	0	0	0	1	0	0	0	0	0	0
Impoundments	RF	Regulated flow	149	0	0	0	0	14	0	0	0	0	0	0
Impoundments	WE	Weirs	154	1	0	0	0	13	0	0	0	0	0	0
Impoundments	RE	Reservoir u/s catchment	135	8	0	0	1	4	0	0	0	0	0	0
Impoundments	PF	Ponded flow (lake or reservoir d/s)	56	2	0	0	3	4	0	0	1	0	0	0
Impoundments	LP	Lake or pond close u/s	164	7	1	0	0	8	0	0	0	0	0	0
Impoundments	HW	Hypolimnic water	8	1	0	0	0	2	0	0	1	0	0	0
Impoundments	RT	River transfer	33	0	0	0	1	0	0	0	0	0	0	0
Impoundments	FT	Freshwater but tidal	61	0	2	0	1	0	0	0	0	0	0	0
Low flow	LF	Low flow	220	0	0	0	49	13	0	0	0	0	0	0
Low flow	AP	Abstraction for public supply	33	11	0	0	0	3	0	0	0	0	0	0
Low flow	AG	Abstraction from groundwater	62	1	1	0	1	6	0	1	0	0	0	0
Low flow	AR	Abstraction from river	36	0	3	0	0	5	0	0	0	0	0	0
Low flow	IR	Abstraction for irrigation	56	2	11	0	13	0	0	2	0	0	11	0
Low flow	CD	Cessation of STW discharge	3	0	0	0	1	0	0	0	0	0	0	0
Low flow	DT	Drought	132	0	0	0	27	1	0	0	0	0	0	0
No flow	NF	No flow	8	0	0	2	3	0	0	0	0	0	0	0
No flow	WI	Winterbourne (natural)	11	0	0	0	5	0	0	0	0	0	0	0
No flow	DC	Dry channel (caused by man)	3	0	0	0	1	0	0	0	0	0	0	0
Saline	SA	Saline	13	0	5	0	2	1	0	0	0	0	1	1
Saline	MA	Marine origin	22	0	0	1	1	4	0	0	0	0	0	0
Saline	IG	Inland geological	3	0	0	0	0	0	0	0	0	0	0	0
Saline	IL	Industrial discharge	5	0	0	0	0	0	0	0	0	0	0	0
Land use	LU	Land use	5	0	0	0	0	0	0	0	0	0	0	0
Land use	CF	Afforestation (conifer)	96	0	9	0	0	0	0	0	0	0	0	0
Land use	IA	Intensive arablisation	397	0	12	0	0	111	0	0	0	0	0	0
Land use	US	Urban/suburban	344	2	0	0	0	46	0	0	2	0	0	0
Land use	MD	Moorland drainage	101	0	1	0	0	2	0	0	0	0	0	0
Land use	UO	Upland overgrazing	5	0	0	0	0	0	0	0	0	0	0	0
Land use	RB	Reedbed at the site	6	0	0	0	0	0	0	0	0	0	0	0

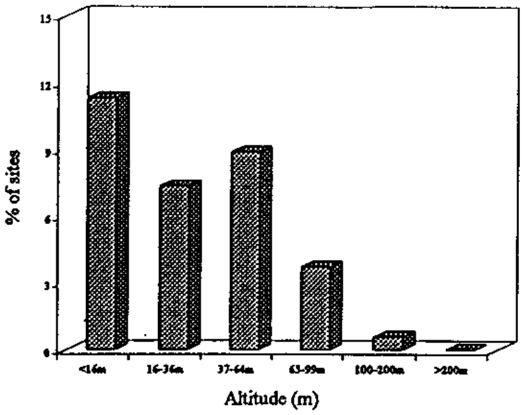
Table 5.2

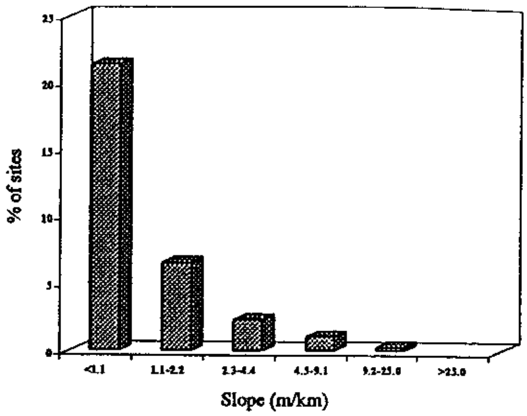
Major stress name	Code	Full name	Total	spatial		temporal			point (p)			diffuse (d)		
				p	d	a	s	c	a	s	c	a	s	c
Reclaimed land	RL	Reclaimed land	4	0	0	0	0	0	0	0	0	0	0	0
Reclaimed land	RI	Industrial reclaimed land	17	0	0	0	0	2	0	0	0	0	0	0
Reclaimed land	OC	Open/cast reclaimed land	7	0	0	0	0	1	0	0	0	0	0	0
Bank erosion	EC	Clay bank erosion	42	0	0	0	1	0	0	0	0	0	0	0
Bank erosion	ES	Sand bank erosion	44	0	0	0	0	0	0	0	0	0	0	0
Bank erosion	EG	Gravel, boulder bank erosion	18	0	0	0	3	0	0	0	0	0	0	0
Sorting problem	PR	Poorly preserved sample	8	0	0	0	3	0	0	0	0	0	0	0
Sampling difficulty	DR	Dredge used to sample	193	0	0	0	1	21	0	0	0	0	0	0
Sampling difficulty	AL	Air-lift used to sample	16	0	0	0	0	0	0	0	0	0	0	0
Sampling difficulty	AC	Access to one bank only	168	0	0	0	1	0	0	0	0	0	0	0
Sampling difficulty	BO	Bouldery site sampling difficult	141	0	0	0	0	2	0	0	0	0	0	0
No perceived problem	NP	No perceived problem	669	0	0	0	0	0	0	0	0	0	0	0
No information	NI	No information	168	0	0	0	3	0	0	0	0	0	0	0
Other	BM	Boat mooring	1	0	0	0	0	0	0	0	0	0	0	0
Other	SF	Sewage fungus	92	1	0	1	3	1	1	0	0	0	0	0
Other	OH	Ochre	125	3	5	0	1	16	0	0	1	0	0	2
Other	CL	Cladophora	431	0	1	0	54	20	0	0	0	0	0	0
Other	MY	Stress is a mystery	80	0	0	1	3	4	0	0	0	0	0	0
Other	AF	Unknown	2	0	0	0	0	0	0	0	0	0	0	0
Other	BL	Unknown	2	0	0	0	0	0	0	0	0	0	0	0
Other	CR	Unknown	1	0	0	0	0	0	0	0	0	0	0	0
Other	EI	Unknown	1	0	0	1	0	0	0	0	0	0	0	0
Other	JT	Unknown	1	0	0	0	0	0	0	0	0	0	0	0
Other	LM	Unknown	1	0	0	0	0	0	0	0	0	0	0	0
Other	MR	Unknown	1	0	0	0	0	0	0	0	0	0	0	0
Other	PG	Unknown	1	0	0	0	0	0	0	0	0	0	0	0
Other	SO	Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Other	UK	Unknown	1	0	1	0	1	0	0	0	0	0	1	0
Other	VR	Unknown	9	0	0	0	0	0	0	0	0	0	0	0
Other	VS	Unknown	10	0	0	0	0	0	0	0	0	0	0	0
		Total	14239	1291	1584	113	604	1750	55	13	342	2	245	599

