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## 2000 GQA Biology Survey Project Record

John Murray-Bligh

January 2003



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**2000 GQA Biology Survey  
Project Record**

**John Murray-Bligh**

**January 2003**

ENVIRONMENT AGENCY



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**Statement of Use**

This report is to help those planning and managing future GQA biology surveys and those analysing data from the 2000 GQA survey. It provides details of the technical and management procedures used in the 2000 biological GQA survey. It includes management documents that were produced to manage the survey.

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## 1 INTRODUCTION

This report provides details of the biological component of the General Quality Assessment (GQA) survey of rivers and canals undertaken in 2000. Its aim is to help those organising and managing future surveys or interpreting the results of the survey. It describes details of the technical procedures and organisational framework that were used. It does not include the results of the survey, which were reported in a separate Technical Report produced in July 2002 (Environment Agency, 2002b). The absence of a similar document for the 1995 survey caused problems in the 2000 survey, particularly the absence of information about the data analysis.

The 2000 GQA survey was the third quinquennial national biological river quality survey (biological GQA survey) of England and Wales using standard sampling and analytical methods developed in 1990, including an analytical quality audit. These were based on the sampling and analytical methods for RIVPACS. Refinements in the method continued, but involved fewer changes than between 1990 and 1995. These changes are outlined in Section 2.7.

The methods were originally developed by the National Rivers Authority (NRA, predecessor to the Environment Agency) and its Regional Biology Group (predecessor to the National Biology Technical Group, NBTG). This group, like NBTG, included representatives from Scotland (the River Purification Boards, predecessors of the Scottish Environmental Protection Agency, SEPA) and Northern Ireland (the Department of the Environment's Industrial Research and Technology Unit, IRTU). As in 1990, the survey was matched by similar surveys in Northern Ireland (undertaken by IRTU) and in Scotland (undertaken by SEPA). Despite this, changes in individuals belonging to the Regional Biology Group/NBTG and actually undertaking the survey were gradual.

Although the fundamental technical procedures and organisational framework were the same as those used in 1995, there were some differences.

1. A 2000 GQA Steering Group provided overall co-ordination of the survey.
2. The National reporting group were involved from the beginning of the survey (they did not come into being and take over reporting of the 1995 survey until the actual survey work and some reporting had been completed).
3. Data was entered onto the national biological database (Biology for Windows, B4W)
4. Data analysis was co-ordinated, and largely undertaken by, the National Centre for Environmental Data and Surveillance (NCEDS) at Twerton. In 1995 (and 1990) this was undertaken by Water Quality in Anglian Region.
5. Isle of Man government laboratories joined NBTG and surveyed the Isle of Man using the standard methods, including the analytical quality audit.
6. A full survey was not undertaken in Scotland, which had adopted an annual survey involving full analysis at key sites and bank-side assessments at numerous low-risk sites. Only samples for which full analysis had been undertaken were fully compatible with this survey.





## 2 MANAGEMENT OF THE SURVEY AND ITS WORKING GROUPS

The survey was undertaken for the Department of the Environment, Food and the Rural Affairs (DEFRA). The Environmental Monitoring Strategy unit at Head Office Bristol initiated it. Alastair Ferguson led the survey.

The GQA 2000 Survey Steering Group was established to co-ordinate overall GQA survey. The Rivers group was responsible for delivering the chemical survey and for regional reporting of results. John Murray-Bligh was responsible for the overall management of the biological component of the survey and the National Biology Technical Group was responsible for delivering it.

Table 2.1 Membership of the 2000 GQA Survey Steering Group in 1999

|                   |   |  |
|-------------------|---|--|
| Alastair Ferguson | - | Chair, Environmental Strategy            |
| Ashley Holt       | - | Water Quality Head Office                |
| Jane Kinniburgh   | - | Environmental Strategy, Reporting        |
| Tony Warn         | - | Water Quality Manager Anglian Region     |
| Martin Stark      | - | Chair Biology Technical Group            |
| John Murray-Bligh | - | Biology Technical Group Year 2000 Survey |
| John Kupiec       | - | NCEDS                                    |
| Dave Jowett       | - | Environmental Strategy, Secretary        |
| Joining later:    |   |  |
| Graeme Storey     | - | NCEDS                                    |
| Ron Thomas        | - | NCEDS                                    |
| Simon Bingham     | - | Environmental Strategy, Reporting        |

The GQA 2000 Survey Steering Group first met on 13 January 1999 (initially as the Millennium Survey Group).

A number of project plans were produced to help ensure that all important matters were dealt with during the initial planning stages. The first list of activities was produced in January 1999 (see Section 2.1) and the third and last on 13 December 2000 (see Section 2.2). A timetable for completion of the main items in each component of the 2000 GQA survey (chemistry, nutrients, biology, aesthetics, and estuaries) were agreed by the GQA 2000 Survey Steering Group in their first meeting, see Section 2.3

At their second meeting, the GQA 2000 Survey Steering Group considered proposals for implementing recommendations made in the post-survey appraisal of the 1995 biological GQA survey, See Section 2.5.

In October 1999 the GQA 2000 Survey Steering Group made decisions about the review of biological sites in preparation for the survey. Notes about this are reproduced in Section 2.4.

The National Biology Technical Group (NBTG) was established in 1989 as the Regional Biology Group to co-ordinate the management of the 1990 National Biological River Quality Survey. It comprised a representative from each Region, as well as Northern Ireland,

Scotland and Isle of Man, together with a small number of staff with national responsibilities for biology within the Environment Agency. The group first met as the NBTG on 24 February 1998, and continued in essentially the same form, with similar membership, until mid 2002 and the BRITE reorganisation of the Environment Agency. The group usually met quarterly and covered all aspects of the management of biology nationally. The national surveys were a major component, but biological R&D, methods for survey, sampling, sorting and analysis (including classifications) were amongst the other related subjects covered by the Group.

Table 2.2 Membership of the 2000 GQA Survey Steering Group in 1999- May 2001

|                        |   |  |
|------------------------|---|--|
| Martin Stark           | - | Chairman, FRCN   |
| Paul Raven             | - | Head of Conservation & Ecology   |
| Paul Logan             | - | National Ecology Advisor, R&D Topic Leader Biological Monitoring         |
| John Murray-Bligh      | - | Technical Secretary  |
| Dave Jowett            | - | Head Office (EMS), Ecology Client Group                                  |
| Graeme Storey          | - | EDS National Centre  |
| Sarah Chadd            | - | Anglian Region (until September 1999)                                    |
| Julia Standsfield      | - | Anglian Region (December 1999)   |
| Jacqui Murphy          | - | Anglian Region (from March 2000)   |
| Shelley Howard         | - | -Midlands Region   |
| Brian Hemsley-Flint    | - | North East Region  |
| Elaine Fisher          | - | North West Region, Marine Biology Technical Group (until September 1999) |
| Karen Williams         | - | North West Region (from December 1999)                                   |
| Bob Dines              | - | Southern Region  |
| George Green           | - | South West Region  |
| Paul Logan             | - | Thames Region, R&D Topic Leader Biological Monitoring (until March 2000) |
| Bill Parr              | - | Thames Region (From May 2000)  |
| Graham Rutt            | - | Welsh Region (until September 1999)                                      |
| Richard Hemsworth      | - | Environment Agency Wales (from December 1999)                            |
| Peter Hale             | - | IRTU Northern Ireland  |
| Dave Lowson            | - | SEPA   |
| Phil Styles            | - | Isle of Man  |
| A frequent invitee was |   |  |
| Alastair Ferguson      | - | EMS, Head Office, R&D Programme Manager Environmental Monitoring         |

NBTG held a special meeting on 26 January 1999 to plan the survey. Minutes of that meeting are reproduced in Section 2.6. The survey was an item on the agendas of most of its (approximately quarterly) meetings until the results were reported in summer 2001. Decisions made by the group were recorded in its minutes and were collated in a document that was continuously updated and circulated periodically to members of the group. This document also included relevant decisions made by the 2000 GQA Survey Steering Group. The final update was on 31 August 2001 (see the following Section 2.7).

One of the main concerns was sufficiency of resources. The full survey represented a considerable increase in effort compared to non-quinquennial survey years, so efforts were made to acquire additional resources. In 1999, when the survey was being planned, a move to more regular annual surveillance of biological quality was being considered, in conjunction with biological quality objectives.

Table 2.3 Biological resource requirements to undertake the GQA survey (FTEs). This table was compiled on 16 March 1999 on the basis of information obtained by NBTG from Regional Biologists.

| REGION     | % GQA completed annually | Additional resources required to complete in 2000 |
|------------|--------------------------|---|
| Anglian    | 100                      | None  |
| Midlands   | 67                       | 1   |
| North East | 40                       | 5   |
| North West | 46                       | 4.75  |
| Southern   | 50                       | 4   |
| South West | 10                       | 2   |
| Thames     | 25                       | 4   |
| Wales      | 10                       | 3.75  |
|            |                          |   |
| TOTAL      |                          | 24.5  |

A small group of biologists met on an ad-hoc basis on 12 December 2000 to assess progress and determine what actions were needed to complete the survey. The notes of this meeting are presented in Sections 5.6 and 5.7.

## 2.1 The first 2000 GQA Biology Survey Project Plan

This was produced in January 1999, modified in May 1999 following consultation with NBTG. Additions are shown in red and deletions crossed out.

### Survey Development

Agree survey steering group

Identify reporting lines and customers

Prepare Draft Survey Plan and timetable.

Draft Survey Plan consultation.

Visit each Region's RB & Area Team leaders to identify problems and needs.

Solicit ideas for using data/samples internally and from external researchers (value-added), which may or may not be related to GQA

JMB acquire MS Project software

MS Project software training

### Staff resourcing

Determine additional staff needed

Refer to decision for annual or quinquennial GQA monitoring  
Confirmation of approval for additional staff (or confirm no approval)  
Advertise for additional staff  
Train additional staff

Confirm that staff have received health & safety training

Survey & analytical methods

2000 GQA Workshop

~~Agency induction~~

Obtain additional equipment for staff

#### Communication Strategy incl. Reporting

Prepare draft strategy for reporting (who does what, how and when)

Draft strategy for reporting consultation

BTG / Discussion Group

Head Office Reporting Group

EDS National Centre (Twerton)

PR

External organisations

Determine output types

Nature of output (Technical Report, 2000 SoE report, leaflet, web page, etc).

Responsibilities

Schedule

Determine management information reporting

Milestone reporting

Liaison

Chasing

Prepare revised strategy for reporting

#### Training

Prepare outline of training needed for 2000 survey

Determine options (as 1990 for all; small number for selected folk; single for cascade)

Estimate costs of options

~~Agree on health & safety training~~

Consult biologists via BTG

Consult health & safety

Consult training

Determine contact in Training

Determine source of finance for training

Consult Training

Draft workshop course syllabus/outline

Course content

Nature of training workshops

Consult Health & Safety

Consult BTG & Areas

Produce definitive course syllabus/outline

Organise trainers for workshop course syllabus/outline

Consult training

Consult Health & Safety

Draft Form A (or equivalent)

- Draft specification for contract for external trainers
- Draft Form C or tender documents for external trainers
- Evaluate tender documents for external trainers
- Issue contract
- Consult with external trainer and internal trainer(s)
- Prepare Workshop course
  - Prepare written course material
  - Procure training aids and equipment
  - Agree training schedule with Regions/Areas
  - Deliver Regional workshops
  - Review feedback from workshops
  - Act on feedback from workshops in consultation with BTG
  - Process invoices and payment for external trainers
  - Certificate attendees
- Prepare roundup workshop (new appointees)
  - Prepare written course material
  - Procure training aids and equipment
  - Agree training schedule with Regions/Areas
  - Deliver Regional workshops
  - Review feedback from workshops
  - Act on feedback from workshops in consultation with BTG
  - Process invoices and payment for external trainers
  - Certificate attendees
- Prepare roundup workshop(s) (deep-water sampling and other late methods, new staff)
  - Prepare written course material
  - Procure training aids and equipment
  - Agree training schedule with Regions/Areas
  - Deliver Regional workshops
  - Review feedback from workshops
  - Act on feedback from workshops in consultation with BTG
  - Process invoices and payment for external trainers
  - Certificate attendees
- Methods manuals
  - Collation of BTG decisions and changes
    - ~~Consult on method of dissemination and format~~
    - ~~Agree method of dissemination and format~~
    - Implement
  - Identify group responsible for manuals - if none BTG/ECG
  - Determine format of new version for 2000 survey
    - Consult R&D Project Methods Manuals
    - Decide on convert to Word
    - Decide on electronic format (CD/Web/ Bulletin Board)
    - Text structure/format
  - Decide on agreed methods
    - Canals (Pond Action?)
    - Deep waters (following RIVPACS deep waters project)
- BT001
  - Light revision (version 1.1)

Complete text  
Consult Andy Stocks

Print master

Copy

Distribute

Version 2.0 for 2000 survey

Identify group responsible for manuals - if none BTG/ECG

Determine content

Consult BTG/discussion Group

Consult Health & Safety

Organise external contractors

Contract specification

Write Form A?

Write Form C/tender document

Evaluate tender documents for external trainers

Issue contract

Consult with external trainer and internal trainer(s)

Write text

Obtain IC code

Print draft master

Consultation of draft

Sign off draft

Edit draft to final version

Print master copy

Reproduce

Advertise

Disseminate

BT002

Determine content

Consultation plan

Consult (may include BTG/discussion Group, Health & Safety, Rivers Group)

~~Consult BTG/discussion Group~~

~~Consult Health & Safety~~

~~Consult Rivers Group~~

Organise external contractors

Contract specification

Write Form A?

Write Form C/tender document

Evaluate tender documents for external trainers

Issue contract

Consult with external trainer and internal trainer(s)

Write text

Obtain IC code

Print draft master

Consultation of draft

Sign off draft

Edit draft to final version

Print master copy

Reproduce  
Advertise  
Disseminate

BT003

Light revision (version 1.0)  
Complete text  
Consult Andy Stocks  
Print master  
Copy  
Distribute  
Version 2.0 for 2000 survey  
Determine content  
Consult BTG/discussion Group  
Obtain revised AQC procedure from AQC sub-group  
Organise external contractors  
Contract specification  
Write Form A?  
Write Form C/tender document  
Evaluate tender documents for external trainers  
Issue contract  
Consult with external trainer and internal trainer(s)  
Write text  
Obtain IC code  
Print draft master  
Consultation of draft  
Sign off draft  
Edit draft to final version  
Print master copy  
Reproduce  
Advertise  
Disseminate

#### AQC Review

Draft Strategy for review (sub-group)  
Consult BTG on draft strategy for AQC review  
Identify shortcomings in existing system  
Analyse data from existing AQC  
Consult Regions & Areas  
Laboratory manager (Area Team Leader)  
Quality controller  
AQC analysts  
AQC'd analysts  
Draft revised AQC procedure  
Consult draft strategy for AQC review  
BTG  
Area Laboratory managers  
ECG  
(If financial implications, Area & Regional management)  
Draft revised AQC procedure for insertion into revised BT003



### Audit

Important to send to auditors in small batches - need to sort problem of transport by courier.

Consult labs.

Midlands Region (Nottingham) needs streamlining (fume cupboards in biology labs?).

Train quality controllers to send samples in small batches (batches of 5)

Reminders to labs to send audit samples

Transfer of audit results data to B4W electronically

Consult IFE (Rick Gunn) to identify format, fields, etc

Check suitable fields have been included in B4W (they should be as I identified them)

Modify B4W if necessary (to convert extract and calculate error data for classification)

Test electronic data transfer

### RIVPACS R&D

#### Methods

##### Deep water sampling

Sample collection in 6 rivers

Receipt of draft report

Consideration of implications for sampling for the survey

Consideration of training needs

Text to methods manual

##### Abundance categories

Receipt of draft report

Consideration of implications for sampling for the survey

Consideration of training needs

Text to methods manual

#### Revised RIVPACS Software

Decision on requirements on interim revision to analyse 2000 survey

LIFE scores

Canals

Deep waters & deep water BAMS

abundances

### Sampling

#### Equipment

Revise list of equipment and suppliers in the file "kit"

Laboratories determine additional equipment needed including spares and consumables

### BOOs

### Stretch Review

Ensure link between biology and chemistry

Comparison between old and new networks via database

Link to reporting of improvement and degradation

Compliance assessment

Assessment

Reporting

### Databases

Link with B4W project

Check that data storage and reporting needs of 2000 survey are met by B4W

Test classification in B4W

Liaison with Twerton

Link with GQA database

### Data collection

Determine responsibilities

Area responsibilities

Regional Biologist responsibilities

Twerton responsibilities

Determine authorities/contacts

Determine data collection and data transfer protocols

Determine procedure for quality assurance for data collection and handling

Determine procedure for data correction

Quality assure and correct data

Transfer biology stretch information from Stretch Database to B4W

### Data analysis & classification

Consideration of what analyses will be undertaken

GQA classification

LIFE scores

RIVPACS abundances

AI diagnostic

Species level analysis (e.g. at SSSIs)

Test databases

B4W data input and reporting

Areas/Regions

Twerton for GQA classification

Audit data transfer

RIVPACS III+ error module

### Post project appraisal

Planning

Form A

Specification

Undertake

### Write Technical Report

## **2.2 The third 2000 GQA Biology Survey Project Plan**

This plan was produced in 13 December 2000

### External Report

Liase with Sarah Hill from Environmental Assessment

Identify what reports are to be produced by Environmental Reporting Section of Head Office (JMB)

Determine what Areas/Regions/Twerton/HO Function/EDS have to do  
Determine what types of reports biology wants  
Liase with Rivers Group to identify what it will report  
    Identify information needed from other functions in order to produce report  
Regional/Area summaries  
    Determine level of detail (e.g. as Tony Warn's report)  
    Collate summaries  
    Correct summaries

#### Project Record (JMB)

To include:  
Milestones/diary of events  
Collation of BTG decisions and changes  
Progress of survey  
    audit progress reports (= survey progress)  
    Nov & Dec summary tables  
    Spring, Nov & Dec updates  
Workshop:     overheads  
                Feedback from workshops  
Ralph Clarke's report  
Revised list of equipment and suppliers in the file "kit"  
Related projects:     AQC Review & Audit  
                        RIVPACS R&D  
                        BQOs & Stretch Review  
                        AI Diagnostics  
Lessons learnt: contingency plans for future surveys: floods  
Details about the classification procedure

#### Databases

##### B4W

Test suitability for GQA classification  
Identify changes to data in B4W that might affect 1995 classification  
Identify what data is needed on B4W  
    Environmental data for RIVPACS  
    Seasons to be used  
    Floods

Link with GQA database  
Separate biology GQA database?

#### Data management

Determine responsibilities  
    Area responsibilities  
    Regional Biologist responsibilities  
    Twerton responsibilities  
Determine authorities/contacts  
Determine data collection and data transfer protocols  
Determine procedure for quality assurance for data collection and handling  
Determine procedure for data correction

## **Data collection**

Collate Biological data from Areas and Regions

Collate environmental data from Areas and Regions

Collate meta-data from Areas & Regions

Floods

Analysts (other lab/contractors)

Collate audit data

From CEH

From contractors (to determine their quality)

Verify (quality assure) data and correct data

Check to identify errors

Centralised: NGR, environmental data mismatch, out of range

Areas: using RBMS: watercourse name, distance from source/altitude

Other: to be specified

Transfer biology stretch information from Stretch Database to B4W

## **Data analysis & classification**

GQA classification

What environmental data to use

existing sites: summer

new sites: floods

alkalinity/conductivity

How many seasons to use (links to floods)

Out of season data (summer, winter)

Consideration of what analyses will be undertaken

For GQA survey

GQA classification

Determine effects of floods on classification

Devise method to link audit data to samples (contractors/other laboratories)

Devise method for dealing with single season/out of season data

Devise method for recording how we classified each site

Other analyses

LIFE scores

RIVPACS abundances

AI diagnostic

Species level analysis (e.g. at SSSIs)

Post flood recovery

Test databases

B4W data input and reporting

Areas/Regions

Twerton for GQA classification

Audit data transfer

RIVPACS III+ error module

Desirable actions

## **Post project appraisal**

Planning

Form A

Specification

Undertake

### Staff resourcing

Measure resources actually used to undertake survey

### R&D database

Produce a database with individual sample data including:

- Stretch data, site codes & matching to hydrometric and RHS sites
- Biology GQA
- Biology audit (includes contractors & lab:sample link)
- Chemistry GQA
- Chemistry non-GQA
- Stresses
- RHS
- Hydrometry

### Add audit data to B4W

- Areas
- Contractors (data and link to samples)

## **2.3 Timetable of main activities proposed by the 2000 GQA Survey Steering Group in January 1999**

The notes below were taken from the minutes of the 2000 GQA survey Steering Groups first meeting.

The biology component of the 2000 survey will be based on a revised network of sampling sites covering the same overall length of rivers surveyed on 1995. The survey will be delivered through the Biology Technical Group under the direction of the Project Board.

The key stages in delivering the survey are:

- Complete the review of the biology sampling network by 31<sup>st</sup> December 1999.
- Transfer the National Biology Database to the NCEDS at Bath by 31<sup>st</sup> December 1999. (Assuming the database will be part of the B4W project output).
- Regions to secure extra resources needed to deliver 2000 survey through the Corporate Planning process, recruit staff and complete training programme by 29<sup>th</sup> February 2000.
- Prepare and deliver regional workshops to finalise the requirements for the survey by the 30<sup>th</sup> November 1999.
- All sites in the revised network to be sampled twice during the spring, summer and autumn seasons. All sampling to be completed by 30<sup>th</sup> November 2000.
- Regions to complete primary analysis of all samples by 26<sup>th</sup> January 2001.
- Regions to send all primary data to the National database at NCEDS by 26<sup>th</sup> January 2001.