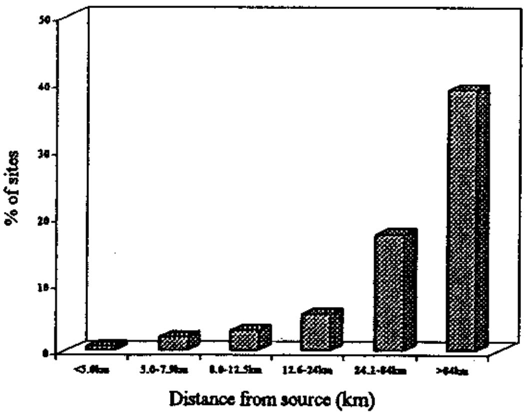
Appendix 5 **The distribution of Unionidae and Heptageniidae in samples collected during the 1990 RQS and 1995 GQA with patterns of occurrence records in relation to eight selected RIVPACS variables.**

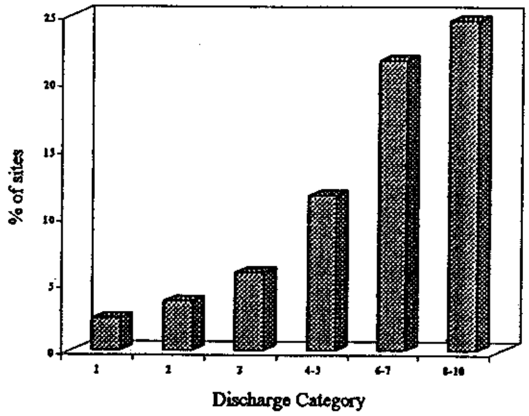
UNIONIDAE

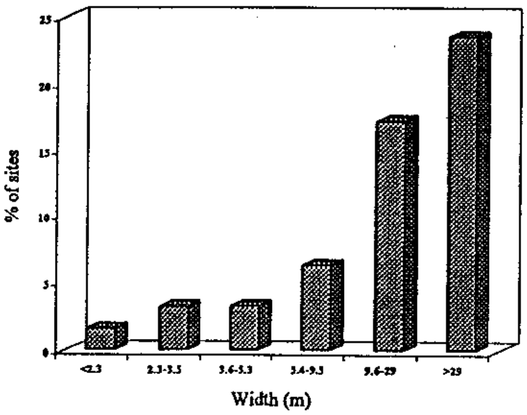
Unionidae

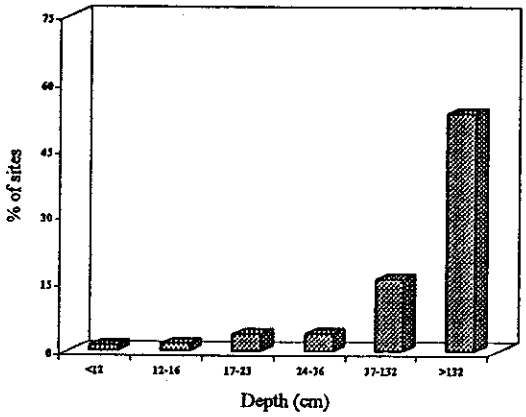

% of sites
0
3
6
9
12
15
<16m
16-36m
37-64m
65-99m
100-200m
>200m
Altitude (m)

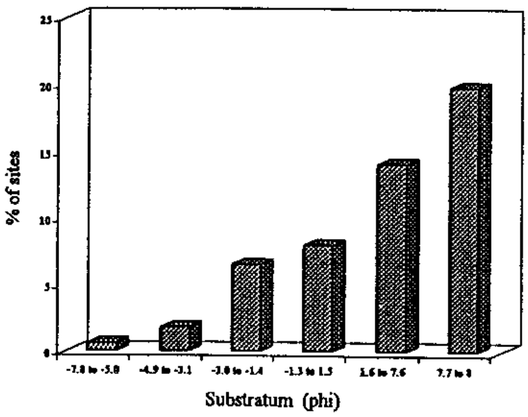

% of sites
0
5
10
15
20
25
<1.1
1.1-2.2
2.3-4.4
4.5-9.1
9.2-23.0
>23.0
Slope (m/km)

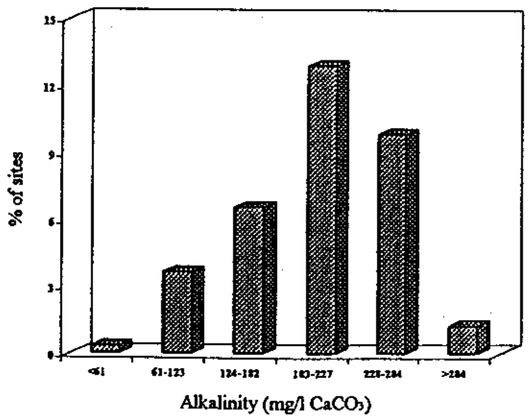

% of sites
0
10
20
30
40
50
<5.0km
5.0-7.9km
8.0-12.5km
12.6-24km
24.1-84km
>84km
Distance from source (km)