- NCEDS to quality check data and regions to sign off as complete by 28<sup>th</sup> February 2001.
- Regions to send agreed number of audit samples to IFE from 1<sup>st</sup> March 2000 to 26<sup>th</sup> January 2001.
- IFE to complete analysis of audit samples by 23<sup>rd</sup> February 2001.
- All audit data to be transferred to the National database by 23<sup>rd</sup> February 2001.
- NCEDS and Regions to agree classification of all stretches on database by 11<sup>th</sup> April 2001.
- Regions to check results and sign off GQA grades for all stretches by 30<sup>th</sup> April 2001.
- NCEDS to produce final lists of GQA grades for all stretches, national summary statistics of lengths in each grade, summary of changes in grade between 1995 and 2000, lists of significant upgraded and downgraded stretches and send information back to the Regions by 31<sup>st</sup> May 2001.
- Regions to prepare summary of main changes between 1995 and 2000 explaining reasons for changes and case study reports on the most significant individual changes in grade by 15<sup>th</sup> June 2001.
- NCEDS to collate all information from Regions and in collaboration with Environmental Strategy (Jane Kinniburgh) produce Agency report on 2000 survey by 31<sup>st</sup> July 2001.

#### **2.4 The Review of biological sites in preparation for the 2000 biological GQA Survey**

This paper was prepared on 13 October for circulation to biologists.

At their first meeting on 13 October 1999, the 2000 GQA Survey Group made a number of decisions were made about the 2000 biology GQA survey. These will be included in the minutes of the meeting, which will be circulated widely. This note is specifically concerned with one item: the review of stretches and sites in preparation for the survey.

In the absence of clear and detailed guidance from Environmental Protection about the stretch review and the meaning of "light touch", the 2000 GQA Survey Group has issued the following instructions. These are to enable preparations for the survey to proceed in a way that ensures that can be done in the same way in every Region and Area.

There will be no stretch review or revision prior to the 2000 biology GQA survey. Where a stretch review has been undertaken, as was planned for Biological Quality Objectives (BQOs), it will not be implemented for the 2000 GQA survey. This is because, if and when such a review is undertaken, it must be done properly and consistently across all Regions and Areas. Even if it was requested, there is insufficient time to do this before the 2000 survey.

The existing (1995) biological GQA site network will have to undergo routine maintenance. This maintenance will include the following.

Where a biological site has been destroyed or damaged, for instance because of engineering works, or it is no longer suitable as a biological GQA site, for instance because of much more intensive bank-side disturbance, it must be replaced by another site that adequately represents the biological quality of the stretch.

Where a biological site is no longer considered to be suitable for monitoring the quality of the stretch, for any reason, it should be replaced by another that represents the biological quality of the stretch and conforms to the specifications for locating biological GQA sites defined in BT002. This must not involve wholesale movement of sites.

Where the chemical site has been moved, it may be necessary to move the biological site too, so that the conditions for biological GQA site location, defined in BT002, are still met. There should be no discharges, weirs or other features between the biological and chemical site, see BT002.

Where the (chemical) stretch has been modified or re-defined since the 1995 survey, it will be necessary to re-evaluate the location of the biological site to ensure that it adequately reflects the quality of the revised stretch and meets the requirements specified in BT002. Where a (chemical) stretch has been dropped, the biological site should also be dropped. Where there is a new (chemical) stretch, a new biological site must be established that conforms to the requirements of biological GQA site location (see BT002).

In order to undertake this maintenance, biologists will have to obtain information about the alterations to the stretches made since the 1995 survey (i.e. the upper and lower locations of each stretch and the location of the chemical GQA site). The EDS National Centre are aware that, in some Regions, the stretch network as understood by those reporting (chemical) GQA has become divorced from the network as understood by those reporting compliance with RQOs. Where this divergence has taken place, biologists will have to wait until differences between the two sets of stretch data have been rectified and the definitive stretch information is available, before they can review the biological sites.

The 2000 GQA Survey Group decided that sampling all canals will not be mandatory in the biological 2000 GQA survey. It will only be necessary to check the location of those canal sites which are to be included in the survey.

If you are unsure about any of these instructions, or require further guidance, please get in touch with me.

John Murray-Bligh  
7-25-5167  
0118 953 5167

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## **2.5 Proposals for implementing recommendations made in the 1995 biological survey Post-Survey Appraisal**

This paper was tabled for consideration by the 2000 GQA survey Steering Group at their second meeting. 2000SG/2/3; 26 November 1999.

### **Proposals for Implementation of R&D Recommendations: Technical Report EMA 036/3 Analysis of 1995 Survey Data - Phase 2 Post-Survey Appraisal - Unit III Post Survey Appraisal**

#### **Issues for consideration by GQA 2000 Steering Group**

This document comprises the relevant recommendations from the above R&D Technical Report together with proposals for implementation as agreed by the R&D Project Board. A complete summary of all recommendations and implementation proposals is also attached.

This unit of the project was a post survey appraisal of the methods and techniques used for the 1995 Biological GQA Survey, and was carried out by the Institute of Freshwater Ecology (IFE). The recommendations summarised here are based on a questionnaire completed by biologists in all Agency Regions, informed by expert opinion from IFE.

Notes in italics after each recommendation have been added to the IFE document by the Agency Project Manager following a meeting of the Project Board on 15th November 1999, and detail the agreed implementation action.

#### **Abbreviations**

|           |   |
|-----------|---|
| BT001     | Procedures for collecting and analysing macroinvertebrate samples. Environment Agency, 1999. and also BT002 - Procedures for collecting and analysing river macroinvertebrate samples for GQA surveys. Environment Agency 1995. |
| NBTG      | National Biology Technical Group  |
| AF & PR   | Alastair Ferguson and Paul Raven (and Ecology Client Group when re-constituted)   |
| GQA Grp   | 2000 GQA Steering Group   |
| JMB       | John Murray-Bligh (on behalf of NBTG/GQA Group)   |
| No action | This issue is already being dealt with or cannot be carried out in the necessary time scale.  |

## ***Sampling Methods***

### ***Pond-net sampling***

Where differences in the implementation of the recommended procedures are known to the Environment Agency, and where these may possibly have a significant effect on the results obtained, then the recommended procedures in the revised BT001 should be made more prescriptive in order to eliminate these differences.

*JMB to amend BT001 if required.*



Special instructions should be included in the revised version of BT001 (Environment Agency 1997a), giving the specialised sampling techniques that may need to be adopted in order to collect three minute pond-net samples in headwater streams.

*IFE to pass suggested modifications to JMB. NBTG to approve inclusion in BT001 by JMB and GQA 2000 Workshops.*

**When appropriate, standardised deep-water sampling procedures are available, sampling with the standard FBA-style pond-net, with handle length of approximately 1m, should be confined to sites that are wadeable for at least 25% of their total width.**

*Agreed that these recommendations will be part of the output from another R&D project and that no action should be taken until the full recommendations are available. For GQA 2000, the same sampling methods should be used as for 1995 to ensure comparability.*

## ***Sample Sorting***

### ***Location of sample processing***

**Whilst it remains unclear whether bankside sample processing is as efficient and comprehensive as laboratory processing, this issue is considered to be so important that a standardised laboratory-based approach should continue to be prescribed for use in the 2000 GQA Survey. This action will ensure that observed BMWP index values and those predicted by RIVPACS III+ are based on the same sorting procedure.**

*NBTG should recommend that all Regions use the recommended procedures for GQA 2000. The GQA Group and AF/PR should confirm that this is a mandatory requirement for the survey.*

### ***Transport, fixation and preservation of samples***

Live samples should always be fully sorted within two working days of their day of collection. If this cannot be achieved then the samples should either be fixed in Formalin or preserved in alcohol.

*Already included in BT 001. NBTG to note and to be emphasised in GQA 2000 Workshops.*

It must be ensured that the quantities of Formalin and, **especially** alcohol added to re-constituted samples should be of sufficient strength to exclude the possibility of the sample decaying, especially if they contain large quantities of organic material

*JMB to update BT001 in discussion with IFE.*

Alcohol is an inadequate fixative and samples which have not been fixed previously with formalin, and which are subject to AQC or audit, should be re-analysed as soon as possible (Environment Agency 1996a). Samples for external audit should be dispatched to the auditors as soon as possible and within two weeks of the date on which the last sample was analysed for AQC (Environment Agency 1996a).

*IFE to add further explanatory text after "inadequate fixative". JMB to strengthen BT001 if necessary.*

### **Sorting time**

The Environment Agency should promote the exchange of ideas on the best methods of achieving AQC standard sample processing in the most cost-effective manner.

*IFE to add text: "Because of the wide variation in sorting times" at start of sentence, and "to meet the AQC standard" after the word "processing". "AQC standard" to be deleted. JMB to raise issue in GQA 2000 Workshops. AF&PR to consider for future investigation.*

## **Identification and Quantification**

### **Identification**

The need to achieve more precise levels of identification, including during national surveys, will require some biologists within each Area laboratory to be competent at species level identification and appropriate training should be planned, where necessary.

*If a decision is taken to include species level identification in the GQA 2000 survey, the GQAGrp/NBTG should implement this.*

### **Quantification**

**It is essential that a system of allocation of abundance classes to each BMWP family is adopted by all Regions for the 2000 GQA Survey.**

**The system adopted by each Region should be standardised or be capable of standardisation between Regions.**

*GQA Grp should make this mandatory for GQA 2000 with implementation by NBTG.*

**Whatever system of categorisation is adopted by each Region for the 2000 GQA Survey the data must be presented to the National Database in the standard categories adopted for the survey.**

*Mandatory in BT001. GQA Grp to confirm that Biology for Windows will correctly handle abundances and NBTG that data are correctly entered by Regions.*

Where present, and where more precise identification is not subsequently required, then a minimum of ten representatives of each BMWP family should be removed from each sample. This will facilitate the correct allocation of taxa to any sub-division of abundance category 1 (*sensu* the 1995 GQA) and the also the correct allocation of taxa on the borderline of categories 1 and 2.

*IFE to amend text to clarify need for an actual count of taxa with 1-10 representatives. JMB to add to BT001 on behalf of GQA Grp - NBTG to implement.*

Where the abundance category of a taxon with more than nine individuals present is in doubt then the taxon should always be assigned to the lower abundance category of the two possible categories in question.

*Agreed - JMB to amend BT001 and notify Regions via workshops.*

## ***Internal AQC and External Audit***

### ***Method of selection of samples for internal AQC and external audit***

Selection of samples for external audit is being operated inconsistently between Regions and a greater level of conformity and closer adherence to the procedures set out in BT003 are recommended.

*GQAGrp to require compliance with standard methods via NBTG.*

### ***Variation between laboratories in AQC and audit procedures***

All Regional and Area laboratories should adhere to the three-phase process, set out in BT003, of training inexperienced sample processors and integrating them in the full AQC scheme

*NBTG to emphasise this approach and JMB to raise in Workshops on behalf of GQA Group.*

### ***General comments on internal AQC and external audit procedures***

The Environment Agency and IFE Project Leaders for the external audit contracts should consult Anglian Region on procedures for species level audits and audits of the assignment of abundance classes.

*JMB to discuss with Anglian (meeting arranged).*

## ***Other Forms of Data Collection and Interpretation***

### ***Macro-invertebrates***

The use of RIVPACS and EQIs alone to examine the biological data collected during GQAs may fail to optimise the cost-effectiveness of the survey. The following recommendations, if adopted, will help this to be evaluated.

The results of the 2000 GQA Survey should also be examined using the two indices LIFE and CCI, the algorithm for detecting acidification being developed by IFE and the diagnostic artificial intelligence procedures being developed by the University of Staffordshire.

The types of analyses of the distribution of taxa and changes in that distribution undertaken by IFE and the University of Staffordshire should be repeated using the 2000 GQA Survey data.

Where this cannot be achieved internally by the Agency then it should form the basis for R&D research programmes.

Some or all of the applications of the CCI and LIFE indices will require species level identification. A target of 10% of the samples collected during the 2000 GQA Survey should be identified to species level for this purpose and these should represent a good geographical spread of samples and good coverage of all river sizes and types.

The resource implications of species level identification may require that the primary sorting of samples from selected sites should involve a more detailed sorting process in which all, or a known proportion of taxa are removed from samples from the selected sites.

Where species level identification cannot be achieved in house then this should be contracted out to organisations with staff with proven and reliable skills at species level identification..

An audit system for species level identification is necessary (see also Section 5.5.5).

Full identification of these samples may not be achievable during 2000 and may have to be deferred to a later year. Any deferment should not be a cause for delay in the publication of the primary survey report.

Existing species level data on nearly 2000 sites held by IFE may be useful to the pursuit of these recommendations.

#### ***Other taxonomic groups***

Single diatom and MTR samples should be collected during the spring macroinvertebrate sampling of 10% of the sites in the 2000 GQA Survey. These should be the same sites for which species level identification is undertaken (see Section 5.7.1).

*(IFE to amend spring to "summer".)*

Staff collecting TDI and MTR data should have received full training in these techniques prior to sampling.

Full identification and/or interpretation of these samples is unlikely to be achievable during 2000 and would probably have to be deferred to a later year. Identification of diatom samples may need to be contracted out. Any deferment should not be a cause for delay in the publication of the primary survey report.

If RHS surveys are planned for 2000, then it would be beneficial if these could include the test sites used to compare different biomonitoring procedures.

An analysis should be undertaken of the relative merits of the variety of biomonitoring techniques available to the Agency.

*All the above recommendations (relating to GQA 2000 and future surveys) should be considered by AF&PR in conjunction with the Ecology Client Group with advice from the GQA Group and NBTG. Actions to NBTG.*

#### ***Time invariant physical variables***

**All time invariant values used for RIVPACS predictions in the 2000 GQA Survey should be re-measured independently by two people and any values differing by >5% should be re-measured by both individuals until an acceptable level of agreement is reached. Values should then be cross-checked against 1995 values and all disparities >10% should be investigated and corrected.**

**Logical checks of environmental data for individual rivers should be made to ensure that rivers flow downhill and the discharge of any site should be no less than the discharge of the next site upstream of it. The values used in connection with the 2000 GQA Survey should be the average of the corrected values measured for the 1995 and 2000 GQA Surveys. For new sites, the values obtained in 2000, after double measurement and subsequent validation and correction, should be used.**

*The 1995 GQA datasets corrected by IFE and Stafford University (as part of Agency R&D projects) should be circulated to Regions for comparison with existing data (on Biology for Windows). Any necessary changes MUST be made to ensure a high quality dataset for use in GQA 2000. GQA Group to co-ordinate, possibly in co-operation with the EDS National Centre. NBTG to note.*

Southern Region's recommendation, that the use of a "Roamer", or similar system, should be mandatory for deriving NGRs, is endorsed here.

*JMB to make mandatory in BT001 - NBTG to note and implement.*

#### **Time variant physical variables.**

Field sampling training days, similar to those provided by the IFE and the NRA prior to the 1995 survey, should be run again prior to the 2000 GQA Survey. It is unlikely that any standard protocols for deep water sampling will be agreed prior to spring 2000 and deep water sampling and prior training should be delayed until these issues are resolved.

*Agreed - JMB has plans underway.*

### ***Survey Design***

#### ***Choice of sampling season***

**2000 GQA Survey sampling should be undertaken in spring and autumn in order to provide a standard basis for inter-survey comparisons of distributional changes.**

*NBTG to reinforce presumption towards spring and autumn with summer sampling only when fully justified. JMB to amend BT001 if required.*

*The final recommendations are not yet completed – they relate to the analytical target (IFE will not be recommending a change from the current target and sample processing errors which again will need no action.*

## 2.6 Minutes of NBTG's special meeting to plan the survey



ENVIRONMENT AGENCY

**BTG Minutes (full) No. 6**

### **BIOLOGY TECHNICAL GROUP SPECIAL MEETING**

**26 January 1999**

**Environment Agency, Olton Court, 10 Warwick Road, Olton, Solihull**

#### **Minutes**

**Attendees:** Martin Stark (MS), Chairman, FRCN  
John Murray-Bligh (JMB), Technical Secretary  
Dave Jowett (DJ), Head Office (EMS), Ecology Client Group  
Graeme Storey (GS), EDS National Centre  
Sarah Chadd (SC), Anglian Region  
Shelley Howard (SH), Midlands Region  
Brian Hemsley-Flint (BHF), North East Region  
Elaine Fisher (EF), North West Region, Marine Biology Technical Group  
Bob Dines (RD), Southern Region  
George Green (GG), South West Region  
Paul Logan (PL), Thames Region  
Graham Rutt (GR), Welsh Region  
Peter Hale (PH), IRTU Northern Ireland  
Phil Styles, (PS), Isle of Man

**By invitation:** Alastair Ferguson, (AF) EMS, Head Office

**Apologies** Dave Lowson (DL), SEPA

#### **Documents Issued:**

Progress of IFE Audit, 19 January 1999

Audit Data Sheet, Version 2.2

#### **1. Aims and Objectives (AF)**

The 1995 GQA survey was to report on the state of the riverine environment. Its format was agreed with DETR prior to the 1995 survey. Three windows were used: biology, chemistry (based on a much reduced number of determinands) and nutrients, and changes in quality were to be reported. There was co-ordination with SEPA and N. Ireland.

**The Agency is committed to reporting biology in the 2000 GQA survey.** The profile of GQA has increased because it provides one of the measures for the government's proposed headline indicators on sustainability.

**Invertebrates will be used in the biological GQA survey for 2000.**

**An important requirement of the 2000 biological survey is that it must allow the Water Quality Function to compare river quality with that in previous surveys.**

In planning the 2000 biological GQA survey, regard must be given to the requirements of the following the proposed EU Water Framework Directive, reporting though WATERNET, and the government's proposed headline indicators.

Europe has 6-year cycle of environmental reporting, as laid down in the Dobbris Agreement. The DETR, Environment Agency, SEPA and DoE Northern Ireland are involved in the developing this reporting.

**The 2000 biological GQA survey will cover watercourses only.**

Consideration will be given to trialling surveys of ponds, lakes and estuaries and other monitoring elements (macrophytes and algae) that will be required by the Water Framework Directive, as well as greater co-ordination with other surveys carried out by the Agency in 2000. The core survey of invertebrates from watercourses must be done. The Agency is short of funds for the 2000 survey. The Agency has not committed additional resources to fund the aspects which might be trialled in the 2000 survey.

The Agency will produce a State of the Environment report in 2000. This document will be an overview, based on information from a wide range of sources including the 'State of the Environment' reports which we have published already (e.g. 'freshwaters' and 'land'). The Agency will report the survey work carried out in 2000, but the details have not been finalised.

**2. Timetable**

The timetable for the 1995 survey will be used as a starting point for the 2000 survey. A separate timetable will have to be drawn-up, based on this and the timetable drawn up by GG for South Wessex.

**3. Resources**

The 2000 biological GQA survey should be planned on the basis that invertebrates will be sampled in two seasons, from a similar number of sites as in 1995, with the same degree of quality assurance and that work on the 2000 GQA survey starts in the 1999/2000 financial year.

After 1995, Southern Region reduced the amount of GQA work by 50%, therefore the resources needed for the 2000 survey will have large impact on Area work.

In South West Region, biologists in South Wessex and Cornwall Areas are committed to a 5-year work programme for Water Resources and do not want a one-off survey to upset this.

AF warned that bids for resources must be made through corporate planning in September or October.

In 1994, Head Office issued a clear statement that the 1995 GQA survey was a high priority for the NRA and that it was an organisational "must do". Most members of BTG thought that they did not have this clear directive for the 2000 survey. AF indicated that last October, Head Office wrote to all Regional Water Quality and Water Managers, and relevant staff in Head Office describing the requirements and resources needed for the 2000 survey. BTG concluded that this message has not got through, particularly to Area Operational staff and that the problem was caused by instructions not being issued through Archie Robertson:

Action AF, by 12 February: to discuss with Ops and copy the message to BTG.

Action all Regional Biologists, by 9 February: to help identify work that Areas and Region consider important but competes with resources for the preparation and delivery of the 2000 GQA survey, for each Region. In order to do this each Region will need to identify the resources needed for the GQA survey and the competing Regional operational commitments so that the shortfall can be identified. This information should be sent to MS and copied to AF.

There had been an assumption that additional funding would be available for reviewing the stretch network and assigning BQOs. This has not been forthcoming so the work must be funded from Area budgets.

The Ecology Client Group meets on 3<sup>rd</sup> March.

Northern Ireland also has an expanding survey with reduced resources. Suggestions have included spreading the survey over 2 years, reporting every 6 years rather than 5, having a rolling programme, and basing the classifications solely on biological methods.

AF indicated that this was similar to the Agency's Head Office's view. This is that biology should lead GQA but that the surveys should be annual (not spread over more than one year) so that quality can be reported annually. In the future, the reliance on chemistry for GQA would be reduced.

PL indicated that national resources would be needed for training etc.

AF indicated that a national resource will be required to co-ordinate the survey, and ensure its delivery. BTG will need to meet to make decisions. AF suggested using existing resource, plus extra for one or two BTG meetings. AF also indicated that there would be a role for the National Centre in collecting and collating the data.

PL suggested that the 2000 survey should be managed as a separate project. AF thought that, because the work is part of the day job this would not need to be identified as a separate project, however it could be run along project lines.