% of sites
0
5
10
15
20
25
1
2
3
4-5
6-7
8-10
Discharge Category

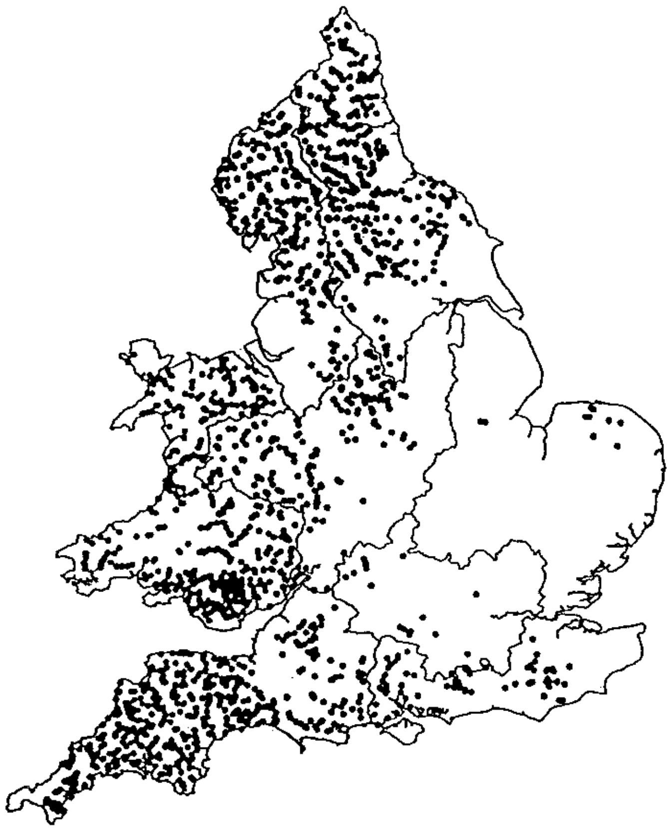

% of sites
0
5
10
15
20
25
<2.3
2.3-3.5
3.6-5.3
5.4-9.5
9.6-29
>29
Width (m)

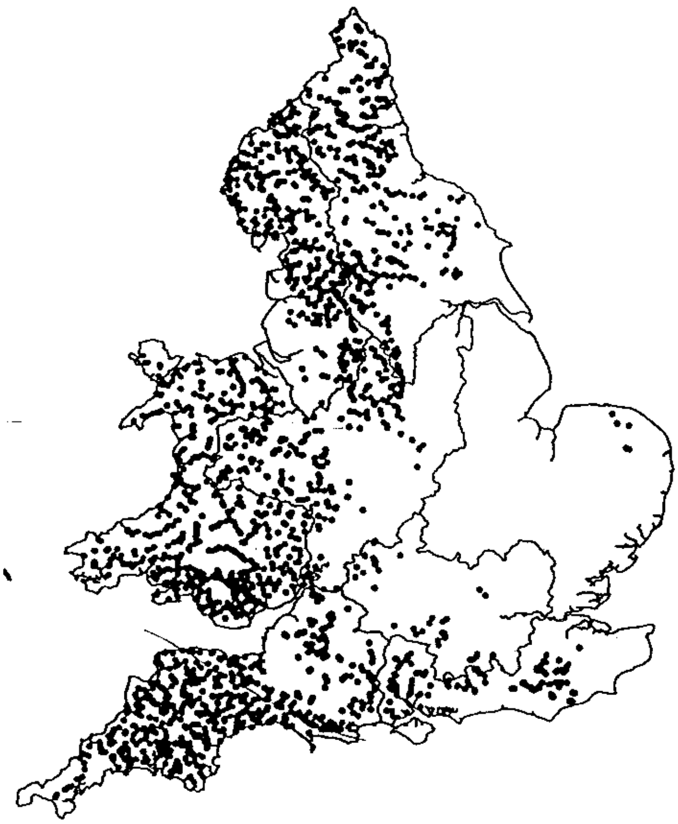

% of sites
0
15
30
45
60
75
<12
12-16
17-23
24-36
37-132
>132
Depth (cm)


% of sites
0
5
10
15
20
25
-7.8 to -5.0
-4.9 to -3.1
-3.0 to -1.4
-1.3 to 1.5
1.6 to 7.6
7.7 to 8
Substratum (phi)

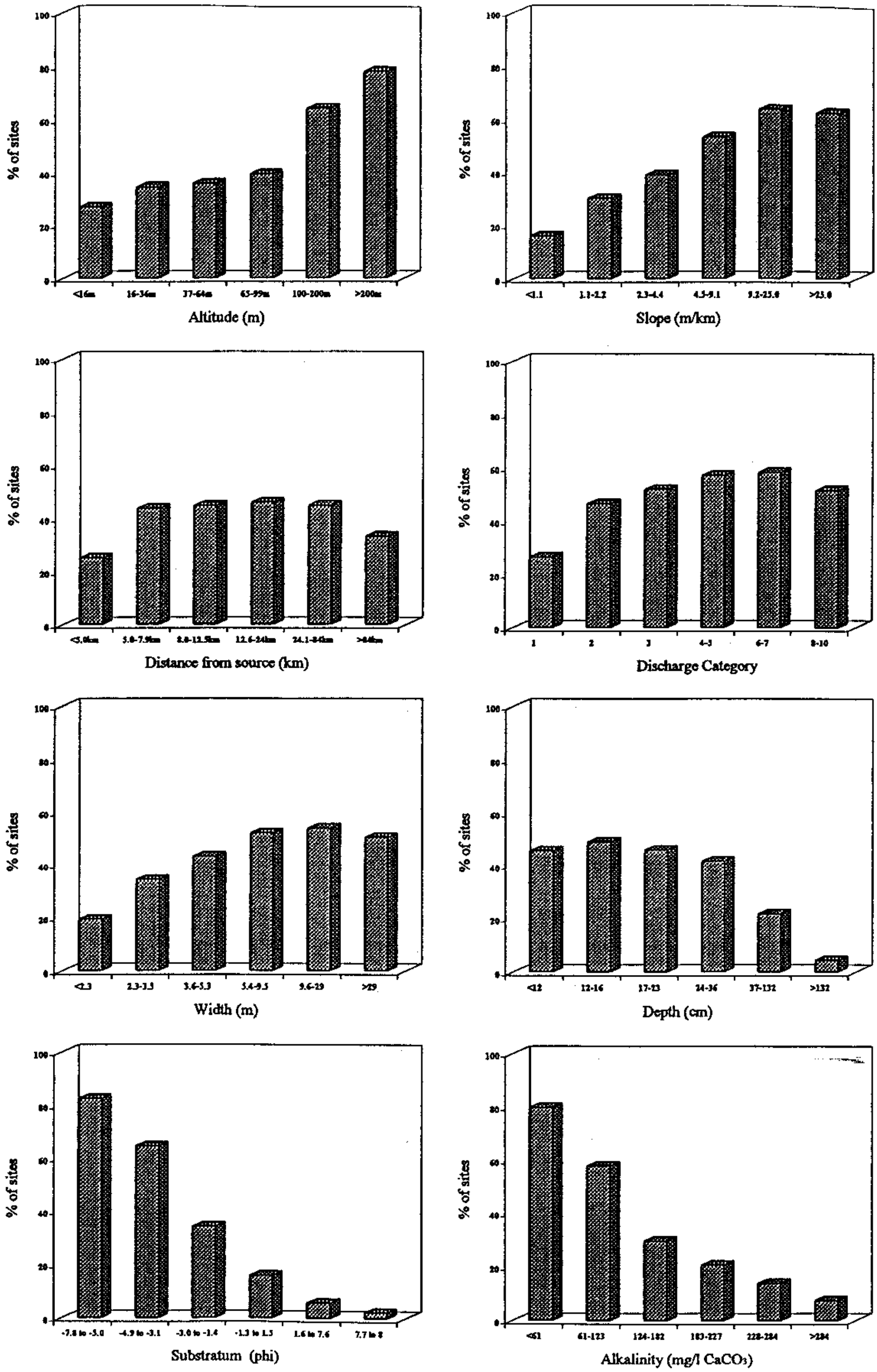

% of sites
0
3
6
9
12
15
<61
61-123
124-182
183-227
228-284
>284
Alkalinity (mg/l CaCO3)

HEPTAGENIIDAE





Heptageniidae



Appendix 6 **An example of the type of output which will be produced to relate the presence and absence of individual BMWP taxa to RIVPACS environmental variables, changes in biological grade, Environment Agency Regions and landscape types.**

FAMILY A

Environmental characteristics of sites in which family A is present or absent in 1995 plus sites where it has been gained or lost since 1990. Mean values (SE).

Variable	Present 1990 + 1995	Absent 1990 + 1995	Gained in 1995	Lost in 1995
Altitude	147 (93)	71 (42)	176 (153)	79 (93)
Slope				
Distance to source				
Discharge				
Width				
Depth				
Substratum				
Alkalinity				

Changes in frequency of family A from 1990 to 1995, at sites which have or have not improved or deteriorated (p>0.5) in biological grade (gains = +%; losses = -%)

Improved in 1995	Change of frequency	1990 grade ns change	Change of frequency	Deteriorated in 1995	Change of frequency
b to a	+7.1%	a	-1.7%	a to b	-12.3%
c to a		b		a to c, d, e or f	
c to b		c		b to c	
d to a or b		d		b to d, e or f	
d to c		e		c to d	
e to a, b or c		f		c to e or f	
e to d				d to e	
f to a, b,c or d				d to f	
f to e				e to f	

Regional changes in frequency of family A between 1990 to 1995.

1990 NRA Region	Present 1990 + 1995	Absent 1990 + 1995	Absent 1990 Present 1995	Present 1990 Absent 1995
Anglian	22.4%	69.1%	1.6%	6.9%
Northumbrian				
North West				
Severn Trent				
Southern				
South West				
Thames				
Welsh				
Wessex				
Yorkshire				
Overall				

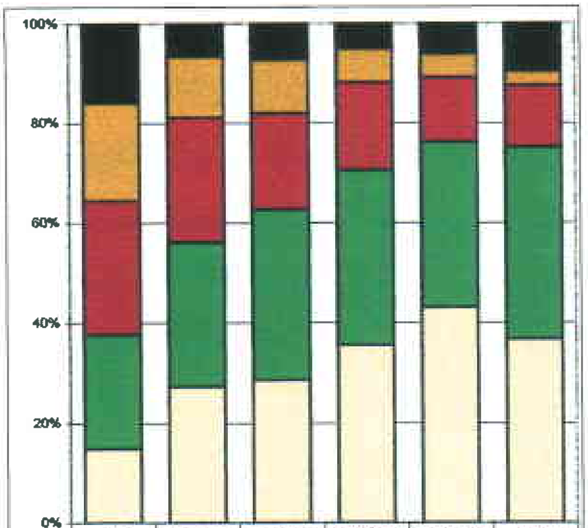
Landscape changes in frequency of family A between 1990 to 1995.

ITE landscape type	Present 1990 + 1995	Absent 1990 + 1995	Absent 1990 Present 1995	Present 1990 Absent 1995
Upland	73.8%	22.4%	1.2%	2.6%
Marginal upland				
Pasture				
Arable				

Appendix 7 **The distribution of four landscape types in Great Britain. Upland – purple; marginal upland – dark brown; pastural – pale brown; arable – green.**

Appendix 8 Relationship between (corrected) biological grades (a-d, e/f) in 1995 and six categories of either site discharge category ((a)-(b)) or site distance from source ((c)-(d)). Figures (a) and (c) show the percentage of sites in each grade, separately for each category; figures (b) and (d) show the percentage of sites in each category, separately for each grade. Total n = 6016 sites.

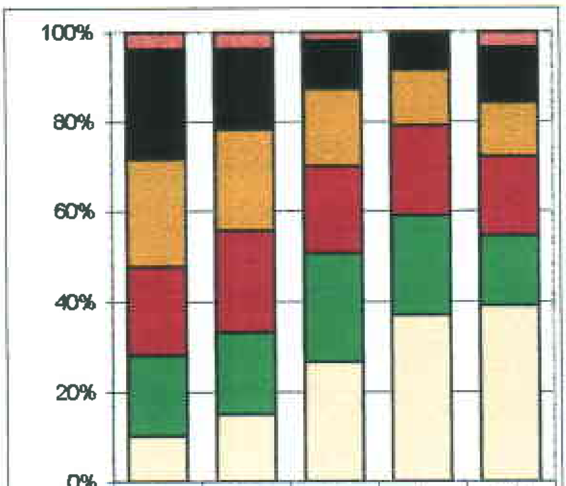
(a)



	<5	5-7.9	8-12.5	12.6-24	24.1-84	>84
e/f	15.9%	6.5%	7.2%	5.0%	6.0%	9.6%
d	19.7%	12.2%	10.7%	6.8%	4.8%	2.8%
c	26.7%	25.0%	19.4%	17.6%	13.0%	12.4%
b	22.9%	28.9%	34.2%	35.0%	33.1%	38.4%
a	14.8%	27.2%	28.5%	35.6%	43.1%	36.7%

Distance from source (km)

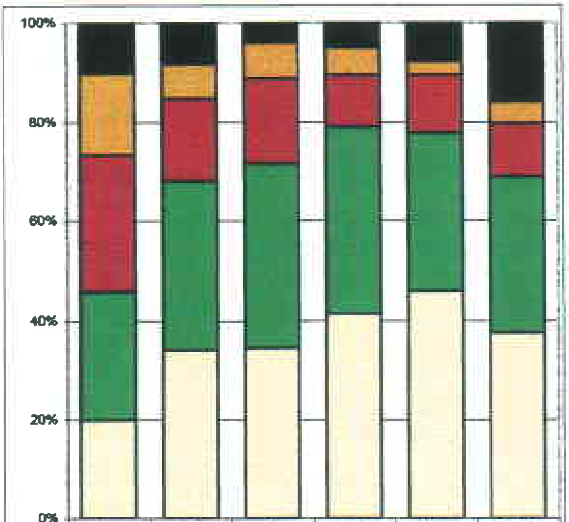
(b)



	a	b	c	d	e/f
>84	3.6%	3.7%	1.8%	0.8%	3.4%
24.1-84	24.6%	18.1%	10.8%	7.5%	12.3%
12.6-24	24.0%	22.5%	17.2%	12.5%	12.1%
8-12.5	19.6%	22.4%	19.4%	20.2%	17.7%
5-7.9	18.0%	18.3%	24.1%	22.2%	15.5%
<5	10.2%	15.0%	26.6%	36.9%	39.0%