**The consensus was that a co-ordinator was needed to manage the survey. A technical specification needs to be written, milestones identified and a timetable drawn up.**

**BTG decided that training workshops were needed for the 2000 survey.** The same combination of trainers from the Agency and IFE (Rick Gunn) was considered ideal. If workshops were held later, new staff would be able to receive training. However, winter is not ideal because of high flows, and holding them all over a short period is tiring for the trainers. Newly appointed and other staff who miss earlier workshops could be accommodated in round-up workshops. Some workshops in 1995 were too large. JMB and Rick Gunn considered that an introduction by a senior authority from (as Bob Dines provided in 1995 for North West Region) was useful.

Reports need to be included in the technical specification to ensure that unfulfilled expectations are avoided. Close liaison with the State of Environment reporting section at Head Office will be necessary for this, and to ensure that publications are factually correct and definitions unaltered. AF suggested that a member of that section should attend a BTG meeting to ensure mutual understanding.

#### **4. Working with other functions**

The National Centre at Twerton is the interface between the Environment Agency and Waternet. Agreement is needed on how the provinces are to link with Waternet. Dorothy Salathiel at DETR is the UK link. It may be logical to have a central database for the whole UK at the Agency's National Centre in Bath.

The Agency's 2000 Survey Working Group has identified groups that are committed to survey work in 2000. It is drawing up a description of the activities and suggestions about how they might be brought together. This includes River Habitat Surveys, hydrometric surveys and, fisheries surveys. They are considering linking the information gathered in these surveys and the advantages that could be gained from doing this.

*AF/DJ, when available: to circulate the information from the Agency's 2000 Survey Working Group about how different surveys will be brought together.*

#### **5. Season pairs.**

**BTG have agreed that the 2000 GQA survey will be based on samples collected in two seasons. Spring and autumn are preferable, but whichever two seasons are used, there must be at least two months between samples.** The choice of season makes very little difference to the classification because RIVPACS takes seasonal differences into account.



## **6. BQOs update**

### **Determining BQOs**

The 2000 survey will be the first for which BQO compliance will be reported.

The BQO project board is commenting now on the first draft of the report on how BQOs will be set. The BQO project board was reminded to review this document.

### **Stretch Review**

*Advice on the revision of the stretch network will be ready by early March.* The workload for this is unchanged. However, there is no additional funding for it.

Despite a number of intensive meetings with the National Centre for Risk Assessment and Options Appraisal (NCRAOA) culminating in comments on NCRAOA's draft paper before Christmas, some fundamental misunderstandings remain. A methodology for biologists to follow in order to apply a risk assessment approach was needed soon after Christmas. Unfortunately, the NCRAOA simply reworked their "thoughts" report. We still don't have a method. The NCRAOA's methods are impractical because they don't take account of our constraints, especially resources. The report focuses on sampling frequency, which is not needed. RD will write a method himself, based on hazard and the quality of the watercourse, within a couple of weeks (but not in time for the next BTG meeting on 10 March). This may involve mapping catchment, adding activities and putting a value on the risks of each.

EF commented that monitoring risks is basis of operational monitoring. The aims of GQA surveys cover both SoE and operational requirements

GR indicated that Colin Strange is unwilling to go ahead with stretch review without official sanction. AF said that there is a commitment in the 'monitoring review' to ensure that our survey networks are as efficient as possible. LAPWING had been used to improve the efficiency of the chemical GQA network and similar principles will be used for the Biology GQA Network.

Most of the existing network had been devised for point source discharges, and for this it is likely to be OK. Need to ensure that other factors are taken into account, such as SSSIs. If previous network review was sufficiently broad, existing network will be OK. Attributes as well as risks are important.

GR Will Water Quality sanction this? AF They will be asked to.

There is no intention to alter the stretches totally: existing stretches will simply be split or combined.

It will still be possible to compare biology with chemistry at every stretch. However, it will not always be possible to compare biological samples directly between surveys where the biological sites have been moved.

For quality assurance, to ensure that BQOs have been set consistently, a BQO training workshop will be held and information on decisions leading to BQO determination and alteration will be stored on spreadsheets that will enable auditing.

PL Need to get national consistency in stretch density. Statutory BQOs will influence this.

### **Sample analysis**

Sites chosen for conservation and flow may need species identification.

BQO project timetable: 5 February, BQO project board; 12 February, monitoring review meeting with WQ managers.

## **7. RIVPACS**

### **Canals**

Canals may be optional in the 2000 survey. Their inclusion depends on the availability of a reliable method. Pond Action and RIVPACS approaches will be available for consideration.

#### **Deep Rivers**

**Deep rivers will be sampled in 2000. Unless RIVPACS R&D indicates otherwise, the same methodology will be used at sites as was used in 1995.**

IFE wants to undertake trials of long-handled pond net, dredge & airlift on six different deep rivers.

AF will try and find money for this work if necessary from the R&D programme.

#### **Environmental variables.**

**Environmental data used in 1995 will be used for 2000 at sites which remain the same. Three seasons' environmental data will have to be collected for new sites or where site characteristics have changed.**

AF Clear instructions must be produced about when new environmental data must be collected, e.g. following a 1 in 1000 year flood.

**Field environmental data will be collected with the biological samples. Alkalinity will only be measured at new sites or where site has changed substantially.**

#### **RIVPACS IV**

The modularization of the core software will be delayed because of delay in starting the project. Other software such as for canals may be developed as modules to bolt on to the existing RIVPACS software.

#### **8. Collecting other data for LIFE etc.**

Other data will be considered if they add value. Decisions will be taken later.

#### **9. Quality Assurance**

##### **AQC**

A workshop on AQC and audit is needed to work through the methods and update as required.

Action JMB, by next BTG meeting: write a paper to BTG with information on the AQC scheme and asking biologists in Regions and Areas for reasons for problems, comments, criticisms and suggestions for improvement.

GG commented that for the AQC to work, laboratories needed at need at least one experienced biologist.

##### **Audit**

The audit scheme will continue. Following a meeting with Rick Gunn, and concerns from John Hilton, JMB has circulated proposals for a minor revision to the contract.

##### **Data Validation**

B4W will have greater data validation facilities than previous databases. The National Centre at Twerton may undertake some validation of the data for the survey.

#### **10. Training**

PH was concerned about Health & Safety issues for the survey, in particular river safety training. In the Agency, line management is responsible.

**Action, JMB, by next BTG meeting, to send a note to point-out the health and safety requirements specified in the sampling manual BT001.**

## **11. Data Handling**

### **B4W, Twerton & Thames**

The algologists have agreed that algology will be included in B4w. It will therefore be an algology and invertebrate database. There will be a preference for invertebrate requirements. We need to decide whether RIVPACS predictions will be undertaken in the Regions or nationally by Twerton.

WQSSG want the old National Biology Database to be the best interim system (BIS) for water quality's biological needs.

Action SC, by 27 January: draft a note for comment by BTG to WQSSG indicating that BTG recommend that they consider B4W as a better option than the National Biology Database, that B4W is used for the 2000 survey, and that GQA results should reside at Twerton, and send the final note to WQSSG for their next meeting on 2 February.

Action PL, by 2 February: speak to Thames WQ because of the implications of the note to WQSSG for their staff.

RIVPACS III+ is the Agency's standard software for biological classification.

The National Biology Database (NBS) took data from Regional databases, ran it through RIVPACS and produced predictions for migration to Tony Wam's GQA database. Tony's database had held classification data for Biological and chemical sites.

Ron Thomas' system at the National Centre in Twerton can cope with the National System, changes to stretches etc.

Will we be able to extract data from Thames National system? Zoë Tomkins needs to be reminded of the requirement to migrate data from the National Biology Database in Thames to B4W. This may happen before the need to archive the NBS.

**Recording site information for (as specified under "site manual" in BT001) will be mandatory for all new and existing sites.**

BTG recommend that the amendments highlighted by Bill Walley in his site validation exercise should be made on local databases before the data is moved to B4W and that a check is also done on B4W.

## **12. Reporting**

Jane Kinniburgh's reporting group is considering how the 2000 survey will be reported. They are also considering how the 2000 survey and other data will be published. e.g. the web site.

A technical record for the biology 2000 GQA will be needed to record what we did. This could be based around a strong technical specification.

## **13. AOB**

**BTG decided to dispose of the samples collected in the 1990 survey, which are being stored near Wareham.**

SH Asked whether data. AF suggests consider value

### **Next meeting**

The next BTG ordinary meeting in Hillsborough will start at 15:30 on 9 March with a presentation on Quality Assurance in Northern Ireland, followed by a full day on 10 March. A cross border meeting with the Irish EPA and other British organisations will be held on 11 March. This will not be a full BTG meeting.

btg6.doc, 24/01/03

## **2.7 Decisions made by NBTG and GQASSG**

This section is the last update of the compilation document 'National Biology Technical Group (NBTG) and GQA Survey Steering Group (GQASG) decisions concerning the 2000 GQA survey' that was circulated periodically to biologists via NBTG during the survey. The last update was dated 31 August 2001. The original sections have been numbered for this Project Record. The meeting at which the decision was made has been identified after each entry. NBTG's meetings are numbered consecutively.

### **2.7.1 General**

The Biology Technical Group agreed unanimously that the 2000 Survey should go ahead. (NBTG4, 8-9 Sept 1998)

The Agency is committed to reporting biology in the 2000 GQA survey. (NBTG6, 26 January 1999)

The 2000 Survey Working Group has agreed that the straightforward biological survey of rivers is covered, but any additional surveys for 2000 would have to go into next business plan. (NBTG7, 9-10 March)

The standard methods must be followed to the letter during the 2000 survey, including deep-water methods when finalised by IFE. (GQASG, 1 December 1999)

### **2.7.2 Management of the 2000 Survey**

NBTG consider that a letter is needed from Archie Robinson indicating that the 2000 survey needs to be done. BQOs not mentioned. Such a letter is needed. (NBTG7, 9-10 March)

The need for an extra meeting to sort out technical aspects of the 2000 survey (e.g. need to identify individuals and training needs, time when Twerton needs the results) was agreed. The Biology Technical Group will hold a special meeting to cover this item in Solihull on 26 January. (NBTG 5, 2-3 December 1998)

Invertebrates will be used in the biological GQA survey for 2000. (NBTG6, 26 January 1999)

The consensus was that a co-ordinator was needed to manage the survey. (NBTG6, 26 January 1999)

The 2000 biological survey will be run on project lines, with NBTG as the project board. (NBTG7, 9-10 March)

A technical specification needs to be written, milestones identified and a timetable drawn up. (NBTG6, 26 January 1999)

Reports need to be included in the technical specification to ensure that unfulfilled expectations are avoided. (NBTG6, 26 January 1999)

A project plan is needed for the 2000 GQA survey. (NBTG7, 9-10 March)  
All Regions should prepare their own project plans along the lines of the national plan and time-scales. (2000GQASG, 1 December 1999)

Regions should provide a Regional project plan, to allow the EDS National Centre to spread its workload when the results become available. NBTG considered that it would be best to ask for this in mid year, when Regions have a better idea of when they are likely to complete their analysis of samples. (NBTG10, December 1999)

The Regional Biologists should sign-off their sample point networks and Water Quality should sign-off the national network. NBTG should sign off the 2000 data and comments on changes, trends etc. should be signed off by the Water Quality contact in Regions. (2000GQASG, 13 October 1999)

The resource problems in North East Region, which may cause the survey to be delivered late or in some cases samples would not be collected was unacceptable as the survey should be a must do for all Regions and that adequate resources were available. (2000GQASG, 9 August 2000)

If there is a problem with the autumn sampling we need to know if it is down to the weather or resource issues in the Areas. (2000GQASG, 7 November 2000)

### 2.7.3 Contingency planning

Areas should be responsible for their own contingency planning (i.e. organising alternative ways of dealing with other important or urgent work that cannot be done because of the GQA survey). NBTG10, December 1999.

### 2.7.4 Using contractors for sorting samples

The following was agreed by JMB (Survey Manager) and Alastair Ferguson (Project Executive), 12 May 2000)

Potential contractors must be able to *demonstrate* that they can meet our quality criteria - e.g. send an audit record for the last year (preferably longer - the longer the better).

The quality of contractors' work must be audited. Guidance is given in BT003, Section 3.10). Each contractor laboratory should have 20 GQA type samples (standard BT001 samples analysed to family) audited by the Agency's auditors (CEH) during the year, irrespective of number of samples analysed. This is because the precision of the audit depends on number of audited samples, not the proportion. These do not all have to be samples from the contracting laboratory, though a proportion of them must be, and the Agency must have Audit data sheets for all

audited samples. You may need to obtain permission from third parties to obtain results of audits not owned by the Agency (do this in advance of organising the audit). The audit must be covered by a separate contract between the Agency and our auditors (see BT003, Section 3.10).

If the number of samples contracted-out is small, there may not be sufficient samples for audit. When there are less than 50 samples, submit 20% of the samples, so that at least two samples go for auditing. You will have to rely more heavily on audit results from other contracts that year in order to measure quality for classification. In such cases, the judgement of the capability of the contractor through experience, having used them before and accreditation, is the critical issue. Contracting laboratories must be confident of getting good data (otherwise it will have to be repeated) and if it involves samples taken near the end of a 'season' this could be difficult.

Samples audited from contractors must not affect the number of samples audited for the contracting Agency laboratory, though it is likely that they will have to adjust proportion of their samples audited to ensure correct number are audited by end of year and they are evenly distributed throughout it. It is important that we have acceptable quality information about the quality of our own laboratories. (BT003 Section 3.4.7)

For purpose of GQA classification, auditors results should be combined with Agency laboratory's results in proportional to the fraction of samples they and the Agency laboratory analyses (follow instructions in BT003 Section 3.4.7).

The existence of AQC procedures is of benefit to ensure that the contractor is able to monitor their work to ensure that they are meeting the quality standard. Contractors do not have to follow the Agency's method (it is inappropriate for individuals anyway). Good quality audit results are evidence that their quality control procedures are adequate.

#### 2.7.5 Requirements of the survey

An important requirement of the 2000 biological survey is that it must allow the Water Quality Function to compare river quality with that in previous surveys. (NBTG6, 26 January 1999)

The 2000 GQA survey can only be a repeat of the 1995 survey. Other methods are beyond scope of GQASG (but will be considered in review). (GQASG, 1 December 1999)

#### 2.7.6 Training workshops

NBTG decided that training workshops were needed for the 2000 survey. (NBTG6, 26 January 1999)

NBTG recommended that there should be a one-day workshop to cover methods for the 2000 survey in each of the 8 Regions. These would be workshops not training

courses and NBTG re-affirmed the value of two-way discussions to help evolve and refine the methods. All staff involved in the GQA survey should attend the workshops, including Team Leaders. However, staff from one Region may attend the workshop in another Region where this is convenient, to encourage a cross-fertilisation of ideas. In addition, round-up workshops should be held later for newly appointed staff. (NBTG8, 21-22 June 1999)

NBTG considered that that IFE's involvement was most helpful in 1995 and would also be for 2000. IFE is intimately involved with the methods and with RIVPACS. The audit staff have an intimate knowledge of GQA samples from all Regions, and problems with them. NBTG agreed that the same Agency person should run all the workshops, to help the cross-fertilisation of ideas, ensure consistency of approach (a major objective of the workshops) and facilitate uptake of ideas. (NBTG8, 21-22 June 1999)

Because the duration of the workshops will be less than in 1995, the sampling video(s) will be shown shortly before the workshops. (NBTG8, 21-22 June 1999)

NBTG agreed that the Regional Biologist would be responsible for organising the Workshop in their Region. This includes organising venues and field sites. (NBTG8, 21-22 June 1999)

NBTG agreed that sub-group should meet to determine the course syllabus and format. The sub-group is to comprise JMB, RD & KW. (NBTG9, 21-22 September 1999)

GQASG confirmed their wish for JM-B to emphasise the standard AQC and audit procedures prescribed in the manual during the workshops. (2000GQASG, 1 December 1999)

#### 2.7.7 Coverage of the survey

The 1995 Survey based on the existing stretch network will be repeated in 2000. (GQASG, 13 October 1999)

The Stretch Review will not take place before the year 2000 Survey. (GQASG, 13 October 1999)

Any changes to sampling points within the existing stretches will be regarded as general maintenance of the existing network. (GQASG, 13 October 1999)

The 2000 biological GQA survey will cover watercourses only. (NBTG6, 26 January 1999)

Deep rivers will be sampled in 2000. (NBTG6, 26 January 1999)

Unless RIVPACS R&D indicates otherwise, the same methodology will be used at sites as was used in 1995. (NBTG6, 26 January 1999)

Canal sampling is not a mandatory component of the year 2000 biology survey. (GQASG, 13 October 1999)

Those Regions that plan to sample canals should do so using the PSYM methodology. (GQASG, 13 October 1999)

Data gathered on canals in the year 2000 will be used to refine the methodology and provide further information to help develop the PSYM classification system. (2000GQASG, 13 October 1999)

If canals are included in the 2000 survey, NBTG will be able provide a classification for canals for the 2000 survey, based on Jeremy Biggs' method for invertebrates only (not for diatoms). (NBTG9, 21-22 September 1999)

Canals are not a mandatory component within the biology GQA in 2000. (2000GQASG, 1 December 1999)

Samples collected from canals in the 2000 GQA survey should be stored after they have been analysed. (NBTG10, December 1999)

Pond Action's sampling methodology for canals has been adopted as an interim method. (NBTG10, December 1999)

NBTG agreed that because no instructions for the stretch review have been issued, a light touch review of the existing GQA network will be done for the 2000 survey, but that the stretch review will not be done for the 2000 survey. (NBTG9, 21-22 September 1999)

#### 2.7.8 Seasons

NBTG have agreed that the 2000 GQA survey will be based on samples collected in two seasons. Spring and autumn are preferable, but whichever two seasons is used, there must be at least two months between samples. (NBTG6, 26 January 1999)

Three seasons' environmental data will have to be collected for new sites or where site characteristics have changed. (NBTG6, 26 January 1999)

NBTG reinforce the presumption towards collecting samples in spring & autumn for the 2000 GQA survey, with samples collected in summer only when this is fully justified by weather and flow conditions (i.e. there is a high risk that it will not be possible to collect samples in autumn because of high flows. Samples are not to be collected in summer merely to ease work schedules or reduce manpower requirements. (NBTG10, December 1999)

Autumn sampling may be extended in to December if necessary. However, there is a strong presumption that samples will be collected before the end of November, because December is outside the normal RIVPACS' and the GQA survey window. (NBTG, 2-3 October 2000)



If there is a problem with the autumn sampling we need to know if it is down to the weather or resource issues in the Areas. (2000GQASG, 7 November 2000)

Sampling in December is permitted. (2000GQASG, 7 November 2000)

#### 2.7.9 Schedules

NBTG agreed that the deadline for completing sample sorting should be the end of February 2001. (NBTG8, 21-22 June 1999)

NBTG agreed that the deadline for completing the analysis of samples for the 2000 GQA survey would be 29 February 2001, and confirmed that this was a deadline and not a target. (NBTG9, 21-22 September 1999)

Following discussions at the National Biology Technical Group and at the GQA 2000 project board, we can confirm that biological sampling for GQA 2000 can continue into December 2000 but should not go beyond this into 2001. (Letter from Paul Raven, 5 December 2000 – see also decision about seasons by NBTG, 2-3 October 2000)

#### 2.7.10 Sample collection

Note that the document BTGWD38 mentioned below is reproduced in Section 4.1 of this Project Record)

There should be no non-compliance with the methods. The standard methods must be followed to the letter during the 2000 survey, including deep-water methods when finalised by IFE. (GQASG, 1 December 1999)

The implementation of methods described in BT001 is mandatory. (NBTG10, December 1999)

All laboratories must collect deep-water samples according to BT001 and not as sampled in 1995 if this was different to BT001. (NBTG10, December 1999)

All samples for the 2000 GQA survey are analysed in the laboratory, as instructed by the 2000 GQA Survey Group and Paul Raven. (NBTG10, December 1999)

A number of decisions about deep water sampling, in particular the equipment and the manner in which it is to be used, were made, following work and recommendations by the Health & Safety sub-group of NBTG. These decisions are outlined in BTGWD38 (revised 9 November 2000 in the light of decisions made by BTG on 2-3 October). The principle changes were to the use of dredges. The medium naturalist's dredge is to be used only in exceptional circumstances, where the small dredge proves not to be suitable by field trial at the site in question. The medium naturalist's dredge is only to be used by individuals who are fully trained, physically capable and happy to use it. See BTGWD38 for further information. The maximum weight of 10 kg should be achieved by using small dredges and modifying the size of collecting nets attached to them. In preference, use a small dredge. At sites where the dredge is likely to fill

with heavy material such as silt, a smaller collecting bag should be used to ensure that the maximum weight limit is not exceeded. A number of other decisions including the need for immediate training, changes to air-lift equipment and guidance on the use of long-handled pond nets were also made. (NBTG 2-3 October 2000).

#### 2.7.11 Sample analysis

There is no requirement in the 2000 GQA survey for species identification to be undertaken. This will be reviewed for future surveys. (GQASG, 1 December 1999)

It is mandatory for abundance data to be collected by the standard method for the 2000 GQA survey. (GQASG, 1 December 1999)

Actual counts, not estimates, for abundances 1-10 should be recorded (as was requested in 1995). (GQASG, 1 December 1999)

#### 2.7.12 Environmental data collection

Three seasons' environmental data will have to be collected for new sites or where site characteristics have changed. (NBTG6, 26 January 1999)

Field environmental data will be collected with the biological samples. (NBTG6, 26 January 1999)

NBTG will not ask for alkalinity to be included in the standard chemical analysis suite for the 2000 GQA survey. (NBTG7, 9-10 March)

Alkalinity will only be measured at new sites or where site has changed substantially. (NBTG6, 26 January 1999)

Lab/chemical samplers must sample new sites 12 times in the year. However, where there is an existing site upstream and downstream of the biological site and there is not a substantial difference in alkalinity between them, it will be permissible to use the average as an estimate of alkalinity. (NBTG7, 9-10 March 1999)

The Group agreed that environmental variables should be collected during the 2000 survey. The Group also agreed that alkalinity should be collected unless hard evidence could be gathered to prove that the 1995 data could be representative of other years. (200GQASG, 1 December 1999)

If Regions are aware that time invariant data have not been double entered already, they should arrange for this to be done, as was requested for the 1995 survey. (NBTG10, December 1999)

#### 2.7.13 Site information

Recording site information for (as specified under "site manual" in BT001) will be mandatory for all new and existing sites. (NBTG6, 26 January 1999)

#### 2.7.14 Audit and AQC

The audit will be based on samples that have undergone AQC analysis before the end of February; any shortfall in the number of samples will be made-up of samples subject to primary analysis only. The audit report will be produced at the end of May. (NBTG7, 9-10 March 1999 - General principle, not just 2000 survey)

Biology Technical Group agreed that all samples analysed to species should be subject to an audit scheme. (NBTG7, 9-10 March 1999 - General principle, not just 2000 survey)

NBTG reaffirmed that all laboratories have at least 20 standard samples audited (with a minimum of 60 per Region), even if this is greater than 10% of the total number of samples. (NBTG7, 9-10 March 1999 - General principle, not just 2000 survey)

Quantitative AQC (i.e. checking the abundance category as well as the presence/absence of taxa) is not mandatory, but recommended as best practice. (NBTG10, December 1999)

Methods in BT001 must be followed to the letter (2000GQASG, 1 December 1999)

The methods described in BT003 are mandatory, including methods described for selecting audit samples. (NBTG10, December 1999)

The 3-phase approach to dealing with inexperienced analysts, described in BT003, is endorsed. (NBTG, December 1999)

If you have insufficient AQC samples, send primary samples instead. Laboratories must still send 20 samples for auditing. (Instruction from JMB, NBTG19, 3-4 May 2001)

#### 2.7.15 Data analysis and classification

Environmental data used in 1995 will be used for 2000 at sites which remain the same. (NBTG6, 26 January 1999)

At existing sites, where alkalinity is not expected to have changed substantially, data used for the 1995 survey will be used for RIVPACS predictions in 2000. (NBTG7, 9-10 March 1999)

NCEDS is to work with Regions to correct known errors in the database. (GQASG, 1 December 1999)

Regions will undertake the classifications themselves, rather than this being done centrally by the EDS National Centre. (2000 Survey Group). NBTG recommends that this issue be re-considered by the 2000 Survey Group and the B4W Project Board when systems to enable B4W to calculate a classification are in place. (NBTG10, Dec 1999)

The errors found in the database for biology still need checking and correcting. (2000GQASG, 9 August 1999)

The inclusion of summer biology samples will not adversely affect the results based on available evidence and provided that a spring or autumn sample was collected no further action was needed. (2000GQASG, 9 August 1999)

Comparing only spring samples is an option where it is not possible to obtain autumn samples. This is a last resort and we should try to complete the survey as planned. Whatever is decided, this should not be seen as a criticism of Area staff. Whatever is decided will need careful presentation. (2000GQASG, 7 November 2000)

An assessment of canals would be made where they have been sampled but the results will not be reported as part of the national results. The data will primarily be used to further validate the PSYM method. (GQASG, 22 January 2001)

#### 2.7.16 Data storage

RIVPACS suitability codes will be stored in B4W. (NBTG7, 9-10 March)

#### 2.7.17 Reports

The Biology Technical Group expressed the need for an update of the Biological Water Quality Monitoring leaflet. (NBTG2, 27-28 April 1998).

Reports need to be included in the technical specification to ensure that unfulfilled expectations are avoided. (NBTG6, 26 January 1999)

The Group agreed that a workshop on classification and reporting systems would be useful. The Group will set up a workshop in early 2001 at a future meeting. (2000GQASG, 1 December 1999)

A publicity leaflet is recommended to explain the GQA survey to landowners, and others. (NBTG10, December 1999)

A project record for the biology component would be useful as a reference for future surveys. (2000GQASG, 1 December 1999)

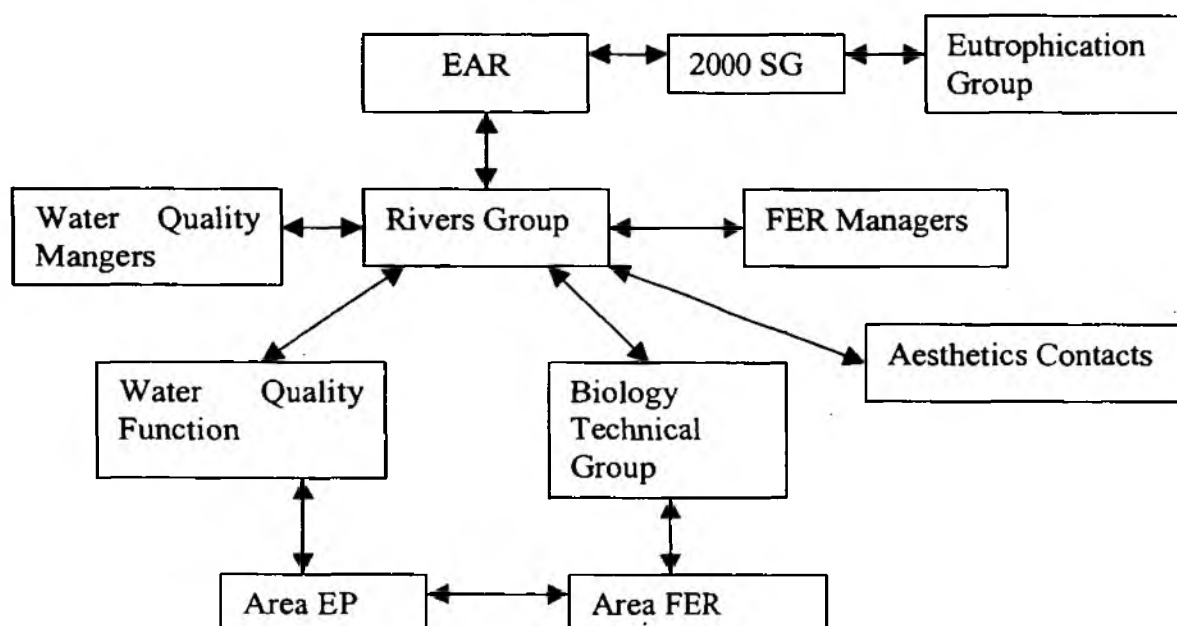
A project record will be produced by JM-B in relation to the biology component. (2000GQASG, 9 August 2000)

We need to look at the effect of differences in available alkalinity data with the 1995 baseline on RIVPACS predictions when the 2000 data is being assessed. (2000 GQASG, 9 August 2000)

The issue of flows must be carefully considered when constructing the report (2000GQASG, 9 August 2000)

We will be comparing 2000 data to both 1995 and 1990. (GQASG, 22 January 2001)

The links between the various group involved in producing the 2000 reports are based on the linkages in the diagram below (GQASG, 5 June 2001):



Further changes to B4W must be put on hold until the 2000 survey reporting was finished. (GQASG, 5 June 2001)

#### 2.7.18 1990 samples

NBTG decided to dispose of the samples collected in the 1990 biological survey, which are being stored near Wareham. (NBTG6, 26 January 1999)

### 3. WORKSHOP

As was recognised in the 1990 survey, and more so in the 1995 survey, it was vital that all biologists involved in the survey followed the same procedures for collecting and analysing the samples. A video to demonstrate the sampling procedure and a comprehensive manual were produced for the 1990 survey. The video was produced for the National Rivers Authority by the RIVPACS development team at the Institute of Freshwater Ecology (IFE, predecessor to the Centre for Hydrology and Ecology, Dorset, CEH Dorset). The manual was revised substantially before the 1995 survey, and two-day training workshops were held in each Region (and in Northern Ireland). The workshops were devised and delivered by John Murray-Bligh (author of the procedures manual) and Rick Gunn (who headed the audit team). These workshops were to ensure that all participants understood the procedures and refinements to it, and that there were no differences in interpretation of the procedures manual. Numerous further changes to the procedure manual occurred as a result of these workshops. An outline of the material covered in the 1995 survey workshops is presented in Section 3.1.

Initially, it was intended that the workshops would be very similar. The following additional items were considered for inclusion:

Table 3.1 Additional items considered for inclusion in the 2000 Biology GQA Survey Workshop

- Sorting - repetitive strain injury
- B4W and data input
- Compare module of RIVPACS 3+, incorporation of error statistics into RIVPACS, bias
- The GQA classification and interpretation of output
- Explanation of the other GQA windows: chemistry, nutrients, and aesthetics
- Sampling canals
- AQC scheme - how well it runs in your Area.

The workshops were delivered in February 2000 to all Regions of the Environment Agency just before the sampling for the 2000 survey started, in March (see Section 3.5) by John Murray-Bligh and Rick Gunn of IFE. A 'Form C' for single tender action was produced and was approved (see Section 3.2). The workshops covered sampling and sample analysis, but were only one day long and did not involve practical field sessions on sample collection. As most biologists undertaking the survey were already familiar with the procedures, the workshops were primarily aimed at correcting any drift in interpretation and in highlighting recent changes in the procedures (particularly relating to health and safety).

NBTG agreed that all staff involved in the survey were to attend it, see Section 2.7.6. Most did so. One exception was South West Region, where only South Wessex Area attended.

The procedure manuals BT001 and BT003 were revised and distributed in preparation for the survey in July (BT001) and August (BT003) 1999. Most of the revisions were minor. However, a new section was added with substantially revised procedures to ensure health and safety when analysing samples in the laboratory and the list of Ordnance Survey 1:50 000 maps was updated. The information about the changes compared to previous editions of both

manuals were listed in their appendices. Additional, unbound copies were sent to every Regional Biologist in early 2000 so that they could reproduce additional copies locally.

Revised notes to accompany the RIVPACS sampling video were produced before the workshops and distributed to biologists via their Regional Biologists, see Section 3.6). These covered the points highlighted when they were shown in the 1995 workshops, particularly where the procedures had changed. All biologists were asked to view the video before attending the workshops, as agreed by NBTG, see Section 2.7.6. During the workshop, only a brief highlight from the video was shown.

John Murray-Bligh and Rick Gunn compiled notes every evening after each workshop. Similar notes had been produced after each of the 1995 Survey workshops and had received favourable comment from attendees, as well as proving to be useful for subsequent revisions to the procedures manuals. Notes for each of the 2000 Survey workshops were sent to the relevant Regional Biologists and Area Team Leaders in the first week of March, as feedback. Notes from all the workshops were compiled into a single document in April 2000 and distributed to all Regional Biologists, at the request of the National Biology Technical Group. These notes are reproduced in Section 3.7.

### **3.1 Material covered in the 1995 Biology GQA Survey Workshop**

#### **Introduction**

The survey - Aim of the workshop (two-way interaction) - Comparability - Proportional sampling - problems (sources of error) - RIVPACS video - air-lift video - minimising damage to samples - quality assurance - How RIVPACS works (3 seasons environmental data).

Demonstration of sample pots, preservation & fixation, time for live sorting, packaging, disasters, AQC vials, common analytical errors.

#### **Map-based environmental data**

Sorting (in lab): washing - sieving (puddling) - lab facilities, fume extraction and ergonomics) sorting (posture, workstation and sorting technique) - sorting errors (audit results).

#### **Field demonstration of sampling normal site**

Site selection - preparing equipment - safety (lifejacket, gloves, barrier creams, the site) - sampling area & survey area - substrate data - search - where to collect kick samples (apportioning time to habitats) - kick sampling technique - transferring sample to pot - rest of search - width, depth (flow) measurements - hands-on kick sampling (critique of individuals style and suggestions) - sample size - comparison of individual's substrate estimates.

#### **Field demonstration of deep site**

Site selection - safety (as in normal site but including double manning and extra safety issues) - sampling area (continuous) & survey area - substrate data - search - discussion of preferred sampling method for the site in question - both banks - dredge demo - long-handled pond net demo - local variations in approach to deep sites - advice about what to do at other problem sites experienced in the Region.

**Workshop discussion session**

Informal discussion of all items covered in the workshop. Possible improvements to the methods. Unstructured, but if necessary, comments elicited by considering aspects of the course in the order in which they were covered.



**3.2 Form to justify single tender action for IFE to assist with the calibration workshops**

**SINGLE TENDER ACTION FORM C**

Region

Thames

Regional SoD Ref

Function

Biology

H O SoD Ref

*Use this form to obtain authorisation of a single tender in accordance with Scheme of Delegation sections listed below.*

| SoD Ref | Category                | Regional Delegation | Mark X (*)                   |                                |
|---------|-------------------------|---------------------|------------------------------|--------------------------------|
| C4      | Expenditure             | 100,000             | <input type="checkbox"/> N > | <input type="checkbox"/> R <   |
| C4      | Expenditure - Fisheries | 50,000              | <input type="checkbox"/> N > | <input type="checkbox"/> R <   |
| O3      | Information Systems     | -                   | <input type="checkbox"/> CIS |                                |
| P2      | Emergency               | Any value           | <input type="checkbox"/> N   | <input type="checkbox"/> R     |
| Q2      | Consultancy Project     | 100,000             | <input type="checkbox"/> N > | <input type="checkbox"/> R < X |

\*N = National delegation; > = Greater than  
R = Regional delegation; < = Less than

**1.SUPPLIER/CONTRACTOR**

**Institute of Freshwater Ecology, River Laboratory, East Stoke, Wareham, Dorset BH20 6BB**

**2.DESCRPTION OF CONTRACT**

To assist with a series of workshops on sampling and analytical methods compatible with RIVPACS in preparation for the 2000 biological GQA survey, to help ensure that all Agency biologists understand the methods that they are to use, and to help with the further refinement of the methods.

1. To help prepare a series of eight one-day workshops to be held in each Region of the Environment Agency.
2. To provide expert information about the collection of samples and environmental data for RIVPACS and to demonstrate these methods in the field.
3. To help to evaluate comments and suggestions for improving the methods used for the biological GQA surveys.
4. To provide expert information on the preservation and transport of samples, in particular for

the audit of analytical quality.

5. To provide expert information about analytical errors in analyses of biological samples for GQA surveys undertaken by the Agency as a whole and by individual laboratories.

Form032/Form C/jc/24 January 2003

### 3.PROJECT DETAILS (IF APPLICABLE)

Project Title

Workshops on sampling and analytical methods for  
the biological GQA survey 2000.

Project Code

Authorised Cost ()

Project Manager

John Murray-Bligh

Project Executive

National Biology Technical Group

### 4.CATEGORY OF SINGLE TENDER ACTION

☐ In House Work Force

Mark X to one:

☐ X Sole

Source Supplier

☐

Emergency

### 5.COST ESTIMATE

Estimated Cost ()

£10 000

### 6.SPECIFY TYPE OF EXPENDITURE

Revenue

☐ X

Mark X to one:

Capital

☐

### 7.JUSTIFY THE USE OF SINGLE TENDER ACTION

Rick Gunn of IFE, who is in charge of auditing the quality of standard invertebrate samples analysed by the Environment Agency, assisted with a similar series of workshops for the 1995 national biological GQA survey. These proved to be very successful. Similar assistance with the workshops for the 2000 biological survey is therefore being sought.

Only IFE can provide expert information about the collection of samples and environmental data for RIVPACS, because RIVPACS and the field sampling techniques were developed by IFE. IFE are currently undertaking an R&D project for the Agency into the development of deep water sampling methods for RIVPACS, and it is important that preliminary information from that project is disseminated at the workshops. This is because the final reports are not expected to be produced before sampling for the 2000 GQA survey begins.

IFE is the only organisation that is fully conversant with the sampling and analytical procedures for RIVPACS, and with the variations of this that are the Environment Agency's standard methods. IFE is therefore the only organisation that could evaluate fully any comments and suggestions for improving the methods used for the biological GQA surveys.

IFE currently audits Environment Agency invertebrate samples. This involves re-analysing a proportion of Agency samples. Because of this, the auditors at IFE are the only people who can provide expert information on the preservation and transport of Agency invertebrate samples for the audit of analytical quality. Furthermore, only the auditors at IFE can provide expert information about analytical errors in analyses of biological samples for GQA surveys undertaken by the Agency as a whole and by its individual laboratories.

*Attach separate page if required*

Form032/Form C/jc/24 January 2003

## 8.COMPLETED BY

Name John Murray-Bligh

Date 8 November 1999

## 9.AUTHORISATION

Consultation

|  |
|--|
|  |
|--|

Signed

Date

Job Title

|  |
|--|
|  |
|--|

### **3.3 Specification for the 2000 Biology GQA Survey calibration workshops.**

This specification was completed on 7 December by John Murray-Bligh.

## **ENVIRONMENT AGENCY**

### **Workshops on sampling and analytical methods for the biological GQA survey 2000.**

#### **SPECIFICATION**

##### **1. Background**

There will be a national biological general quality assessment survey of rivers in 2000. It is imperative that all participants follow the same sampling and analytical methods, to ensure that the data is comparable. To do this, all the participants must be fully aware of the Agency's standard method, and understand which procedures are critical and why.

The Agency's methods are still being refined. Between them, Agency biologists have a considerable amount of experience and expertise. It is important that this expertise is taken into account when refining the methods. It is also important that this expertise is spread throughout the Agency, so that biologists can take advantage of new developments and benefit from the experiences of others.

In 1995, a series of workshops was held to meet similar requirements in preparation for the 1995 survey. These were very successful. It is our intention to hold a similar series of workshops in preparation for the 2000 survey. These workshops were run by a member of staff from the Environment Agency who was familiar with the methods, and an expert from IFE who was not only familiar with RIVPACS but was also able to provide information and advice about the Agency's methods, samples and analytical quality, based on experience gained from undertaking the analytical quality audits.

This specification is for the provision of support for a series of workshops to be held in preparation for the 2000 GQA survey.

##### **2. Objectives**

###### **Overall Objective:**

To assist with a series of workshops on sampling and analytical methods compatible with RIVPACS in preparation for the 2000 GQA survey, to help ensure that all Agency biologists understand the methods that they are to use, and to help with the further refinement of the methods.

###### **Specific Objectives:**

1. To help prepare a series of eight one-day workshops to be held in each Region of the Environment Agency.
2. To provide expert information about the collection of samples and environmental data

for RIVPACS and to demonstrate these methods in the field.

3. To help to evaluate comments and suggestions for improving the methods used for the biological GQA surveys.
4. To provide expert information on the preservation and transport of samples, in particular for the audit of analytical quality.
5. To provide expert information about analytical errors in analyses of biological samples for GQA surveys undertaken by the Agency as a whole and by individual laboratories.

### **3. Methodology**

#### **Overall Approach:**

A member of staff from IFE will accompany staff from the Environment Agency, will assist in presenting the workshops in each Region and will help to compile specific comments for each Region following each workshop.

#### **Methodology:**

- a) Attend a meeting to help prepare detailed plans for the workshops.
- b) Give a short presentation in the workshop on minimising damage to samples after they have been collected.
- c) Demonstrate the correct equipment and procedures for collecting samples for RIVPACS and hold a discussion on the relative merits and application of different procedures for doing this.
- d) Provide technical assistance throughout the workshop.
- e) Provide a single expert 'opinion' against which Agency biologists can standardise their procedures.
- f) Shortly after each workshop, help compile notes for feedback to individual Regions and contribute to more generally applicable feedback to the Agency as a whole.
- g) Provide expert assistance with the incorporation of feedback into revisions to National procedures.

### **4. Monitoring**

The project will be monitored by the Project Manager through feedback from the Agency's workshop presenter and Agency participants.

## 5. Time-scales

The Collaborator shall adhere to the following programme:

| Work item   | Completion Month (end of) |
|---|---------------------------|
| 1 Detailed planning                               | Jan 2000                  |
| 2 Complete training workshops                     | Feb 2000                  |
| 3 Contribute to post-workshop feedback to Regions | Feb 2000                  |
| 4 Contribute to feedback to whole Agency          | Mar 2000                  |

## 6. Summary of Output Requirements

No permanent outputs are expected.

The contractor will assist in the provision of written feedback from each workshop to individual Regions or Areas and to overall feedback to all, to improve the effectiveness and efficiency of our methods and quality of the 2000 Biological GQA survey.

The contractor will assist in amending the Agency's standard methods documents for collecting and analysing invertebrate samples (BT001), for undertaking GQA surveys (BT002), and for quality assurance of invertebrate samples (BT003).

### 3.4 Quotation from IFE for work to assist with the calibration workshops



**Institute of  
Freshwater  
Ecology**

John Murray-Bligh  
EA Thames Region  
Kings Meadow House  
Kings Meadow Road  
Reading  
RG1 8DQ

**River Laboratory**  
East Stoke, Wareham  
Dorset BH20 6BB  
United Kingdom

Telephone: 01929 462314  
Facsimile: 01929 462180  
E-mail  
RJMG@ifc.ac.uk

11 January 2000

Dear John

John Hilton has asked me to respond to your letter of 22 December and I can now provide a formal quotation for assistance with the National River Survey Workshops. The quotation is itemised according to the headings in your letter. As mentioned yesterday in our telephone conversation, I have allowed an extra day for delivery to cover the revised schedule that we discussed and the use of an IFE vehicle for the Exminster-based workshop only.