Distance from source (km)

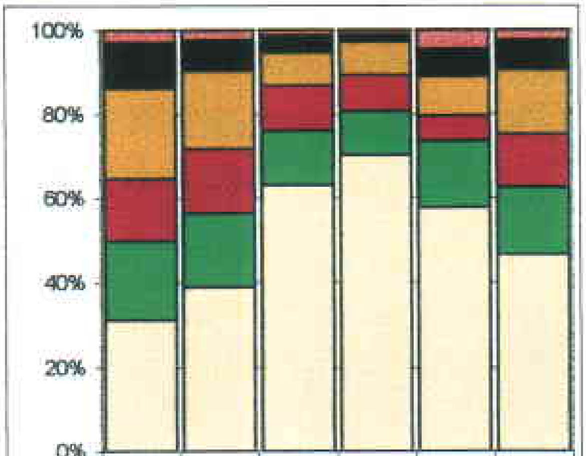
(c)



	1	2	3	4-5	6-7	8-10
e/f	10.3%	8.3%	3.8%	5.0%	7.8%	15.9%
d	16.3%	7.0%	7.3%	5.5%	2.8%	4.3%
c	27.6%	16.5%	17.1%	10.5%	11.5%	10.9%
b	25.9%	33.9%	37.2%	37.6%	32.0%	31.2%
a	19.9%	34.2%	34.6%	41.5%	45.9%	37.7%

Discharge class

(d)



	a	b	c	d	e/f	Grand Total
8-10	2.9%	2.3%	1.2%	0.9%	4.4%	2.3%
6-7	10.9%	7.3%	4.0%	1.8%	6.6%	7.1%
4-5	21.5%	18.6%	7.9%	7.8%	9.3%	15.4%
3	14.8%	15.2%	10.7%	8.6%	5.8%	12.7%
2	18.6%	17.6%	13.1%	10.5%	16.1%	16.1%
1	31.3%	38.9%	63.1%	70.3%	57.7%	46.5%

Discharge class

Appendix 9 The main user questionnaire circulated to the Environment Agency

1995 GENERAL QUALITY ASSESSMENT - BIOLOGY

POST SURVEY APPRAISAL

ENVIRONMENT AGENCY REGION : NORTH WEST

NAME OF PERSON COMPLETING QUESTIONNAIRE :

NAMES OF OTHERS CONTRIBUTING TO RESPONSE :

REGION : NORTH WEST

According to IFE records, a total of 868 sites were surveyed for aquatic macro-invertebrates in your Region during the 1995 GQA.

Q1: For each of the following categories of watercourse type, please indicate your opinion on the adequacy of the number of sites sampled in order to get a reliable representation of the biological condition of rivers in your region. Tick only one column per watercourse type.

WATERCOURSE TYPE		MANY MORE THAN NECESSARY	SLIGHTLY MORE THAN NECESSARY	APPROXIMATELY RIGHT NUMBER	SLIGHTLY FEWER THAN NECESSARY	MANY FEWER THAN NECESSARY
ALL WATERCOURSES AS A WHOLE						
CLEAN LARGE, DEEP RIVERS						
POLLUTED LARGE, DEEP RIVERS						
CLEAN MIDDLE REACHES						
POLLUTED MIDDLE REACHES						
CLEAN UPLAND HEADWATERS						
POLLUTED UPLAND HEADWATERS						
CLEAN LOWLAND HEADWATERS						
POLLUTED LOWLAND HEADWATERS						
ACIDIFIED SITES						
AGRICULTURALLY ENRICHED SITES						
URBAN WATERCOURSES						
CANALS						
DRAINS AND DITCHES						
OTHER 1 (STATE)						
OTHER 2 (STATE)						
OTHER 3 (STATE)						
OTHER 4 (STATE)						
OTHER 5 (STATE)						

REGION : NORTH WEST

Q2 If you feel that there are any differences between your component areas/laboratories, in the adequacy of the number of sites sampled, which are significant and need recording, please give them in the following text box.

Q3 Please use the following text box to provide any additional comments you may wish to make on the number and type of sites sampled.

REGION : NORTH WEST

For the purposes of the 1995 GQA, a manual was produced that offered recommendations on the manner in which samples should be collected during the survey. The reference to this manual is as follows:

Murray-Bligh, J A D (1997) Procedures for collecting and analysing macroinvertebrate samples for RIVPACS. Environment Agency Internal Document BT 001, Version 1.0, 13th March, 1997.

Methods are constantly being refined and any views you have will be taken into consideration when producing the recommendations for the 2000 survey.

Q4 The recommended methods for collecting macro-invertebrate samples exclusively using a pond-net are laid out in sections 3.7.1 to 3.7.3f (pp 3.25 - 3.32) and 3.7.6 (p 3.41). Did you fully follow these procedures for collecting samples in 1995 GQA?

YES ☐ **NO** ☐

Q5 If you answered no to Q4, what modifications did you make to the recommended method?

Q6 If you answered yes to Q4, in what way, if any, did the method you adopted for sampling by pond-net and search in the 1995 GQA differ from the procedures you generally adopted prior to that survey? Please include the main differences, if any between the approaches adopted for the 1990 RQS and 1995 GQA.

REGION : NORTH WEST

In the 1995 GQA sampling manual (BT001) alternative methods are recommended for sampling deep water sites. General procedures were recommended for dredge sampling in section 3.7.1 (pp 3.25 - 3.28) and more specific procedures in section 3.7.4 (pp 3.32 - 3.36). Recommended airlift procedures are given in 3.7.1 (pp 3.25 - 3.28) and 3.7.5 (pp 3.36 - 3.40). Further recommendations on additional sweep sampling and emptying nets are given for both methods in sections 3.7.3g (p 3.32) and 3.7.6 (p 3.41) respectively.

Q7 Which of the following methods did you use to sample sites that were too deep to sample by pond-net except from the bank? Please tick any that apply.

DREDGE ☐ **AIR-LIFT** ☐

BANKSIDE NETTING ONLY ☐ **OTHER** ☐

SPECIFY OTHER ....

Q8 If you used a dredge and/or an airlift, did you fully follow the above procedures for collecting samples in 1995 GQA?

YES ☐ **NO** ☐

Q9 If you answered no to Q8, what modifications did you make to the recommended methods?

Q10 If you answered yes to Q9, in what way, if any, did the methods you adopted for deep water sampling in the 1995 GQA differ from the procedures you generally adopted prior to that survey? Please include the main differences, if any between the approaches adopted for the 1990 RQS and 1995 GQA.

REGION : NORTH WEST

Q11 If you feel that there are any differences between your component areas/laboratories, in the compliance with sampling procedures set out in manual BT0001, which are significant and need recording, please give them in the following text box.

Q12 Please use the following text box to provide any additional comments you may wish to make on the recommended methods to be used to sample macro-invertebrates in national surveys.

REGION : NORTH WEST

The 1995 GQA manual (BT 001) laid down methods of sorting and identifying macro-invertebrate samples (Section 3.9, pp 3.42 – 3.47 and Section 3.10, pp. 3.47 – 3.60). Laboratory sorting of samples was requested in preference to bankside sorting and live identification.

Q13 Did you ever undertake live bankside sorting and identification of samples during the 1995 survey?

SORTING

NEVER ☐ SOMETIMES ☐ ALWAYS ☐

IDENTIFICATION

NEVER ☐ SOMETIMES ☐ ALWAYS ☐

Q14 If you answered "always" or "sometimes" for either part of Q13 please describe the circumstances where you used bankside sorting and what the advantages of this approach were.

SORTING:

IDENTIFICATION:

REGION : NORTH WEST

Q15 After sampling, how did you transport the samples to the laboratory?

FIXED IN FORMALDEHYDE	
PRESERVED IN ALCOHOL	
LIVE	
OTHER (STATE)	

Q16 If you answered "live" to Q15, please give details of the **exact** procedure used.

Q17 Do your laboratories have adequate facilities for the safe handling of formaldehyde? If appropriate, explain how this differs between areas.

YES ☐ **NO** ☐

Differences between areas:

Q18 Do any of your laboratories have adequate facilities for the safe handling of formaldehyde but do not use them for the applying formaldehyde as a preservative for GQA macro-invertebrate samples? If so please give reasons

YES ☐ **NO** ☐

Reasons:

REGION : NORTH WEST

Q19 If you feel that there are any differences between your component areas/laboratories, in the way in which you process samples, which are significant and need recording, please give them in the following text box.

Q20 Please use the following text box to provide any additional comments you may wish to make on the recommended methods to be used to process macro-invertebrate samples for national surveys.

1995 GQA - POST SURVEY APPRAISAL SAMPLE IDENTIFICATION (1)

REGION : NORTH WEST

The 1995 GQA manual required that all the aquatic macro-invertebrates in the sample be identified, including the pupae caddis and dipterans (Section 3.10.3, p3.55 – 3.56).

Q21 What level of identification did you achieve for your samples from the 1995 GQA? Please give answers for each of the four taxonomic levels below.

TAXONOMIC LEVEL	ALWAYS	SOMETIMES	NEVER
BMWP FAMILIES			
ALL FAMILIES			
RIVPACS SPECIES LEVEL (SOME TAXA ONLY)			
RIVPACS SPECIES LEVEL (ALL TAXA)			

Q22 Which families do you have the greatest difficulty in identifying? Include difficult life stages of groups you otherwise find easy to identify (e.g. Goeridae pupae, immature Leuctridae/Capnidae etc).

REGION (PLEASE COMPLETE):

Q23 If you feel that there are any differences between your component areas/laboratories, in the level of identification achieved, which are significant and need recording, please give them in the following text box.

Q24 Please use the following text box to provide any additional comments you may wish to make on the identification of taxa. Amongst the issues you may wish to comment on are the value ranges of abundance classes and difficulties in the estimation of the correct classes for each family.

Identification

Assignment of abundance classes

REGION : NORTH WEST

Analytical Quality Control (AQC) and Quality Audit (Audit or QA) procedures were required for the 1995 GQA. AQC is an internal procedure in which experienced analysts check the sorting and identification performance of colleagues for a pre-set proportion of samples processed. The audit is an external procedure in which the performance of Agency staff at sorting and identification is assessed by experts from another organisation, based upon a pre-determined number of all samples processed. Samples may be subject to external audit before or after internal AQC checks.

Q25 Do you think that internal AQC was of value in helping to control the performance of sample sorting and identification. Please use the text box provided, if you wish, to give reasons for your answer:

SORTING	**YES**	☐	**NO**	☐
IDENTIFICATION	**YES**	☐	**NO**	☐

Reasons:

Q26 Please describe the process you currently use for selecting samples for internal AQC.

REGION (PLEASE COMPLETE):

Q27 Please describe the process you currently use for selecting samples for external audit

Q28 What type of action do you take when samples fail to pass the national AQC target in your Region.

Q29 What type of action do you take when samples fail to pass the external audit target in your Region.

REGION : NORTH WEST

Q30 If you feel that there are any differences between your component areas/laboratories, in your AQC and audit procedures, which are significant and need recording, please give them in the following text box.

Q31 Please use the following text box to provide any additional comments you may wish to make on the use of AQC and audit procedures for the sorting and identification of macro-invertebrate samples, with special reference to national GQA surveys.

REGION : NORTH WEST

The macro-invertebrate data collected during the 1995 GQA was used to determine the BMWP score, number of scoring taxa and ASPT (Average Score Per Taxon) for each sample. Individual seasons taxon lists for spring and autumn were also combined to form a site taxon list for the year. BMWP index values were computed for the combined seasons lists for each site. RIVPACS was then used to produce optimal (= expected) faunal lists and BMWP index values for each sample or combination of samples. The ratio of observed to expected BMWP index values (often referred to as EQI or Ecological Quality Index) was used to band sites into grades of biological condition. Separate grades were determined for each season's and for paired seasons' faunal lists for each site based on each of ASPT and number of BMWP taxa. An overall site grade for was determined by taking the lower of the grades determined separately for ASPT and number of taxa for the two seasons combined list.

The EQI band ranges used for assessing the combined seasons ASPT and number of taxa grades for the 1995 GQA were as follows:

Grade	Description	Lower grade limits	
		EQI ASPT	EQI number of taxa
a	Very good	1.00	0.85
b	Good	0.90	0.70
c	Fairly good	0.77	0.55
d	Fair	0.65	0.45
e	Poor	0.50	0.30
f	Bad	0.00	0.00

Q32 Please use the following text box to give any comments you wish on this banding system and how it has worked in interpreting the 1995 GQA data. Please record any differences between your component areas/laboratories that are significant and need recording.