#### Quotation:

|    |                                |                    |           |
|----|--------------------------------|--------------------|-----------|
| 1. | Delivery of workshops: 15 days |                    | £■■■      |
| 2. | Preparation & planning: 2 days |                    | £■■■      |
| 3. | Discussions & feedback: 2 days |                    | £■■■      |
| 4. | T & S                          | Overnight          | 10 x £■■■ |
|    |                                | Non-overnight      | 4 x £■■■  |
|    |                                | Use of IFE vehicle | £■■■      |
|    |                                | Total T & S        | £■■■      |
| 5. | Equipment                      |                    | £■■■      |
| 6. | Total cost                     |                    | £■■■      |

Best wishes

Rick Gunn

### 3.5 Itinerary for the 2000 GQA biology survey calibration workshops

#### ITINERARY FOR GQA WORKSHOPS

|              |  |   |
|--------------|--|---|
| Mon 31 Jan   | Travel to Penrith                          | Mrs Stockdale, Barco House, Carleton Rd, Penrith Tel. 01768 863 176 |
| Tues 1 Feb   | North West Workshop                        | Penrith Lab Tel. 01768 866 666                                      |
|              | Travel to Bangor                           | Rosemary Abbas, Bwthyn, Brynafon, Menai Bridge Tel. 01248 713 119   |
| Wed 2 Feb    | Welsh Workshop                             | Bangor Lab Tel. 01248 670 770 Overnight as above                    |
| Thurs 3 Feb  | Return travel to Dorset                    |   |
| Mon 7 Feb    | Travel to Eastleigh                        | Mays Farmhouse, Longwood Dean, Eastleigh Tel. 01962 777 486         |
| Tues 8 Feb   | Southern Workshop                          | Eastleigh Lab Tel. 01962 713 267                                    |
|              | Travel to Reading                          |   |
| Wed 9 Feb    | Thames Workshop                            | Fobney Lab Tel. 01189 535 000                                       |
| Thurs 10 Feb | Return travel to Dorset                    |   |
| Mon 14 Feb   | Travel to York                             |   |
| Tues 15 Feb  | North East Workshop                        | York Lab Tel. 01904 692 296   |
|              | Travel to Nottingham                       |   |
| Wed 16 Feb   | Midlands Workshop                          | Nottingham Lab Tel. 01159 455 722                                   |
|              | Travel to Huntingdon                       |   |
| Thurs 17 Feb | Anglian Workshop                           | Brampton Lab Tel. 01480 414 581                                     |
| Fri 18 Feb   | Return travel to Dorset                    |   |
| Mon 21 Feb   | South West Workshop<br>(South Wessex only) | Blandford Lab Tel. *70 = 01258 456080                               |

Mobiles: RJMG: 07711 779 703  
JM-B: 0374 412 979



### 3.6 Notes on the RIVPACS training video "RIVPACS field sampling: Pond Net Sampling"

These notes were produced by John Murray-Bligh and were issued to Regional Biologists in January 2000, before the workshops. This was to enable biologists to watch the video before the workshop.

Since the video was produced, the sampling methods have been refined further. Nevertheless, the video remains relatively accurate and comprehensive for kick sampling. As such, it is a useful training tool, but the following changes must be pointed-out.

The shallow, mono-filament nylon nets attached to the pond nets that are used in the video are no longer considered to be suitable. Instead, 0.5 m deep multi-filament woven polyester nets should be used. Note that 0.3 m deep nets are also available but that the 0.5 m deep net is the standard to be used for RIVPACS. Woven nets are much more flexible and easier to empty and to repair than mono-filament nets, and their depth ensures that animals collected in the net do not get washed-out accidentally.

After collecting a sample at the first site, the video shows how NOT to put a sample in a pot! Never squash a sample into a pot. We insist that large samples are split between two or more pots, or that they are put into larger (2½ l) buckets with air-tight lids.

Polythene bags are not used with rigid sampling pots. One of the reasons for using them was that they made it easier to empty stiff mono-filament nets. The other reason was as an additional barrier for formalin fixative, but we insist on air-tight lids for all sampling pots.

Environment Agency biologists do not measure the flow rate at any site (nor do biologists in the Scottish Environmental Protection Agency or the Department of the Environment in Northern Ireland). Instead, the mean annual discharge is obtained from hydrometric staff.

The main part of the sample is collected by three minutes of active sampling, as explained in the video. For better standardisation, the search is limited to one minute. This period is split between the initial search for surface dwelling insects such as pond skaters, and a search for animals attached to large stones and other objects. One minute of active searching is always done, even if it is unfruitful. In the search, individual animals are picked-out and put into the sample, in contrast to the main sample in which the collector is blind to the individual animals which end up in it.

The methods shown in the video are suitable only for shallow and relatively fast-flowing streams. In deeper waters different techniques are used, and the main sample is either collected by pond-net, long-handled pond-net, medium Naturalist's dredge, or a simple air-lift sampler. Details of these methods are given in the sampling procedures manual: Environment Agency, 1999. *Procedure for collecting and analysing macro-invertebrate samples for GQA surveys*. Quality Management Systems for Environmental Monitoring: Biological Techniques, BT001. Bristol, Environment Agency. Canals should be sampled according to Pond Action's method developed in the PSYM R&D project. This method has not been incorporated in BT001 yet, as it was adopted very recently (December 1999).

### 3.7 Presenters' feedback from the 2000 GQA Biology Calibration Workshops

These notes incorporate amendments made in the light of feedback and comments from Regional Biologists on the first drafts that were sent to individual Regions shortly after the Workshops.

#### 3.7.1 General comments

Sampling for the 2000 Survey should not extend beyond 30 November. Any samples taken in (late) August as a precaution against high flows at flashy sites must be recorded as "summer" samples, not "early autumn" ones. For flashy stream sites, it is recommended that a summer sample is collected and stored. It need only be processed if it subsequently proves impossible to collect an autumn sample.

'Ocean Heavy-Duty Gloves with Elasticated Armlet' are available from Collins Nets. They will supply these in a smaller size, but the minimum order is 100 pairs. Julie Bywater (Thames Region, Wallingford) is prepared to co-ordinate an order for the Agency.

The Agency's biological database B4W cannot store the individual measurements of depth that are used to determine average depth for RIVPACS. The RIVPACS sampling video recommended that you record Right, Mid and Left hand measurements individually, so that you can compare depths at different times. If you want to record individual measurements, you will have to do so in a memo field.

Formaldehyde is a fixative, IMS is not. Samples should be fixed wherever possible. 70% IMS is a better preservative than 10% formalin (4% formaldehyde) therefore samples should ideally be fixed in formalin and reconstituted in IMS, 70% *final* concentration. Specimens in the vial should be preserved in IMS, *not formalin*.

If laboratories fix samples in formalin, wash and analyse them, and then return them to formalin, they may be doing so on grounds of cost. The problem with this is that formalin is not as good as alcohol as a preservative because of its acidity.

There is no need to add formalin if formalin has previously been added to a sample. We also suspect that there is no need to add formalin if the sample has already been preserved. This differs from the advice we gave in 1995, where we recommended that formalin should be added even if sample had previously been preserved in alcohol. This probably needs further investigation, but we feel that it is much more important to ensure that fixative or preservative is of an adequate strength in the sample. It is not possible to get a 70% solution of preservative in a sample by adding 70% alcohol. Samples preserved well but not fixed can be in good condition by the time they are audited, but samples not preserved well are unlikely to be in good condition.

In most samples that the auditors receive in poor condition, the contents of the vial are OK. This suggests that the concentration of preservative is the problem, particularly the dilution of preservative when added to the main sample containing plant material, detritus etc in addition to invertebrates.

The auditors at IFE will investigate reporting on the state of preservation of audit samples in order to provide laboratories and Regions with information about the adequacy of preservation.

There is some confusion in the type of warning labels that should be applied to different types of samples. Skull and crossbones (indicating poison) should be used with concentrated formalin. Harmful labels should be used for dilute formalin and alcohol. Flammable labels should be used for alcohol, whether concentrated or dilute (70%).

The primary analyst should place no more than three examples of each taxon (including non-scoring taxa) in the primary vial.

AQC inspectors *must not* alter the contents of the primary vial. They should place only additional taxa in the AQC vial, not one of each taxon that they pick from their own re-sort of the sample.

The procedure by which AQC samples are selected needs to be amended in a couple of laboratories. One in every batch of ten primary samples should be selected randomly for AQC inspection. The Quality Controller should do this. The ball-in-the-bag method is recommended. After ten samples have been analysed in the laboratory (as a whole), ten balls (one of which is identical to the other nine other than in colour) are put in a bag. Balls representing individual samples in the batch of ten (in order of their analysis) are removed from the bag, but not replaced until all ten balls representing ten primary samples have been removed from it. The sample represented by the single coloured ball becomes the AQC sample for that batch of ten samples. AQC samples from batches of ten can be chosen randomly in advance, so long as the primary analyst and AQC inspector have no way of knowing whether a particular sample is more likely than others to be chosen as an AQC sample. Similarly, it is important that AQC inspectors have no way of knowing in advance whether a particular AQC sample is more likely than others to be chosen as an audit sample.

All samples containers and vials sent to the auditors must be labelled fully, as described in BT001 and BT003. Full labelling assists the auditors when matching samples with data sheets. AQC Inspectors must re-instate site information on labels on sample containers for audit samples.

Sample pots should be sealed with PVC insulating tape before dispatch to IFE.

Efforts to send batches of samples earlier in the year and at regular intervals throughout the year would be much appreciated by the auditors.

We recommend that Areas pool together to send batches of audit samples to IFE, if they are able to transport samples by courier within the Region.

Returning samples to the Agency after they have been audited is not covered by the audit contract. If you want the auditors to retain or return samples to you, please let them know before you send the samples to them, and include a note with the samples (not just a note on the back of the data sheet). If you don't do this there is a risk that

the auditors will automatically discard the samples after they have been re-analysed. If you want the auditors to return the samples to you, please make sure that you also have sorted the costs out as well.

Samples not required for audit can be discarded. However, it's a good idea to store one or two AQC-samples throughout the survey, just in case there is a problem with the audit (e.g. samples missing or damaged lost in transit) and replacement audit samples are needed.

The workshop revealed some shortcomings in the current management systems and communication within the Agency.

In one Region (South West), only one Area chose to attend a workshop. It was unfortunate that the three Areas that did not attend were also the three Areas not included in IFE's 1995 post-survey appraisal (R&D Technical Report E102).

From a national perspective, Regional Biologists have no line management responsibility for their respective Area teams, and thus cannot be responsible for ensuring that standard methods and other requirements for the national survey are complied with. Despite assurances from Regional Biologists that standard methods were being followed in 1995, it has transpired that in some cases this was not so (see also R&D Technical Report E102). Although the willingness to comply with standard procedures appears to greater now than it was, there is still no mechanism for ensuring that standard methods and instructions for the survey will be complied with in full.

We consider that non-compliance compromises the efforts of the vast majority of Areas who are expending considerable effort in ensuring that they undertake the national survey correctly and to a high quality. JMB has been told that biologist's still cannot agree and make decisions. This was a criticism following the 1990 survey that it is important for biologists to dispel.

Although we specifically did not cover the Agency's B4W database, we detected considerable unease in most of the workshops with the B4W database that is to be used for recording and analysing the results of the survey. The length of time that it takes to enter data was a particular concern to many.

### 3.7.2 General hints

Hint from North West: extractor cupboards have been fitted in the Penrith laboratory, either side of the fume cupboard. These cupboards vent via the fume cupboard to outside. They are fitted with trays on rollers that hold samples stored in the standard BDH sample pots. The cupboards enable preserved samples to be stored conveniently in the laboratory.

Hint from Wales and North East: electronic meters for measuring ambient formaldehyde concentrations are available from PPM Limited (Portable Precision Monitors), Uned 2, Llys y Fedwen, Parc Menai, Bangor, Gwynedd, Wales. Tel. 01248 671717. They are also supplied by C Tennant & Co Ltd, West Bromwich.

Hint from Southern: 5 litre sampling buckets with clip-on lids are available. However, they do not recommend larger (10 litre) buckets because they are too flimsy.

Hint from Thames: the BDH Merck Catalogue 2000 details "A New Alternative to Formalin Fixation". It was recommended that the effectiveness and the preferred concentration to use for macro-invertebrate samples should be the subject of an R&D exercise.

Hint from Thames: it is important to minimise the time that the lids for the bucket-type containers recommended in BT001 are folded back. This is because they will start to split. They should be folded down when in storage.

Hint from South West (Devon): Severn Trent plc no longer supplies Alcohol exposure meters. The address of a new supplier, Casella Ltd., is given in updated list "Kit".

Hint from North East: use computer wrist rests either side of the sorting tray to rest hands on. This may reduce the risk of RSI.

Hint from Midlands: On a pond net, shrink tube or other tape around the join of the frame and the handle to cover the sharp edges of the ends of the frame will reduce the risk of injury if your hand slips whilst climbing out of a river.

Hint from South Wessex: Leica UK is now offering a range of wedge-shaped, add-on modifications for Wild stereomicroscopes to improve their ergonomic design. These include the possibility of viewing at 90° to the base-plate (i.e. straight ahead without bending your neck). Leaflet available from Leica UK Ltd "Ergonomic programme for Leica stereomicroscopes".

### 3.7.3 North West Region, Penrith, 1 February 2000

The Region voiced a concern that task-based risk assessments for risks common to every biological laboratory are being written independently in each one. There were concerns that the judgements of risk and the means of minimising risks may differ, and the consequences of this if an accident occurred. There was a view that assessments for these risks could be produced for the whole Agency. There is sufficient expertise in the Agency for the risks to be assessed well. This would also reduce duplication of effort, although it was acknowledged that Areas had been asked to undertake these individually so that team leaders, with their teams, considered the risks themselves.

There was concern about the low suitability of RIVPACS for some whole catchments in the Region. Sites with artificial banks commonly have low suitability. RIVPACS sometimes classified sites with low suitability in the same group despite them being dissimilar and geographically distant. RIVPACS suitability needs to be addressed in future R&D as well as in reports of Agency surveys.

There was discussion about what action to take when the AQC is in Alarm State. The manual offers three options: re-analyse samples, scrap data, or accept data with the proviso that its quality is below par. It is JMB's view that re-analysing or scrapping

data would only be used in exceptional circumstances, depending on how critical it is for data to be of good quality (e.g. samples on which a court case rests).

Hint: extractor cupboards have been fitted in the Penrith laboratory, either side of the fume cupboard. These cupboards vent via the fume cupboard to outside. They are fitted with trays on rollers that hold samples stored in the standard BDH sample pots. The cupboards enable preserved samples to be stored conveniently in the laboratory.

At least one Area uses artificially bouldery sites below bridges on reaches that are otherwise mostly or entirely silty. Although these sites are atypical of stretch, they are better for water quality analysis because they support a more diverse fauna which includes more indicators of good quality that are better able to reflect the water quality. The faunas at sites on silty areas that are typical of the reach indicate a poorer water quality than those of isolated artificial riffles below bridges. These sites are used for GQA and the Region/Area continues to use them because the survey is primarily for, and funded by, Water Quality.

We (the presenters) believe that these sites are not suitable for RIVPACS. They are akin to using artificial substrate samplers. The problem of samples from silty reaches classifying poorer quality than from isolated artificial riffles below bridges needs to be investigated. We believe that this highlights the need for clear objectives for biological surveys. In particular, we believe that it is vital that the objectives of the revised BQO monitoring scheme are clear. The best sites for monitoring water quality are not necessarily the best sites for monitoring ecological or environmental quality.

Abundance will be used increasingly. In 1995, abundance was used mainly for R&D, but the data will be used to enable the indices and procedures being developed in this R&D to be applied retrospectively to 1995 data (to serve as a baseline for comparison) once the new methods become operational. Bill Walley revised the BMWP-scores system for which the inclusion of abundance data provided significant improvement to ASPT. These revised scores were used in the artificial intelligence R&D project. Original, revised BMWP-scores and classification based on artificial intelligence (in addition to the primary data) for 1995 were distributed to all regions on the RBMS computer package (y2k checked and harmonised on Agency desktop in South West Region). In addition, the distribution of taxa by abundance were mapped and reported in R&D Technical Report E12 (also available on the web at [www.soc.staffs.ac.uk/research/groups/cies/](http://www.soc.staffs.ac.uk/research/groups/cies/)) [this address changed in 2002 to <http://www.cies.staffs.ac.uk/>]. IFE have used abundance data in the development of abundance related indices for RIVPACS. The LIFE index uses abundance data, and this will be used increasingly for Water Resources work. Abundance is also used in the River Pollution Diagnosis System currently being developed by Bill Walley.

Sticky labels should not be used in vials containing IMS.

The facilities for analysing samples in South Area are not entirely satisfactory. This arose when the Area moved from Sale to Birchwood a couple of years ago. For sorting samples there, biologists have a "work room". However, this has no fume cupboard or external vent, nor facilities for storing preserved samples. Anything else has to be taken back to the old site at Sale, which is 15 miles away. The Area put up

with this inconvenience, but the GQA survey has brought the problem to the fore. The "work room" only has room for two people, and more will be sorting for GQA.

#### 3.7.4 Wales, Bangor, 2 February 2000

The Region needs to ensure that 50 cm depth bags are fitted to pond nets rather than shallow 30 cm nets. Larger nets are less prone to becoming blocked with detritus, and fast swimming insects such as beetles are less likely to be lost. There is also a smaller bow wave because deeper nets create less water resistance. However, deeper nets are more easily damaged on rough riverbeds, particularly in urban sites.

Depth does not need to be measured along the same transect as width. Depth needs to be measured within the sampling area, but where the depth is most easily measured and should represent the median for the site. It should not be in a particularly wide or narrow part of the site.

Biologists in this Region were concerned about where average depth for RIVPACS should be stored in the Agency's biological database B4W. There is a field in B4W for storing channel depth and sampling depth. There was uncertainty whether channel depth was for recording the depth of the river channel, contrasting with water depth used by RIVPACS. We did not know which field should be used, but recommend that the field to be used for RIVPACS is labelled as such in the database. Midlands Region use sampling depth to record the depth of water where the sample was collected, in contrast to the average depth of the site used for RIVPACS which takes account of parts of the site that were inaccessible to the sampler. They did not use this data.

In mid-stream, the depth measurement can be zero when flows are low. See figure 3.6 in the sampling manual BT001.

Hint: formaldehyde meters. Available from PPM Limited (Portable Precision Monitors), Bangor. Details to be posted to the Nat\_Ecology discussion group.

#### 3.7.5 Southern Region, Colden Common, 8 February

The format of this workshop was re-arranged because the conference room was unavailable until the afternoon. This was because the date for the workshop was not flexible and we wished to minimise travel between Regions. The introduction and coverage of principles and new techniques for the 2000 Survey was covered in the laboratory, where space was restricted and there was no opportunity to use an overhead projector. The training video had to be viewed after the discussion on sampling techniques because video equipment was also not available until the afternoon. This format was not a success.

The Medium Naturalist's Dredge is used in one Area of Southern Region without its rigid arms in an attempt to make it lighter and therefore easier to throw. We believed that the arms are an integral part of the dredge that ensure that it rests on the river bed in the correct attitude and helps to ensure that it operates effectively. We

recommended that the rigid arms should be re-fitted. Lightweight arms do not add appreciably to the weight of the dredge.

In one Area, samples containing large amounts of fine material were not sorted fully. Instead, only a portion of the fine material was sorted, because it tended to yield few additional animals. The presenters did not recommend this as it deviates from the standard method. The whole sample should be sorted. Because the Area laboratory in question had a very good analytical record according to audits, we believed that it did have some headroom available for risking lower analytical quality in order to increase throughput. During discussion, another Area indicated that they used to sort only a portion of the fine material, but now sort it all because in chalk streams in particular, they were missing small caddis.

Hint from Southern: 5 litre sampling buckets with clip-on lids are available. However, they do not recommend larger (10 litre) buckets because they are too flimsy.

We re-iterated that full labelling, as described in BT001 and BT003 is mandatory, and particularly important for audit samples.

### 3.7.6 Thames Region (West and South East Areas), Fobney Mead, 9 February

Biologists commented that when choosing the best location for sites, there was no time available for walking the length of the river. Although they know the rivers in the vicinity of the sites, they do not know their character elsewhere. They suggested an independent assessment of the suitability of sites would be useful.

Biologists indicated that site maps/photographs/site location notes are only available for some sites, they therefore need more time or more staff to complete them in this survey. Compiling this information takes about the same time as sampling and sometimes slightly longer. We recognise that this is a problem that they have inherited as a result of their managers' decision to ignore instructions for producing these for the 1995 survey.

If the Survey Area (see BT001) and Sampling Area for a site cannot be re-located, then it should be replaced by a new site. This is because the classification will be based on environmental variables measured in 1995. It is therefore important that the environmental variables measured in 1995 relate to the same site.

Flow data should have been re-determined for the 1995 survey, following the discovery of gross inaccuracies in this data on the water quality classification maps previously used. Research at IFE indicated that flow category needed to be correct to the nearest category. For 1995, flow should be determined by the Regional Hydrometric Section, using micro-low-flow software, or their best estimate where this software is inappropriate. It seems likely that this was not done in Thames Region. We recommend that flow categories are re-determined.