REGION : NORTH WEST

Q33 the evaluation of the biological condition of river stretches in the 1995 GQA depended exclusively on the use of RIVPACS to interpret macro-invertebrate data. What other methods would you like to see applied to the interpretation of the type of macro-invertebrate assemblage data collected during the 1995 GQA?

SYSTEM OF EVALUATION	TYPE OF STRESS/SITE FOR WHICH THE PROPOSED SYSTEM IS OF PARTICULAR RELEVANCE

Q34 The evaluation of the biological condition of river stretches in the 1995 GQA depended exclusively on the use of macro-invertebrate data. What other taxonomic groups and methods of approach, **if any**, would you like to see applied to the interpretation of the biological condition of the river stretch?

SYSTEM OF EVALUATION	TYPE OF STRESS/SITE FOR WHICH THE PROPOSED SYSTEM IS OF PARTICULAR RELEVANCE

REGION : NORTH WEST

Q35 If you feel that there are any differences between your component areas/laboratories, in the importance attached to alternative approaches to assessing biological condition, which are significant and need recording, please give them in the following text box.

Q36 Please use the following text box to provide any additional comments you may wish to make on the use of alternative approaches to the assessment of the biological condition of river stretches.

REGION : NORTH WEST

For the 1995 GQA, techniques were set out for collecting environmental data for RIVPACS predictions (BT 001, Sections 3.5 and 3.6, pp 3.7 - 3.25). Some data were time invariant and could be read off maps. Others were time variant and needed to be measured at the site.

Q37 RIVPACS requires annual mean alkalinity values in order to make the best available faunal predictions. If alkalinity values are not available, any of the listed determinands below may be used as a surrogate. Which determinand was most commonly used for predictions in your Region?

ALKALINITY ☐ **HARDNESS** ☐

CALCIUM ☐ **CONDUCTIVITY** ☐

Q38 The manual recommends (p2.21) that an absolute minimum of three evenly spaced alkalinity or surrogate values are used to calculate the annual mean value but recommends that a minimum of twelve monthly values are obtained. **Approximately** what proportion of the annual mean alkalinity values you obtained for the 1995 GQA survey were based on >9 values.

>75% ☐ **>50%** ☐ **≥25%** ☐ **<25%** ☐

Q39 On what year(s) were most of your annual mean alkalinity values based?

1995 ☐ **1994** ☐ **1994-95** ☐ **1993-95** ☐ **1990** ☐

OTHER ☐ **PLEASE STATE:**

Q40 For sites that were common to the 1995 GQA and 1990 RQS, approximately what proportion of the time invariant values (NGR, altitude, slope, distance from source and discharge category) were derived in the following manner:

NEWLY CALCULATED IN 1995 ☐ %

BASED ENTIRELY ON 1990 VALUES ☐ %

AVERAGED FROM 1990 & 1995 VALUES ☐ %

1995 GQA - POST SURVEY APPRAISAL ENVIRONMENTAL DATA (2)

REGION : NORTH WEST

Q41 For the majority of sites, which of the following determinands were measured by more than one independent person as a means of quality control on the accuracy of the data acquisition? Please tick all that apply.

NGR ☐ **ALTITUDE** ☐ **SLOPE** ☐

DISTANCE TO SOURCE ☐ **DISCHARGE CATEGORY** ☐

Q42 Please indicate how difficult you find it to record each of the following RIVPACS variables and what the difficulties were, if any?

NGR **HIGH** ☐ **MODERATE** ☐ **LOW** ☐

Main difficulty

ALTITUDE **HIGH** ☐ **MODERATE** ☐ **LOW** ☐

Main difficulty

SLOPE **HIGH** ☐ **MODERATE** ☐ **LOW** ☐

Main difficulty

DISCHARGE **HIGH** ☐ **MODERATE** ☐ **LOW** ☐

Main difficulty

REGION : NORTH WEST

Q42 (Continued)

DISTANCE TO SOURCE: HIGH ☐ MODERATE ☐ LOW ☐

Main difficulty

ALKALINITY HIGH ☐ MODERATE ☐ LOW ☐

Main difficulty

WIDTH HIGH ☐ MODERATE ☐ LOW ☐

Main difficulty

MEAN DEPTH HIGH ☐ MODERATE ☐ LOW ☐

Main difficulty

SUBSTRATUM COVER: HIGH ☐ MODERATE ☐ LOW ☐

Main difficulty

Q43 For the majority of sites, which of the following determinands were measured by more than one independent person in each season as a means of quality control on the accuracy of the data acquisition? Tick all that apply.

DEPTH ☐ WIDTH ☐ SUBSTRATUM ☐

REGION : NORTH WEST

Q44 What other environmental variables would you like to see recorded during GQAs for use for predictive or interpretative purposes?

Q45 If you feel that there are any differences between your component areas/laboratories, in the difficulties associated with recording environmental data for RIVPACS, which are significant and need recording, please give them in the following text box.

Q46 Please use the following text box to provide any additional comments you may wish to make on the difficulties associated with recording environmental data for RIVPACS

REGION : NORTH WEST

The 1995 GQA manual (BT 001, Chapter 4) included extensive recommendations concerning the specifications of the equipment to be used during the survey.

Q47 Please use the space below to make any comments you wish on the equipment specifications provided in the manual, including difficulties encountered in using any of the equipment and recommendations for better alternatives. Please note any significant differences between areas.

REGION : NORTH WEST

Q48 In addition to any use that was made of the biological and environmental data for national reporting or evaluation of the 1995 GQA, were any reports on the survey produced at your area or regional level?

YES ☐ **NO** ☐

Q49 If you answered yes to Q48, please list the reports. Please indicate with an asterisk which, if any, of these reports included comparisons between the results of the 1990 RQS and the 1995 GQA:

Q50 Please give a brief description of the type of reports produced in your Region which made use of the 1995 GQA biological and environmental data for purposes other than recording the proportions of river length in different biological grades. Continue on a separate page if needed.

Q51 Please list, very briefly, any other uses you would like to see made of the 1995 GQA data at regional or national level.

REGION : NORTH WEST

Q52 Do you consider that in the 1995 GQA your Region had a consistent approach to all aspects of the GQA (which could affect the data) across its component Areas?

YES ☐ **NO** ☐

Q53 If you answered No to Q129, please list the major variations that occurred in the following text box.

Q54 Please use the following text box to record any comments you wish to make about the 1995 GQA which are relevant to the design and implementation of future surveys and which have not been covered by the preceding question. Please continue on a separate sheet if necessary.

VERY MANY THANKS FOR YOUR TIME AND HELP IN COMPLETING THIS IMPORTANT QUESTIONNAIRE PLEASE RETURN YOUR FORM TO THE FOLLOWING ADDRESS BY 3rd May 1999:

Mike T Furse, Institute of Freshwater Ecology, River Laboratory, East Stoke, WAREHAM Dorset BH20 6BB. E-mail : m.furse@ife.ac.uk

A summary of replies will be circulated to all Regions.

Appendix 10 The supplementary user questionnaire circulated to the Environment Agency

1995 GENERAL QUALITY ASSESSMENT - BIOLOGY

POST SURVEY APPRAISAL

SUPPLEMENTARY QUESTIONNAIRE

Completion of this supplement is less important than the main questionnaire. However, we would be grateful for any replies you are able to offer to any of the questions. Thank you.

ENVIRONMENT AGENCY REGION : NORTH WEST

NAME OF PERSON COMPLETING QUESTIONNAIRE :

NAMES OF OTHERS CONTRIBUTING TO RESPONSE :

1995 GQA - POST SURVEY APPRAISAL — NUMBER OF SAMPLES (S1)

SUPPLEMENT — **REGION : NORTH WEST**

The 1990 River Quality Survey involved the collection of macro-invertebrate samples from each of three seasons, spring, summer and autumn, partly on the advice of the Institute of Freshwater Ecology team responsible for the development of RIVPACS. In order to enhance the level of coverage of sites in 1995 within the available budget and to maintain the other operational duties of the Agency biologists, the number of visits to each site was reduced to two. Single samples were taken in each of spring and autumn. It was claimed that this would not result in unacceptable reduction in the reliability of evaluations of environmental quality derived from RIVPACS.

QS1: Under the system of collecting a single sample per visit, what do you consider the **optimal number** of sampling visits to each site to provide a reliable estimate of the biological condition of a site over the year of sampling as a whole?

ONE ☐ **TWO** ☐

THREE ☐ **FOUR** ☐

MORE THAN FOUR ☐ **STATE:**

QS2 Under your optimal sampling programme, when do you consider sampling should take place?

QS3: Under the system of collecting a single sample per visit, what do you consider the **minimum number** of sampling visits to each site to provide an acceptable estimate of the biological condition of a site over the year of sampling as a whole.

ONE ☐ **TWO** ☐

THREE ☐ **FOUR** ☐

MORE THAN FOUR ☐ **STATE:**

QS4 Under your minimum sampling programme, when do you consider sampling should take place?

1995 GQA - POST SURVEY APPRAISAL   NUMBER OF SAMPLES (S2)

SUPPLEMENT   **REGION : NORTH WEST**

QS5 If you have had experience of sampling programmes that have involved both three and two seasons single sample collections (e.g. the 1990 RQS and 1995 GQA), to what extent do you think the reliability of the assessments made from two single season samples was poorer than three seasons?

MUCH POORER (2 SEASONS SAMPLING UNACCEPTABLE) ☐

SLIGHTLY POORER (2 SEASONS SAMPLING ACCEPTABLE) ☐

NO APPARENT DIFFERENCE (2 SEASONS PREFERABLE) ☐

QS6 Do you think that replicate sampling would improve the quality of assessments of the biological condition of sites.

YES ☐

NO ☐

DON'T KNOW ☐

QS7 If you answered yes to QS6, what is your optimal replicate sampling regime, in terms of number of seasons and numbers of replicates per season?

NUMBER OF SEASONS ☐

NUMBER OF SAMPLES PER SEASON ☐

QS8 If you answered yes to QS6 and completed QS7, what seasons/months would you recommend for sampling?

1995 GQA - POST SURVEY APPRAISAL — NUMBER OF SAMPLES (S3)

SUPPLEMENT — **REGION : NORTH WEST**

QS9 If you feel that there are any differences between your component areas/laboratories, in the number of samples that should be collected and the timing of sampling, which are significant and need recording, please give them in the following text box.

QS10 Please use the following text box to provide any additional comments you may wish to make on. the number of samples that should be collected and the timing of sampling

1995 GQA - POST SURVEY APPRAISAL   SAMPLE PROCESSING (S1)

SUPPLEMENT   **REGION : NORTH WEST**

QS11 Whilst accepting that this is a "how long is a length of string" question, please estimate the **APPROXIMATE AVERAGE LENGTH OF TIME**, in minutes, you took to sort the following type of sample in the 1995 GQA. Your answers should take account of the range of samples from those with few individual taxa to those with numerous and/or diverse taxa.

SAMPLE TYPE	AVERAGE TIME IN MINUTES
Mainly gravel or coarser substratum with little detritus or macrophyte material	
Mainly gravel or coarser substratum with copious detritus and/or macrophyte material	
Mainly sand with little detritus or macrophyte material	
Mainly sand with copious detritus and/or macrophyte material	
Mainly silt with little detritus or macrophyte material	
Mainly silt with copious detritus and/or macrophyte material	

QS12 If you feel that there are any differences between your component areas/laboratories, in the length of time you take to process various types of sample, which are significant and need recording, please give them in the following text box.

SUPPLEMENT **REGION : NORTH WEST**

QS13 What is your opinion of the following text descriptions of each grade of the 1995 RQS system. Please suggest any alternative wording you think appropriate.

GRADE A - VERY GOOD: The biology is similar to (or better than) that expected for an average and unpolluted river of this size, type and location. There is a high diversity of Families, usually with several species in each. It is rare to find a dominance of any one Family.

GRADE B - GOOD: The biology shows minor differences from Grade A and falls a little short of that expected for an unpolluted river of this size, type and location. There may be a small reduction in the number of Families that are sensitive to pollution, and a moderate increase in the number of individuals in the Families that tolerate pollution (like worms and midges). This may indicate the first signs of organic pollution.

GRADE C - FAIRLY GOOD: The biology is worse than that expected for an unpolluted river of this size, type and location. Many of the sensitive Families are absent or the number of individuals is reduced, and in many cases there is a marked rise in the number of individuals in the Families that tolerate pollution.

QS13 Continued.

GRADE D - FAIR: The biology shows big differences from that expected for an unpolluted river of this size, type and location. Sensitive Families are scarce and contain only small numbers of individuals. There may be a range of those Families that tolerate pollution and some of these may have high numbers of individuals.

GRADE E - POOR: The biology is restricted to animals that tolerate pollution with some families dominant in terms of the numbers of individuals. Sensitive families will be rare or absent.

GRADE F - BAD: The biology is limited to a small number of very tolerant families, often only worms, midge larvae, leeches and the water hoglouse. These may be present in very high numbers. Even these may be missing if the pollution is toxic. In the very worst case there may be no life present in the river.

Thanks for any replies you have given in this supplement. A summary of replies will be circulated to all regions please can you return your form to the following address by 3rd May, 1999: Mike T Furse, Institute of Freshwater Ecology, River Laboratory, East Stoke, WAREHAM Dorset BH20 6BB. E-mail: m.furse@ife.ac.uk

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