There appeared to be problems with distance from source in at least one Area. These were not re-calculated for the 1995 survey, as instructed then. Some of these



measurements had been obtained from EP Department, and were based on the length of the named watercourse taken from maps other than 1:50 000. We re-iterated the instruction in BT001. Distance from source must be based on the furthest source upstream, regardless of the name of the watercourse and must be determined from 1:50 000 Ordnance Survey maps. These measurements should be checked for the 2000 survey. However, it seems that in this Area (whole Region?) the distances from source will have to be re-determined from scratch. This will inevitably take more time.

Biologists indicated a problem in differentiating parts of the method that are important to maintain standardisation from those that they can ignore. We considered that it is only possible to cut corners if there is sufficient leeway in analytical quality (i.e. audit results were good). Thames Region does not have much leeway.

We were asked whether it was permissible to use a dry suit to collect pond net samples for deep rivers, or whether they must be sampled from the banks with a long-handled net. So long as sampling was safe and some material was collected from the main channel, we considered that either approach was satisfactory. We re-iterated the instruction for the 2000 survey, that each deep-water site should be sampled in the same way that it was sampled in 1995, so long as this complied with BT001, to maintain comparability.

Some biologists were reducing the amount of sorting of large samples by scanning some fractions of the sample rather than sorting them methodically in detail. We commented that if the analytical quality, as indicated by the audit results, was sufficiently good, it would be possible to reduce sorting time at the expense of quality. We strongly recommend that less material is put into sorting trays (if necessary, use more trays), because this is likely to speed sorting.

The Region was not using polythene bags or refrigeration when returning live samples to the laboratory. We consider that refrigeration is vital, because errors are additive. By the time they reach the auditors, some samples from Thames are not in good condition, though this is probably because of poor preservation.

We stressed that concentrated rather than dilute preservative should be added to samples.

Problems in running the AQC procedure in a small laboratory with only two experienced analysts were raised. A particular problem was that of maintaining anonymity. We suggest that this needs further investigation.

Hint: The BDH Merck Catalogue 2000 details "A New Alternative to Formalin Fixation". It was recommended that the effectiveness and the preferred concentration to use for macro-invertebrate samples should be the subject of an R&D exercise

Hint: It is important to minimise the time that the lids for the bucket-type containers recommended in BT001 are folded back. This is because they will start to split. They should be folded down when in storage.

#### Notes subsequent to workshop

In Thames in 1990, some sites were only sampled in one season. In North East Area 90 sites were samples in 3 seasons, and 20 in a single season. Single season data was reported in 1990. In 1991, a much better and more comprehensive GQA survey was undertaken, which was more like that done in 1995. Use of 1991 data would enable a greater number of sites to be compared against 1995 (and 2000).

Some environmental data was not updated 1995, despite being re-measured.

#### 3.7.7 Devon Area, 10 February 2000

(These notes are derived from an informal visit to the Exminster laboratory by John Murray-Bligh.)

##### Slope

A site is just downstream from a contour. The slope at the site is not shallow but quite steep. The next contour downstream is a long way away. Following the method for determining slope in BT001 gives a very shallow slope. The contour just upstream and the one upstream from that gives a very steep slope. What should be done?

I suggest that you treat the site as being on a contour (OK if it's very close).

Hint: Severn Trent plc no longer supplies Alcohol exposure meters. The address of a new supplier, Casella Ltd., is given in updated list "Kit".

#### 3.7.8 North East Region, York, 15 February 2000

Wide discrepancies in the cost of transporting samples containing formalin were discovered at the workshop. TNT charge Ridings and Dales Areas £180 for each consignment to the auditors at IFE Wareham, regardless of number of samples. Northumbria Area is charged £15, also by TNT.

Biologists were concerned whether depth for RIVPACS should be stored under Channel Depth or Sample Depth in B4W. We Recommend that the field used for the RIVPACS variable should be identified as such in B4W.

The Occupational Health Advisor, who attended the workshop was concerned that when hand cleansers were used, particularly antiseptic alcohol based cleansers, a skin protection cream should also be used to restore natural oils.

The Health and Safety Advisor attended. He concluded that a sub-group comprising H&S and biologists should be established to deal nationally with H&S issues, in particular to set guidelines for best practice.

Previously, staff have received a letter warning of the risks of Leptospirosis to give to their GPs. New staff do not receive this. This needs to be resolved.

New staff do not receive Health and Safety training for sampling until some time after starting. This needs to be resolved.

#### Desk Height

One of the biologists had been tested ergonomically and been found to be the ideal dimensions for the benches. Another biologist indicated that they could not get comfortable in some laboratories because they were too tall for the benches.

Hint: use computer wrist rests either side of the sorting tray to rest hands on. This may reduce the risk of RSI.

We were shown some sorting trays that were as long as a large tray, but were narrower.

Hint: PPE meters are used for measuring ambient formaldehyde concentrations. Details will be provided via the discussion group. They are supplied by C Tennant & Co Ltd, West Bromwich. Further information incorporated in list of equipment "kit".

#### 3.7.9 Midlands Region, Nottingham, 16 February

There was concern that the Priority Planning Exercise would mean that project and other work which helped to maintain morale would be dropped. Job satisfaction would be diminished.

Should canal samples be audited? This topic was not resolved at the Workshop, but is being resolved now.

A non-standard dredge is being used in a non-standard way in one Area. Instructions in the 1995 workshop were ignored. The national co-ordinator was not informed at the time, nor was the Regional Biologists Group or the GQA Survey Group (Rivers Group). Because of this, the equipment was not included in the current research on deep water sampling methods. The Regional Biologist for Midlands has decided to allow the Area to continue to use it for the 2000 Survey, despite concerns expressed by the presenters, to allow local comparisons with the 1995 results.

The Regional Biologist's justification is that "they had been told by the Area concerned that it was a H&S issue and the alternative was not to sample at all. There has been no information presented to NBTG on the deep-water sampling R&D Project and a final method not yet agreed. As this may alter BT001 they preferred the ability to compare 1995 with 2000 (as requested by EP) followed by a change rather than a different approach in 1995, 2000, and 2005, none of which can be compared. Training on deep water sampling has not been provided pending any proposed changes due to the R&D. Air lift equipment is not available in the region and would not be purchased until assessed after the R&D reported back on the results."

We continue to recommend the use of a standard method because the deep water R&D project is only considering the existing standard methods.

We reminded the Region that only air-lift samples may be collected from boats, and that any other samples collected from boats contravene the standard methods.

It is helpful if the AQC inspector has access to the primary analyst's data, though they should not know the site name or name of the primary analyst.

Hints: On a pond net, shrink tube or other tape around the join of the frame and the handle to cover the sharp edges of the ends of the frame will reduce the risk of injury if your hand slips whilst climbing out of a river.

Samples must be kept cold as well as being analysed within 48 hours. Many samples from this Region are not well preserved by the time they reach the auditors.

There was concern that the Agency's biology database B4W was not calculating substratum correctly because of confusion over bedrock.

Suppliers for Secchi disks and clinometers, which are needed for surveying canals, were not known. JMB has put a request for this information to the Nat\_Ecology discussion group.

It is important to remember that rangefinders need regular calibration, more often, it seems, than most other equipment.

3.7.10 Anglian Region, Huntingdon (includes Thames Region, North East Area), 17 February 2000

It is advisable to empty the sampling net if you notice a singleton that you do not want to lose from the sample.

A combination of deeper pools and glides with riffles is acceptable in narrow headwater sites. In larger streams where there are classic riffle and pool sequences, sites should be located on either pool or riffle.

If a group of animals (e.g. a flotilla of gerrids) are seen on site, their abundances should not be included in the results for that site because they do not constitute a part of the sample.

The contents of the search will depend on how much effort you put into it. However, you should not put yourself at risk to get another animal. The aim of sampling is to get comparable samples. This involves a degree of effort equivalent to the *norm* taken by everyone else.

If you come across a stone covered in, for example Ancyridae, should you scrape them all into your sample or just put one or two of them in? This will affect their abundance in the sample. Whilst sampling, you should bear in mind that you should apportion effort to the cover of each habitat. If you brush ancyrids into the sample you should bear in mind the time that you are devoting to one stone. A quick brush is OK, but you should not spend longer. Remember also that the search is for obtaining additional taxa, not greater abundances of taxa already in the sample.

Abundances may need to be re-considered in the light of developments such as LIFE, Q14 and the artificial intelligence work.

Discharge and RIVPACS needs to be reconsidered for use with LIFE index.

Nigel Holmes' method for estimating river width may be used where it is not possible to measure because of depth and inaccessibility of the opposite bank. The width is estimated by measuring the distance between yourself and an object on the near-side bank that looks to be a similar distance away from you as the far bank of the river.

An alteration to the audit was recommended, to be implemented when the audit contract is renewed. Non-scoring families will be included in the audit, although the measures of quality (losses and gains) will remain limited to BMWP-scoring taxa for comparative purposes.

Aquatic representatives of non-scoring taxa must be recorded in the results of the 200 survey.

Abundances in category 1 (1-9 individuals) must be recorded as actual abundances as well as an abundance category. This is to allow this first category to be split (as many biologists now believe to be desirable) and to ensure that taxa have been assigned correctly to this category.

Suggestions for undertaking quantitative AQC inspections (as recommended for the 2000 GQA survey) were discussed. At least one Area has undertaken quantitative inspections already. It seems sensible to make use of this experience and adopt the methods developed in Anglian Region. I (JMB) will try to post details via the discussion group.

When using a dredge, one of the trawls must be parallel to the bank. Material from the dredge must be puddled to get rid of silt before it is sub-sampled. The material to be discarded must be searched for unionids, viviparids and other noticeable taxa. Only material from the dredge should be discarded, and no material from the sweep or search.

Live samples must be analysed within 48 hours.

IFE can audit beyond family if necessary. The cost is dependent upon the identification levels required for each taxonomic group, these to be specified by the Agency biologist for each batch of samples.

In AQC inspection, one Area is not recording vial gains as errors. They should do so, because the AQC and audit should reflect errors in the DATA, whatever their cause. We estimate that 1% of errors arise from data transcription, and these need control as much as errors from other sources.

### 3.7.11 South West Region, Blandford, 21 February 2000

Note: figures re-numbered for this Project Record.

Only one of the four Areas in South West Region attended the workshops. We felt that the other three Areas missed an opportunity to demonstrate their full compliance with the methods, particularly as these were the three Areas not covered by the 1995 biology GQA post-survey appraisal.

The auditors have noticed that some samples from South West Region are not adequately preserved.

One Area (Cornwall) is putting too many specimens of each taxon in the vial. The vial should contain no more than three individuals of each taxon. If too many specimens are in the vial, it is difficult for the auditors to be sure which specimens refer to the taxa on the audit data sheet. Mis-identifications could be missed and recorded as omissions because other genera belonging to the correct family are present in the vial. This inhibits the effectiveness of the audit in providing information on mis-identifications. If a laboratory prefers not to put specimens back in the main sample after separating them out, we recommend that a separate vial containing representatives are placed in a separate vial for auditing.

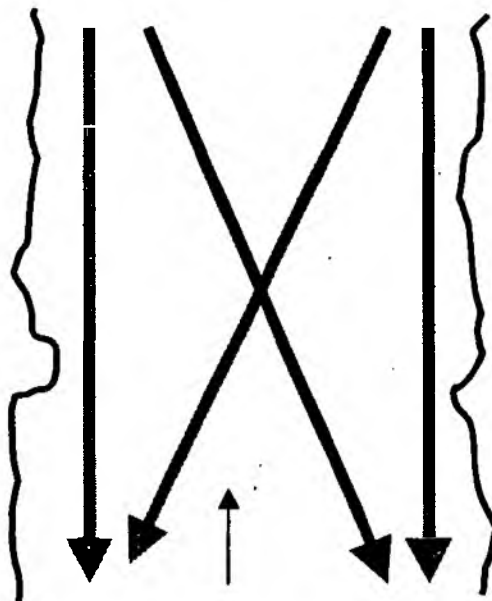


Figure 3.1 Direction of sampling

Whilst sampling, biologists sometimes notice specimens of *Dendrocoelum lacteum* and Planariidae, but cannot find these delicate species when sorting the sample. We recommend that specimens of these taxa that are noticed whilst sampling are put into a vial containing alcohol, in the field. This vial must be labelled and placed in the sample container with the rest of the sample.

South Wessex had been limiting the search for surface-dwellers to 20s and the search for attached specimens to 40s. There is no set time for the two components of the search (for surface-dwellers and specimens clinging to stones, weed, etc). In watercourses where there are no emergents or large rocks, the one minute search may be entirely for surface-dwellers.

We were asked whether it is acceptable to sample diagonally from bank to bank and up each margin at sites where different habitats were not distributed into discrete areas (See Fig 3.1).

So long as all habitats are sampled approximately in proportion to the area of their habitats, this is OK.

The main part of a dredge sample should comprise 3-5 successful dredge trawls. Unsuccessful dredge trawls, where the dredge does not function properly are not included.

We were asked whether it is acceptable to sample shallow margins with a pond net and the main channel with a dredge (see Fig 3.2)

It is not permissible to mix pond net and dredge sampling for the main sample. However, dredge samples are all complemented with a 1-minute sweep of marginal areas with a pond net, so the area identified in Fig 2 may be sampled by the sweep. Its benthos should be sampled by dredge, if a dredge is being used for the rest of the river.

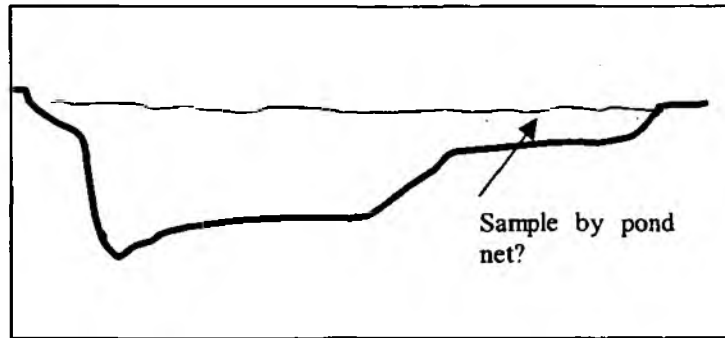


Fig 3.2 Search this area with a pond-net and collect main sample from this area with main sample method adopted for the rest of the site

We were asked whether it was acceptable to try to reach into a deep area of main channel that is otherwise inaccessible with a pond net if the main sample is collected by pond net. We answered that it was and that some areas of a site may well be inaccessible because they are too deep. It is worth trying to get some material from these areas. If it is possible to gain access to the other bank, it is worth trying from there.

If a proportion of dredged material is discarded (to limit it to 3 litres), animals found whilst checking the discarded portion are part of the main sample, not part of the search. It is likely to take more than a minute to search through the material to be discarded. Anything collected in the main sample remains a part of it.

In order to achieve an adequate concentration of preservative in a sample, it is acceptable, and may be necessary, to decant-off preservative added to the sample and re-add preservative, to allow for dilution when it is absorbed by plant material and detritus.

Beetle larvae were identified as a group that is difficult to identify. A number of other Regions commented similarly. This group seems to be top of the wish list for new keys. JMB recommends the key by Anders Nilsson in *Insects of North Europe* (mentioned in BT001).

Hint: Leica UK is now offering a range of wedge-shaped, add-on modifications for Wild stereomicroscopes to improve their ergonomic design. These include the possibility of viewing at 90° to the base-plate (i.e. straight ahead without bending your neck). Leaflet available from Leica UK Ltd "Ergonomic programme for Leica stereomicroscopes".

#### 4 SAMPLING METHODS FOR DEEP WATERS

Deep waters have always posed a problem. The standard RIVPACS procedure included a variety of different methods (pond-net with long extension, medium naturalist's dredge and Yorkshire-pattern air-lift). Sampling from the bank-side with a long-handled pond net, with extension if necessary, had been recommended in 1995, wherever it was possible to get at least some material from the main channel, in preference to the other methods. This recommendation was reiterated in the workshops for the 2000 survey. Nevertheless, this still left considerable leeway for biologists to base the method used for deep water sites on their local preferences.

As a part of the ongoing research to develop RIVPACS, IFE had been commissioned to investigate deep water sampling methods. Unfortunately, their report (R&D Technical Report E134) was produced too late to affect the choice of sampling devices for the 2000 survey. This report was released to Regions and the public on 23<sup>rd</sup> April 2001, although early drafts and the main conclusions had been released earlier.

Between 1995 and 2000, the design of the Yorkshire air-lift sampler was modified. These changes affected its ease of use rather than its sampling performance.

Shortly after sampling began, concerns were raised in Southern Region about the health and safety risks associated with the methods for sampling deep waters. A risk assessment of the dredge sampler was undertaken by consultants commissioned by Southern Region in March 2000. Their report identified a number of risk associated with the medium naturalists dredge, the most important of which was that its weight when full exceeded by a large margin the general maximum recommended in the Agency's manual lifting guidelines.

Biologists were advised not to sample deep waters in 2000 using either dredge or pond-net with a long extension handle (see NBTG's decision, Section 3.2.10). This caused a small number of sites not to be sampled in 2000.

Table 4.1 Dredge sites in the 2000 GQA survey, based on information received in spring 2000. First is number of river sites, second is number of canal sites. This was the state of knowledge on 6 November 2000, based on responses to a questionnaire that were compiled in June (see Section 5.4). The information in this table may have been updated in the interim.

|            |                   |
|------------|-------------------|
| Anglian    | Central 0,0       |
|            | Eastern 15,0      |
|            | Northern 0,0      |
| Midlands   | Upper Severn 0,23 |
|            | Lower Severn 5,3  |
|            | Upper Trent 1,0   |
|            | Lower Trent 0,0   |
| North East | Yorkshire 2,0     |
|            | Ridings 0,0       |
|            | Northumbria 0,0   |
| North West | Northern 0,0      |
|            | Central 0,0       |
|            | Southern 0,0      |



|            |                   |
|------------|-------------------|
| Southern   | Kent 9,0          |
|            | Sussex 17,0       |
|            | Hants & IoW 0,0   |
| South West | North Wessex 66,0 |
|            | South Wessex 0,0  |
|            | Devon 1,0         |
|            | Cornwall 4,0      |
| Thames     | North East 0,0    |
|            | South East 0,0    |
|            | West 0,0          |
| Wales      | South Western 1,0 |
|            | South Eastern 0,0 |
|            | Northern 2,0      |

Following a second evaluation by the consultants, this time on the pond-net with and without an extension handle, and the air-lift sampler, the restrictions were partially lifted. This followed recommendations by NBTG's Health and Safety Working Group, which included the National Occupational Health Advisor and a representative from the Agency's Regional Health and Safety Advisors. Revised recommendations were issued by NBTG in October 2000 and re-issued, after small amendments, in November 2000 (reproduced in Section 4.1). These were, of course, too late to influence much of the 2000 survey.

#### **4.1 Recommendations about deep water sampling, issued in early November 2000 by NBTG.**



ENVIRONMENT AGENCY

**BTG Working Document No. 38**

### **NATIONAL BIOLOGY TECHNICAL GROUP**

#### **Modifications to the methods used for sampling invertebrates from deep waters (BT001)**

Following an ergonomic assessment of the medium naturalist's dredge and a second ergonomic assessment covering small dredge, long-handled pond net and the Yorkshire-pattern air-lift sampler, the National Biology Technical Group has made the following recommendations, which are based on the recommendations of its Health and Safety Sub-group.

#### **Short-term**

##### **Selection of equipment and risk assessment**

1. Each site should have a particular sampling method associated with it. In the longer term, criteria will be established for selecting the type of sampling device to be used at different sites. In the short-term, Biology Teams will have to use their own judgement. Each site requires a risk assessment prior to sampling. In assessing the possible hazards and risks the type of sampling equipment should be determined and noted on the site assessment form. The full site assessment therefore should include those risks associated with the equipment.

##### **Immediate training**

2. Each Biology team that undertakes deep-water sampling (using any of dredge, air-lift and extended long-handled pond net should have a deep water sampling field day to introduce the revised procedures recommended in the report. The field training day should include dredges, air-lift and long-handled net as appropriate for the area/region and be attended by the staff who will use this equipment. Staff should try throwing the dredge into a river and see how far they can throw it. If there are sites that require the dredge to be thrown out a long way, it may be necessary to assign those sites only to staff who can throw the dredge sufficiently far. A 10 kg weight and spring-balance should be taken into the field to give biologists a better idea of the weights involved. This training needs to be combined with the video produced by Mark Rayson and Phil Smith.

##### **Dredges**

3. The total weight of dredges must be limited to 10 kg maximum (dredge + sample).
4. For short term (the 2000 survey), the maximum weight of 10 kg should be achieved by using small dredges and modifying the size of collecting nets attached to them. In preference, use a small dredge. At sites where the dredge is likely to fill with heavy material such as silt, a smaller collecting bag should be used to ensure that the maximum weight limit is not exceeded. This is an interim solution for the 2000 survey.

5. The standard method in BT001 (3 to 5 trawls) should be used for deploying the small dredge, with more trawls used if need so that a suitably sized sample is obtained (i.e. equivalent to the amount collected in a standard 3-minute pond-net sample, see BT001, Section 3.7.4).
6. The medium naturalist's dredge is to be used only in exceptional circumstances, where the small dredge proves not to be suitable by field trial at the site in question. The medium naturalist's dredge is only to be used by individuals who are fully trained, physically capable and happy to use it. 'Fully trained' means that a biologist has attended the field training session (Recommendation 2); has seen the video (Recommendation 2) understands the relevant sections of BT0001, and has had guidance on manual lifting. Physical capability of the individual is to be determined by the occupational health advisor. The maximum fill-level (equivalent to 10 kg) is to be marked on the collecting bag. The instructions for throwing the medium naturalist's dredge are to be amended (to the under-arm throw recommended in Mark Rayson's report).

#### **Air lifts**

7. In the short term, webbing straps must be fitted to gas cylinders and other ancillary equipment for the air-lifts, to make them more easy to handle.

#### **Pond nets**

8. Pond nets with extended handles up to 4m may be used, so long as the net is lifted (for puddling its contents in the water) from no more than 2m along the pole and that the amount of material in it is severely limited. If held 2m along the handle, there may be 0.5 kg of material in it, if held 1 m along the pole, there may be 1 kg material in it (see report for guidance). If the net is held with both hands on the metal frame and the net puddled vertically below you, 8 kg of material may be in the bag, or 4kg if the frame is held in one hand. Collecting nets must be emptied much more frequently than once every minute. If the net is completely filled with heavy material such as silt, its contents should be discarded and the elapsed sampling time adjusted accordingly. A net full of less dense vegetation (e.g. *Elodea*) will weigh much less than 10 kg and may therefore be acceptable.

#### **Actions for Regional Biologists**

9. The video on dredging and extra-long handled pond-net has been be copied to the 8 Regional Biologists for cascade to their Area Teams.
10. Regional Biologists should support the dissemination of training within their Regions and be responsible for ensuring that it takes place (even if they do not actually give the training).

### Medium term

1. We need to determine what biologists are actually doing (assessment of what is being done at each site). The data should be collected in time for the next 2000 survey group meeting in early November.
2. CEH need to assess the scientific validity of using the small dredge and shorter net, so that adjustments can be made to results (if necessary) and to assess what the implications of using the small dredge are on RIVPACS.

### Longer term

1. Throwing and trawling the dredge by two people needs to be investigated.
2. A generic safe working procedure should be produced for dredges, involving Paul Taylor, Phil Smith and Jim Flory, to a date agreeable to NBTG. *(NBTG suggest that the sub-group asks Paul Taylor, Phil Smith and Jim Flory whether they could produce this in time for NBTG's next meeting, so that it can be implemented before next year's sampling begins.)*
3. A generic procedure should be devised for determining the equipment that should be used, and the way that it should be used, at individual sites.
4. Alternative techniques need to be investigated, e.g. puddling from side to side rather than up and down
5. A training package should be devised that includes the video, modified to incorporate air-lifts. Training in field methods should link to competencies and be certificated.
6. A manual handling course specifically aimed at biological activities is needed.
7. Equipment specifications should be drawn-up for manufacturers.
8. Whatever method is adopted in the longer term for RIVPACS sampling from deep rivers, it should be subject to full ergonomic risk assessment.



## 5 SURVEY PROGRESS

### 5.1 Overview

Floods hampered sampling in the spring. The floods not only caused delays but also prevented a large proportion of samples being collected in the spring. Some of the sites affected were sampled in the summer to ensure that two samples were collected from every site, following the recommendations of NBTG (see Section 2.7.8). However, some sites were sampled only once during the survey. The reasons for samples not being collected in summer at sites where it was not possible to sample in spring were not given by the laboratories concerned, but limited resources and other priorities were suspected as the reason in most cases.

In May 2000, concerns about repetitive strain injury (RSI) caused by laboratory sample analysis were raised by South West Region, following a second suspected case. Before the survey, the procedures manual BT001 had been revised to incorporate the latest information about best practice to avoid occurrence of RSI, and these had been explained during the calibration workshops. These were amongst the measures that had been taken to avoid repetitive wrist-strain injury occurring as a result of the 2000 Survey and similar surveys (see Section 5.7).

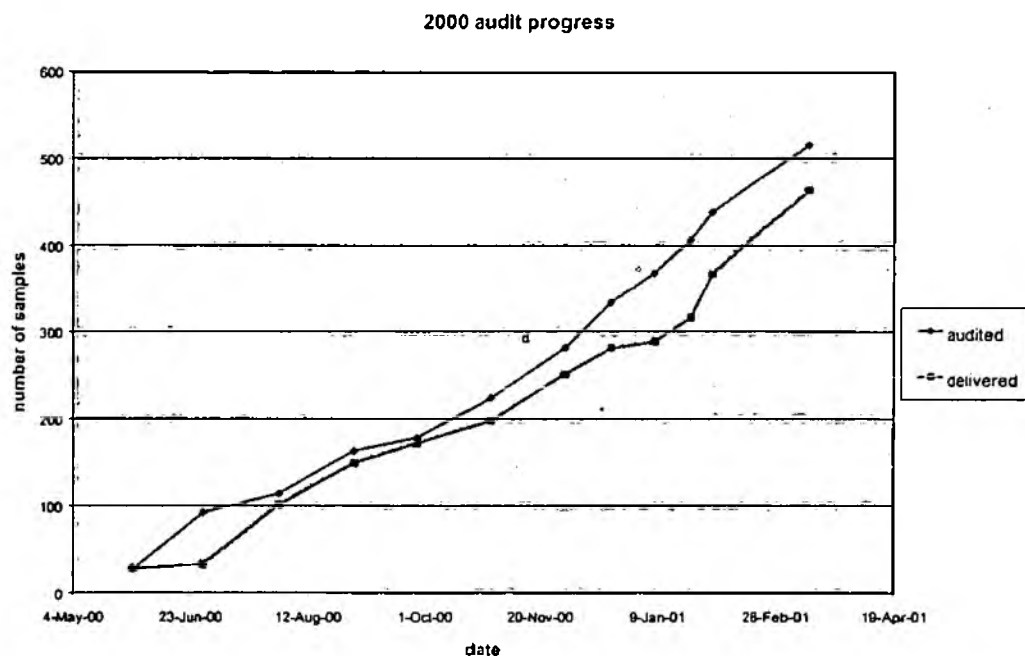


Figure 5.1 Progress of the 2000 GQA survey, based on monthly reports produced by the auditors. Samples 'audited' are those for which results had been returned to the Agency. Samples 'delivered' were those that had been received by the auditors. A total of 520 samples from Environment Agency laboratories were to be audited in 2000.

Progress of the survey was monitored by the monthly reports from the auditors. The results of the audit were an integral part of the survey because they were used in the error module of RIVPACS to provide probabilities of the GQA classification and likelihood of change in quality classes compared to previous surveys. The quarterly meetings of NBTG provided a

forum for dealing with more general concerns. A survey of progress with the biological survey was compiled in May 2000 (see Section 5.3). This was followed by a more detailed survey of progress being requested from Area Biology laboratories and Regional Biologists in June (see Section 5.4), following the spring sampling season, and in September, before the start of autumn sampling.

During the autumn, the auditors raised concerns that fewer than expected samples had been delivered to them. If they received too many samples to audit at the end of the survey, it was likely that they would be unable to analyse them all in time to meet the deadline for completing the audit analyses. This deadline was the end of March 2001, a month after the completion of the primary analysis of samples. Slow delivery of audit samples to the auditors was a perennial problem, but of particular concern in 2000 because any delay could affect reporting the results to DEFRA.

In November 2000, when sampling was to finish, the auditors had only received half of the 520 audit samples that they were expecting from Environment Agency laboratories. This precipitated the more detailed investigation of progress, see Section 5.5.

A further summary of progress was made in December 2000, following a request for information from Regional biologists in November 2000. This information was to determine the total number of samples, as well as progress with their laboratory analysis, in preparation for data analysis, see Section 5.8. It was used in a short meeting to manage the completion of laboratory analysis and begin data analysis (see Sections 5.6 and 5.7).

## **5.2 Biology Function's response to the RSI incident in South Wessex laboratory**

John Murray-Bligh, 16 May 2000

### **NATIONAL BIOLOGY TECHNICAL GROUP**

(Information extracted from minutes)

At the National Biology Technical Group's meeting on 21-22 June 1999, Andy Hicklin (Area Team Leader Biology, North Wessex) reported on the second suspected case of repetitive strain injury in the South Wessex laboratory. George Green had reported the suspected incident to National H&S through Andy Crilly earlier that month. An early draft of the 'emergency' safe system of work produced by George Green was distributed to the National Biology Technical Group at this meeting by John Murray-Bligh "Risks relating to (safe systems of work for) processing of freshwater and marine invertebrate samples, Version 2, 16 July 1999" for their consideration. The group suggested that shallow trays may reduce the risk of injury from sorting and recommended that the occupational health advisor or Health and Safety assess his laboratory and consider practices used in other laboratories in the Region. As an Action, George Green sent a copy of the Risk Assessment to members of the group.

At the National Biology Technical Group's meeting in September 1999, the group considered the Agency's Code of Practice for laboratories, which was to be based on chemistry labs. There was concern that biology laboratories also need to be considered. As a result, a sub-group was established to produce an Agency-wide code of practice for biology laboratories, based on those existing in individual Regions.

Also at the National Biology Technical Group's meeting in September 1999, George Green gave more information about the two incidences of suspected RSI in South Wessex laboratory. George had hoped to be able to circulate the independent ergonomic assessment, but the Area Manager was concerned about some sections of the report. Instead, George described its contents, which included the workstations (trays, seats, etc) and the exposure time. It suggested that ample processing time be limited and that regular rest breaks be introduced. An emergency Safe System of Work was introduced in South Wessex biology laboratory, pending a proper review.

At the National Biology Technical Group's meeting on 8-9 December 1999, George Green distributed a draft summary report on "the Risks to Biology Staff whilst Processing Invertebrate Samples in the Laboratory" This was based on a consultant's report, excluding parts not considered to be relevant for Safe Systems of Work, and was prepared by George Green and Dave Woodbury (South West Region H&S Advisor), and also extracts from "Biology Laboratory Code of Practice, draft IV - 10<sup>th</sup> November 1999".

George reported on developments in the South Wessex incident. The group was consulted on the draft Code of Practice, and asked to pay particular attention to the consultant's report. George was to produce an amended draft, which was to be circulated to Areas for comment prior to adoption.

The need for an H&S code of practice for biology/ecology fieldwork was also raised. The group supported the need for a code of practice for fieldwork, but based on the local risk assessments.



At the National Biology Technical Group's meeting on 20-21 March, George Green reported that he was waiting to hear from Andrew Crilly (Midlands, Health & Safety) and would incorporate feedback into the existing draft Laboratory Code of Practice.

The group was informed that dredges were under investigation for Health and Safety in Southern Region (a preliminary report on proposed study was distributed). As an action, all Regional Biologists ensured that their Area Team Leaders were aware of the issues concerning the health and safety investigation on dredges, but action was left to them.

National Biology Technical Group agreed to set-up a sub-group specifically to consider H&S. This has been suggested by Andy Stocks (H&S Advisor, North East Region) during the course of North East Region's calibration workshop for the GQA biology survey.

#### MANUAL FOR SAMPLING AND ANALYSING INVERTEBRATE SAMPLES

A revised version of the Agency's manual was issued on 30 July 1999 and distributed to every Area Biology Laboratory, as well as to all Regional Biologists.

Information arising from the incident at South Wessex was included in the manual. There was already some advice on the risks of RSI from sorting samples and how to avoid them. This information was enhanced in the light of suggestions for reducing the risks based on the interim guidance issued in South Wessex laboratory and advice from the consultants contracted by South Wessex. Lindsay Hall (Environment Agency Occupational Health advisor at Head Office) reviewed the text. He had attended a National Biology Technical Group Meeting shortly after he was appointed. Following comments from Lindsay, information about the risks and advice on avoiding them was moved to a separate Section of the manual "Health implications of sorting samples in the laboratory".

#### PRE-2000 GQA SURVEY CALIBRATION WORKSHOPS

A series of workshops were held in February 2000, just before work on the 2000 Biology GQA Survey started. A workshop was held in every Region, and every biologist involved in the survey attended (except for biologists from North Wessex, Devon and Cornwall Areas of South West Region). Rick Gunn (CEH) and John Murray-Bligh (survey manager and author of the Agency's methods manual for sampling and analysing invertebrate samples) presented the workshops. One section of the workshops was devoted to sorting samples. We took the opportunity to stress the problem of RSI to all biologists and to pass on the latest advice on reducing the risks.

### 5.3 Progress with the GQA survey, first compilation, 19 May 2000

#### Anglian Region, Eastern Area (18/5/2000)

Expect to take no more than a handful of samples in June. They have/will be pulling out all the stops to achieve this.

#### Anglian Region, Central Area (12/5/2000)

Do not anticipate being able to complete until end June due to a combination of high flows, new starters and other pressures (pollution incidents etc).

#### Anglian Region Northern Area (18/5/2000)

Expect to take about 50 samples, across various catchments, in June.

#### North East Region (11/5/2000)

Seem to be on top of things.

#### North East Region, Northumbria Area (11/5/2000)

Virtually completed spring survey, No intention of running into summer sampling. Well on with sorting as well.

#### North East Region Dales Area (11/5/2000)

Suffered a slow start with a very wet April but are now catching up. Provided weather holds should finish sampling by end May with no intention of running into Summer. Sorting has had a slow start but new staff will be starting in June so should catch up.

#### North East Region, Ridings Area (11/5/2000)

Got off to a slow start with staff problems in March, wet April causing high rivers. However have caught up now and providing the weather holds should have all sampling complete by end May. There is no intention of running into summer sampling. Sorting has started but emphasis has been on collecting samples. All staff now in place.

#### North West Region (12/5/2000)

The expectation is that all GQA samples will have been collected by the end of the season. The dredge has not been used in this Region.

#### Southern Region

Expect to complete by end of Spring. Possible problem in Hants if it rains.

#### South West Region, South Wessex Area (9 & 12/5/2000)

Problems of access to rivers because of flooding. If river levels permit, we should collect all but 14 of our 185 spring GQA samples by the end of May.

#### Thames Region, North East Area. (8/5/2000)

C. 60 samples still to collect. Worries about R. Roding still in flood, so may need to go over for that. Judy England on leave for 2.5 months (July - Sept) and Dave Leeming on study leave for 1 month (over summer), leaving one biologist and one trainee biologist. Therefore, considering contracting-out GQA sorting & ID (c. 60 samples).

#### Thames Region summary (15/5/2000)

463 samples collected out of approximately 573. Collection of remaining 100 or so samples before the end of May is going to be close.

Thames Region West Area (15/5/2000)

240 collected out of 286. None (or very few) sorted as yet. Confident that all will be collected by end of May.

Thames Region South East Area (15/5/2000)

110 collected out of 125 (approx.). Most sorted already. Collection will be complete by the end of the week.

Thames Region, North East Area (15/5/2000)

113 collected out of 162. Very few sorted. Collection before the end of May depends on the weather. Likely to be tight.

Biologists in Southern Region are finding a significant fall in "quality" in some of their rivers which they think is due to the very high flows following recent storms - most of the animals are now on holiday in the English Channel. This may affect final GQA grades for the 2000 survey if the autumn samples do not produce an adequate combined-taxa list.

#### 5.4 Progress with spring GQA survey, 14 July 2000

This section presents the replies from each Region to information that Regional Biologists were asked to collate for their Regions. They were requested by NBTG for 23 June, but a final compilation could not be produced until information had been gathered from all Regions on 14 July 2001.

The original questions were:

The number of spring samples not collected in spring (and the number still to be collected at 23 June)

How did the weather affect rivers in your Area, and was any impact evident in samples analysed so far.

How many dredge samples did you collect in each of your Areas in spring 2000 a) in rivers, and b) in canals?

Are there any major issues that you think should be raised at this stage?

##### 5.4.1 Anglian Region

**How many dredge samples did you collect in each of your Areas collected in spring 2000 a) in rivers, and b) in canals?**

Central Area: a) none, b) none

Eastern Area: a) 15, b) none

Northern Area: a) none, b) none

**The number of spring samples not collected in spring (and the number still to be collected at 23 June)**

Central Area: 76 (out of 250) (none still to be collected at 23 June)

Eastern Area: 32 (none still to be collected at 23 June)

Northern Area: 50 (8 still to be collected at 23 June)

**How did the weather affect rivers in your Area, and was any impact evident in samples analysed so far.**

Central Area: hopefully not, as we waited specifically for flows to drop before we went sampling again, i.e. "good" samples were taken. In the past our high flow affected results were down to sampling (difficulties) when the rivers were still "up".

Eastern Area: no rivers particularly affected by high flows. No known quality problems caused by high flows catchment-wide.

Northern Area: the following watercourses suffering from high flow and quality of sample reduced, apparently due to sampling difficulty: Rase (middle section)-might also be impacted by increased 'urban' runoff from Mkt. Rasen; Caistor Canal; South Forty Foot Drain; Eye Brook; North Gwash (also possible 'urban' runoff impact from Oakham). The following were flowing high at time of sampling, but no apparent impact on sample quality: Witham, Barlings Eau, Nene, Glen.

**Are there any major issues that you think should be raised at this stage?**

Concerns about the impact of low biology grades in this Region affecting staff morale and increasing staff turnover have been reported from Northern Area.

### **Update, 14 July**

1. I believe sorting of our GQA samples is almost complete.
2. Our full quota of AQC samples is complete. They will shortly be on the way to Rick.
3. We have a temp starting on Monday 17/7/00 to clear our backlog of data input to B4W (funding provided by CIS. Budget for resolving data issues resulting from harmonisation).

### **5.4.2 Midlands Region**

#### **The number of spring samples not collected in spring (and the number still to be collected at 23 June)**

All rivers were collected in spring, 10 canal samples were deferred to June, and 2 of these haven't been done (at 4 July) due to locked access.

#### **How did the weather affect rivers in your Area, and was any impact evident in samples analysed so far.**

There were high flows especially in April and end of May (and now) which we have been able to work round and cope with. No indication so far that the assessments will be affected but there's a lot of analysis still to do. Some low scores are probably pollution related, not flow related.

#### **How many dredge samples did you collect in each of your Areas in spring 2000 a) in rivers, and b) in canals?**

Upper Severn Area: 0 on rivers, 23 canals

Lower Severn Area: 5 rivers, 3 canals

Upper Trent Area: 1 river

Lower Trent Area: none

NB: this contradicts a message sent to the H&S sub-group 6 days after the information above was sent to me:

This year so far we have used dredges on only 6 river sites, 5 of these were in LS who admitted to using a small dredge of which 4 were from a boat (R Severn). Only 23 canal sites were done using the dredge (sub-sampled from edge and therefore supported by the water) in US. All the other deeper sites and canals were taken using a hand-net (100 canals). I

#### **Are there any major issues that you think should be raised at this stage?**

No reply

### **5.4.3 North East Region**

#### **The number of spring samples not collected in spring (and the number still to be collected at 23 June)**

None

#### **How did the weather affect rivers in your Area, and was any impact evident in samples analysed so far.**

It delayed/slowed down sampling in some catchments, there is no evidence so far of any impact in analysed samples.

**How many dredge samples did you collect in each of your Areas in spring 2000 a) in rivers, and b) in canals?**

2 - on River Derwent, (plus possibly two others- ecologist away this week and no one else knows I will check next week)

**Are there any major issues that you think should be raised at this stage?**

Only staffing levels.

#### 5.4.4 North West Region

**The number of spring samples not collected in spring (and the number still to be collected at 23 June)**

2 samples.

a) River Bollin - couldn't get access due to new 8ft high welded shut gate ! Site will be investigated and hopefully sampled summer and autumn. b) 1 site on the Wheelock could not be collected due to a Bull in the field. This is a site where 2 others sites are apparently within 200m approx. (i.e. 3 very close together).

**How did the weather affect rivers in your Area, and was any impact evident in samples analysed so far.**

North: no evidence of impact on samples due to weather.

Central: weather fairly normal for the time of year so the effects should be little more than usual seasonal variation.

South: little impact as we started early. 1 site on the Dane was sampled by sweep due to high flow (previously kick).

**How many dredge samples did you collect in each of your Areas in spring 2000 a) in rivers, and b) in canals?**

No canal samples and no dredge samples for NW.

**Are there any major issues that you think should be raised at this stage?**

None other than B4W problems.

North: ongoing concerns on lack of functionality and documentation of B4W.

Central: although we now have the reporting tools (still need to know if they can be tailored to regionally requirements), no one can access them despite putting in several helpdesk calls. This is causing major delays on report production. B4W may serve as a data storage system (even though it takes much longer to input) but is an extremely poor operational tool.

South: time taken to input samples to B4W.

#### 5.4.5 Southern Region

**The number of spring samples not collected in spring (and the number still to be collected at 23 June)**

Kent: all samples collected during spring season.

Sussex: all samples were taken during spring season.  
Hampshire: all samples were taken during spring season.

**How did the weather affect rivers in your Area, and was any impact evident in samples analysed so far.**

Kent: rivers were very spatey during sampling times but insufficient analysis has taken place to determine any impact. As sampling started at the beginning of March, many were collected before the rain became a problem.

Sussex: We don't have a real handle on how badly the spring samples were affected by low flows, but I'm pretty sure a number of samples were very sparse. We are currently looking at how poor the scores are, and I'll let you know when we have a better picture.

During spring our rivers reached extremes of both very low flows and spate conditions. The heavy rain of the last 2 weeks of Feb put our rivers in spate in early March, but by mid March levels had fallen drastically (about a foot a day on the Arun!) and were below the seasonal average before rising rapidly again. All of our sampling was therefore affected by the Feb or March/April high flows. I doubt that the period of lower than average flows was significant given the extreme conditions resulting from high flow events.

Hampshire: we have not analysed many but the general consensus on our spring samples is that they are scoring highly. I'm not sure about the more urban streams (strangely these tend to get left towards the end!) but there is some evidence of a reduction in the lower scoring taxa from areas like the New Forest, corresponding to our observations that there was less leaf litter in these streams. I think it's probably too soon to really know what the effect was - loss of low scoring taxa may give high ASPT scores, but lower BMWP and diversity overall. Whatever it is, I think it's likely to be fairly subtle - the Hants chalk rivers seem to be achieving BMWPs 200-250 in middle reaches so it can't be too drastic!

**How many dredge samples did you collect in each of your Areas in spring 2000 a) in rivers, and b) in canals?**

Kent: 9 dredge samples, all with the standard dredge.

Sussex: 17 dredge samples, all with the lightweight dredge.

Hampshire: no dredge samples

**Are there any major issues that you think should be raised at this stage?**

Kent: no expectation at present that final analysis deadline will not be met.

Sussex: No expectation at present that final analysis deadline will not be met.

Hampshire: No expectation at present that final analysis deadline will not be met.

#### 5.4.6 South West Region

**The number of spring samples not collected in spring (and the number still to be collected at 23 June)**

Number of spring samples NOT taken: 25 in total (24 South Wessex, 1 North Wessex). In South Wessex 12 of the outstanding samples were collected in early

June, leaving 12 to be taken when river levels permit (hopefully within the next 2 weeks).

**How did the weather affect rivers in your Area, and was any impact evident in samples analysed so far.**

High flows caused all Areas problems with sampling. There was a last minute rush to May to collect samples - so sampling was not evenly spread throughout the season. Cornwall reports that high flows also resulted in larger samples than usual. Unfortunately flows did not recede enough in May to allow all the samples to be collected in South Wessex. North Wessex reports that the flows may have an impact on the benthos, but no evidence of this from processing yet. An attempt was made to avoid sampling during or immediately after flood events.

**How many dredge samples did you collect in each of your Areas collected in spring 2000 a) in rivers, and b) in canals?**

Dredges taken = 71 (North Wessex 66, Cornwall 4, Devon 1) - all rivers.

Dredges NOT taken due to H&S concerns = 9 (Devon 7, Cornwall 1, South Wessex 1).

**Are there any major issues that you think should be raised at this stage?**

Processing behind schedule in South Wessex and Cornwall, North Wessex and Devon report that deadline will be very tight!

#### 5.4.7 Thames Region

**The number of spring samples not collected in spring (and the number still to be collected at 23 June)**

North East Area: none - all collected due to valiant effort by all staff (and lots of manic running around).

South East Area: we collected samples from all our sites within the spring time window (122 sites).

West Area: all 287 spring samples collected. 20 out of 287 sorted. 0 on B4W.

**How did the weather affect rivers in your Area, and was any impact evident in samples analysed so far.**

North East Area: a lot of rivers were high for a long time, however we managed to leave them until they had recovered for a while before we sampled them (hence manic sampling for last 2 weeks). No major evidence of impacts in the samples sorted.

South East Area: the rainfall & high flows did prevent collection of samples for 3-4 weeks in April/May. Claire reckons that as we did not sample till flows subsided, the results were not significantly impacted. Perhaps 5-6 sites (mainly main River Thames) showed some decrease in scores but by no more than 20.

West Area: only collected 20 samples in April 'cos of a bit of rain. Some of those could be classed as 'dodgy'.

**How many dredge samples did you collect in each of your Areas in spring 2000 a) in rivers, and b) in canals?**

North East Area: none - pond net extensions used instead!



South East Area: no dredge samples collected at any sites, bank-side sweeps/marginal sampling used in main River Thames, no canals sampled.

West Area: none.

**Are there any major issues that you think should be raised at this stage?**

North East Area: Only where do we send the PSYM samples? If we have to retain them how long will we have to keep them? Storage space is limited.

South East Area: no major issues from us! Spring sampling went very well considering the interruption caused by high flows, we got good audit results from the first 10 samples sent to IFE (phew!), we are currently checking the environmental parameters, and providing it doesn't rain solidly from Sept - Nov and that there are no major Area catastrophes/staff exits etc. the autumn sampling should run smoothly - what more can I say...

... apart from 'didn't we do well' in true Brucey style!!!

West Area: two months to sort and input all Autumn samples (Dec/Jan) - this includes Christmas/new year when, effectively (or maybe ineffectively!), we lose at least 2 weeks due to merriment.

#### 5.4.8 Wales

**The number of spring samples not collected in spring (and the number still to be collected at 23 June)**

All spring samples collected successfully.

836 sites sampled in spring and 402 samples sorted by mid July.

**How did the weather affect rivers in your Area, and was any impact evident in samples analysed so far.**

High flows delayed sampling particularly in South East Area but all taken in time.

**How many dredge samples did you collect in each of your Areas in spring 2000 a) in rivers, and b) in canals?**

South Western Area 1 river, 0 canal

South Eastern Area 0 river, 0 canal

Northern Area 2 river, 0 canal.

**Are there any major issues that you think should be raised at this stage?**

Promotion of a biologist in South Eastern Area has left a vacancy. This, with pollution incident and *ad hoc* biological work, is causing a backlog to build up. Therefore, the Area is likely to enter autumn survey with 130 samples from spring to sort.

#### 5.4.9 Isle of Man

Everything going to plan. Almost processed spring samples and half way through summer chem/env. surveys.

#### 5.4.10 General Issues

Data entry on B4W is still slow. Mechanisms for checking the data (site, environmental and biological), running the classification and reporting have still got to be resolved. We also need to link chemical and biological sites on our databases (we cannot match them at present).

H&S concerns about deep water sampling equipment also need resolution before autumn sampling. The H&S sub-group of NBTG have recommended that medium naturalist's dredges are banned (following a risk assessment by external consultant). The problem is that, when full, its weight far exceeds the manual lifting guidelines (50kg, whereas guideline is 10kg). We need to evaluate alternatives rapidly for autumn. Small naturalist dredges may be a solution.

Safe procedures for long-handled pond nets (with extension poles) need to be drawn-up before autumn, if these do not exist already.

A risk assessment of air-lift samplers is needed, if this has not been done already.

## 5.5 Progress with the Autumn 2000 GQA Biology Survey, 10 Nov 2000

This section presents the replies from each Region to a questionnaire sent to Regional Biologists.

The original questions were:

"Would Regional Biologists please ask each of their Area Teams for the following information about progress with the GQA survey. Would Regional Biologists please collate their Region's responses (leaving each Area's response separate) and return them to me. I would like this to be completed this in time for the 2000 Survey Group meeting on Tuesday 7 November, so I'd be grateful for your reply by Friday 3 November.

- 1 How is autumn sampling progressing, and are you on target?
- 2 How many samples do you still have to sort and identify to complete the survey and how many of these are spring samples?
- 3 Has the weather affected rivers in your Area this autumn (if it has, please indicate the severity and extent) and is any impact evident in samples analysed so far?
- 4 Are there any major issues that you think should be raised at this stage?

### 5.5.1 Anglian Region

- 1 How is autumn sampling progressing, and are you on target?

*Central Area:* A little behind as at 31/10/00 but expect to catch-up in November, weather permitting.

*Eastern Area:* Ahead of target as at 13/10/00.

*Northern Area:* A little behind target. Expect to be 10-15 samples behind by the end of October but weather permitting will catch up in November.

Regional comment (8/11/00): we will need to sample in December.

- 2 How many samples do you still have to sort and identify to complete the survey and how many of these are spring samples?

*Central Area:* All spring samples sorted. As at 31/10/00, 120 autumn samples to take, sort and ID.

*Eastern Area:* All spring samples sorted. As of 13/10/00, 140 autumn samples to take, sort and ID.

*Northern Area:* All spring samples sorted. As at 31/10/00 approximately 100 autumn samples to take, sort and ID

- 3 Has the weather affected rivers in your Area this autumn (if it has, please indicate the severity and extent) and is any impact evident in samples analysed so far?

*Central Area:* The weather has been problematic resulting in some re-organisation of the sampling programme. No impacts relating to sampling difficulty so far. Some diversities are down a little but no major impacts seen so far.

*Eastern Area:* As of 13/10/00 weather has not adversely affected sampling or samples. Scores have been particularly good, probably due to the wetter year and increased flows.

*Northern Area:* The weather has been problematic resulting in some re-organisation of the sampling programme. No impacts relating to sampling difficulty so far. One sample has indicated reduced quality, probably due to increased runoff (R. Rase, d/s Market Rasen).

4 Are there any major issues that you think should be raised at this stage?

*All Areas:* Not just GQA related - swifter operation of B4W must be seen as a priority to allow faster input and onward dissemination of data.

A few thoughts from Region.

- The weather of the last couple of weeks has made things particularly tricky and the picture reflected above may have changed slightly however we are luckier than some!
- We are keen to derive 1999 GQA Grades. Earlier in the year there were some problems with B4W regarding this. Are you aware whether the November release will resolve them? We feel that processing the 1999 data would be a good test of the system in readiness for dealing with the 2000 data.
- At the last NBTG there was a passing comment that Twerton will be responsible for deriving the 2000 grades. Has this been formally confirmed - we don't want any surprises early next year! (This bullet links to my e-mail to John Steel, copied to you, regarding training priorities).

#### 5.5.2 Midlands Region

At a recent Regional meeting, each Area gave brief progress update – only major issue was the delay in sampling caused by petrol crisis and weather. Completion of programme within seasonal window now very much dependent on weather in rest of October and November.

You are probably aware that since then the weather has not been kind but we are making every effort to obtain the samples. Although the analysis for spring is complete we have not made much inroad into the analysis for autumn. It is difficult at this stage to determine whether the weather has had an impact on the quality of the samples.

Most figures correct to 5 November.

1 How is autumn sampling progressing, and are you on target?

*Upper Trent:* 177 rivers, 55 canals taken, 38 rivers and 5 canals still left to do

*Lower Trent:* Autumn sampling was progressing well and we were on target until the week beginning 23/10/00 when flooding made sampling impossible. Out of a total of 418 samples for the autumn (395 = river, 23 = canal), 256 river samples have been taken with 139 river samples and 23 canal samples left to take.

*Upper Severn:* 159 rivers and 23 canals taken, 76 rivers to do.

*Lower Severn:*

a) Progress has been severely affected this week; so far samples taken = 133, samples TO BE taken = 155 i.e. 48% of prog. completed.

b) are we on target? Well we've got 3.5 weeks left till end of November, and since next week is a definite no-go (see pictures of general mayhem on national news) that means 2.5 weeks so we might be able to blitz 'em by the end of the month PROVIDING WE HAVE NO MORE RAIN & THE FUEL CRISIS DOESN'T

**MATERIALIZER** Sensibly I would say there is every chance that we'll be sampling in December.

2 How many samples do you still have to sort and identify to complete the survey and how many of these are spring samples?

*Upper Trent:* all spring done, approximately 100 autumn samples analysed, approx. 180 to do.

*Lower Trent:* We have sorted all of the spring samples. Of the 256 river samples that have been taken there are 81 left to sort and identify.

*Upper Severn:* spring analysis complete, approx. 200? To do this autumn.

*Lower Severn:* a) Of the 133 samples taken, 61 have been sorted (by close of play today, Friday 3rd November). That means there are still 72 of these to be sorted plus the 155 that have still to be taken making a grand total of 227.

b) All the spring samples have been sorted, AQC'd and audited.

3 Has the weather affected rivers in your Area this Autumn (if it has, please indicate the severity and extent) and is any impact evident in samples analysed so far?

*Upper Trent:* severe effect on sampling in October, effect on samples unknown.

*Lower Trent:* The effect of the weather on the survey has meant that sampling has not been possible for the last fortnight.

*Upper Severn:* Severe flooding and high flows over whole area restricting sampling.

*Lower Severn:* a) Have rivers been affected this Autumn? Yes, it's definitely curtailed our master plan of getting all our sampling completed by the end of October. I reckon most watercourses had pretty high flows from the summer before we even started our autumn programme.

b) As regards sampling; since we've mostly sampled our runs which tend not to be affected by weather and we've sorted these first, our initial impression is that they are okay. HOWEVER, under current circumstances we cannot assume that all samples will be unaffected as we've still to tackle the biggies.

4 Are there any major issues that you think should be raised at this stage?

*Upper Trent:* [no comment]

*Lower Trent:* fuel crisis.

*Upper Severn:* probably need to extend sampling into December and analysis into March

*Lower Severn:* Major Issues? Yes, why not let Autumn sampling include December... in the deep south of Region here in Lower Severn, December never seems to be much different weather-wise to November? (We'll probably get blizzards at Xmas now!).

### 5.5.3 North East Region

1 How is autumn sampling progressing, and are you on target?

*Ridings:* As of 16 October, just over half the autumn samples have been collected.

*Northumbria:* All sampling is behind target due to the weather. We are in danger of breaching our agreement with Fisheries not to sample salmonid rivers for routine purposes after Oct 31st. Do other Areas have such agreements?

*Dales:* Autumn Sampling is being held up due to the wet weather we have collected 77 samples but have 115 still to collect. If the weather improves we will be able to meet the deadline but if it continues to rain we will struggle.

2 How many samples do you still have to sort and identify to complete the survey and how many of these are spring samples

*Ridings:* All spring GQA samples sorted, identified and virtually all are on B4W. 330 autumn samples still to sort.

*Northumbria:* about 190 left to sort

*Dales:* We have 128 spring samples analysed outstanding 64 outstanding. None of the Autumn samples have been analysed.

3 Has the weather affected rivers in your Area this Autumn (if it has, please indicate the severity and extent) and is any impact evident in samples analysed so far?

*Ridings:* High flow is currently halting any sampling. No autumn samples have been collected under physical conditions likely to produce inconsistent invertebrate data.

*Northumbria:* Weather is becoming a key issue with no sampling in the last fortnight and none expected this week. A small number of samples prior to this gave poor results and this is suspected due to collection too soon after high flows. We will try to leave a few days after high flows where possible but it depends on what sampling windows we get. I have also reminded staff re: H&S to ensure no one is tempted to do anything silly re: sampling.

*Dales:* It is too early to identify any impacts from the samples

4 Are there any major issues that you think should be raised at this stage?

*Ridings:* none.

*Northumbria:* Not beyond above.

*Dales:* Obviously the major issue for Dales is lack of resources. We have highlighted again at the Quarterly Review that we may not meet the deadline for the GQA.

#### 5.5.4 North West Region

(North Area results correct at 13.10.00)

1 How is autumn sampling progressing, and are you on target?

*North Area:* Autumn GQA samples still to be collected = 195

*Central Area:* 84 autumn samples have been collected out of a total of 254.

*South Area:* Approx. 1/4 of rivers have been sampled. 63 samples collected out of a total of approx. 300.

2 How many samples do you still have to sort and identify to complete the survey and how many of these are spring samples

*North Area:* Spring GQA samples still to be sorted = 78; autumn GQA samples still to be sorted = 266

*Central Area:* All spring samples sorted. All audit samples for spring have been sent. 30 Autumn samples sorted.

*South Area:* All spring samples have sorted. Most autumn samples have been sorted.

The spring backlog is totally attributable to long term sickness absence within the North Cumbria team. Attempts to address this in a reasonably timely fashion have been compromised by overspent budgets in EP in Area and Region and refusal to pay for sickness cover, and our dependence on recharge. In effect, there is no budget contingency for sickness, and it cannot be worked around in the context of a small team because of the high percentage impact on resource and the unyielding must-do nature and time-scales for delivery this year. Currently we are using an employment agency temp. as a sample sorter on a fast training track.

The South Cumbria output is more or less on target.

The team member in the North team is still off sick, and a rapid return is not expected, so our ability to deliver the fully completed survey data set by the Feb deadline is by no means certain.

3 Has the weather affected rivers in your Area this Autumn (if it has, please indicate the severity and extent) and is any impact evident in samples analysed so far?

*North Area:*

*Central Area:* The weather has hampered collection of autumn samples so far. Also we need to be aware that the high flows will have an impact on results as we are having to sample as soon as flows are low enough and not leaving time for rivers to recover.

*South Area:* Weather severely hampering sampling.

4 Are there any major issues that you think should be raised at this stage?

*Central Area:* The other factor is B4W. This is still taking up considerable time.

*South Area:* Concerned about more potential fuel problems looming.

The major issue to raise is the problem of getting samples in due to the weather.

### 5.5.5 Southern Region

1 How is autumn sampling progressing, and are you on target?

*Hampshire & IoW:* IoW Outstanding, New Forest 50%, Test nearly complete, Itchen complete, SE Hants Complete

*Sussex:* 36 of 129 autumn samples collected. Had planned to complete autumn sampling by now - this and other field work slipping back with implications for meeting GQA sample analysis deadline. If can get out sampling soon should be ok - depends on weather!! Temp. biologist starts on 23/10 specifically to help with analysis - if can't get samples taken soon will run into problems.

*Kent:* 167 sites still to sample, i.e. we are behind and keen to see some dry weather (aren't we all. Ed.)

Regional update, 9/11/00: Regarding the current situation, Kent and Sussex have been totally stalled for some time and prospects are not good. With their chalk rivers, Hampshire are more hopeful of getting the samples but they still need the rivers to drop back to normal winter levels - whether they will is anybody's guess.

2 How many samples do you still have to sort and identify to complete the survey and how many of these are spring samples?

*Hampshire & IoW:* Spring analysis complete - just started on autumn

*Sussex:* 117 samples to sort (spring completed), 17 to be sent to Kent (to compensate for their having extra student this year).

*Kent:* We have 34 left to sort, plus 6 from Hampshire (spring samples).

Are we on target, well???????????? NO, but do we need longer to sort? that really depends on the weather. We have enough samples to keep us on GQA for a couple of weeks, but if we cannot get out to sample, we will start analysing other samples, etc and will be behind on the programme.

3 Has the weather affected rivers in your Area this Autumn (if it has, please indicate the severity and extent) and is any impact evident in samples analysed so far?

*Hampshire & IoW:* Extremely high flows at present. In spring there were also high flows: chalk stream scores were a little low, New Forest streams generally a bit higher, Urban streams a mix - some have achieved best ever scores and some have suffered from wash out.

*Sussex:* Suspected major impact from extreme high flows on flashy clay rivers, in particular - most inverts. probably out to sea. No samples analysed since floods so no actual measure of this.

*Kent*: I don't think they noticed a lot of difference in spring but they have collected very few autumn samples so far (probably less than 25%). The rivers are a little full! And those they do have were taken before the floods.

4 Are there any major issues that you think should be raised at this stage?

*Hampshire & IoW*: Flow is a major issue - it is questionable whether biotic scores really represent quality.....could we expect good scores in 2001 Spring from maturing larvae?

Do not foresee that we will need deadline extended

*Sussex*: As outlined in (1), we may have problems meeting analysis deadline if things persist too much longer. The analysis deadline may "force" us to go out and collect samples, when conditions are not ideal!?

For the longer term, should we be looking to rely on single year data for GQA/FWD reporting in the future?? Should we consider alternatives to how we report 2000 GQA (e.g. use of 1999 data in exceptional cases, such as ours).

*Kent*:

#### 5.5.6 South West Region

Update 6-7 November

1 How is autumn sampling progressing, and are you on target?

*North Wessex*: 221 of 371 autumn samples collected.

*South Wessex*: We have collected 148 of 187 autumn samples, which leaves us 39 to collect before the end of November or December.

*Cornwall*: 20 samples need to be collected (30 Oct).

*Devon*: Autumn sampling: 199 samples collected, 113 to collect

2 How many samples do you still have to sort and identify to complete the survey and how many of these are spring samples?

*North Wessex*: 440 samples remaining to be sorted (including autumn samples still to be taken), of which 150 are spring samples. 2/3 of the samples that we have sorted have been entered onto the biology database.

*South Wessex*: So far we have processed 158 of 187 spring samples. This leaves 216 spring/autumn samples to be processed by the end of February. At our present processing rate we are likely to have a backlog of 90 samples by the end of February.

*Cornwall*: 252 to process (including the 20 yet to be sampled).

*Devon*: Spring sorting: 17 samples to sort. Autumn sorting: not started yet (312)

3 Has the weather affected rivers in your Area this Autumn (if it has, please indicate the severity and extent) and is any impact evident in samples analysed so far?

*North Wessex*: We have been unable to go out sampling for the last couple of weeks due to the high water levels. The majority of our rivers have been affected.

*South Wessex*: High river levels have seriously affected our ability to collect samples within the appropriate time-scales. Cannot comment yet on whether high levels have influenced the diversity of the fauna.

*Cornwall*: We have lost a lot of sampling time, only covering half our usual daily number of sites due to flows. Our samples for both seasons have been large. We had hoped that Autumn samples would have been smaller than the Spring samples, but this hasn't been the case! Fortunately, at the start of September we targeted main river sites and sites that had previously been identified as problematical during high flows,



just in case the weather deteriorated. Annoyingly, we could have got it all done if it hadn't been for the fuel strike. Considering 1990 and 1995 were drought years it should make comparison interesting. Should generate some interesting LIFE scores though.

*Devon:* Flooding and the fuel panic have made life very difficult.(In fact this is the worse GQA I have encountered!) We have also had problems due to a member of staff who has been on long term sick leave and the recent departure of one of my most experienced members of staff!! (Ho hum!) In theory we can still complete the Autumn sampling in time. However, we need it to stop raining and the river flows to drop!! It looks unlikely that we will be able to gather any samples for this week!

4 Are there any major issues that you think should be raised at this stage?

*North Wessex:*

*South Wessex:* Unless I can contract samples externally, South Wessex will miss the February deadline.

*Cornwall:* We have filled our vacancy, Duncan Struggles replaced by Adrian Brown. I anticipate we will be two months over the deadline. The good news is that data quality has been excellent, with only a single QC failure (3 missed) to date. It'll be late, but it'll be good.

*Devon:* As a region we have recognised that we are all struggling and have found some money to attempt to employ someone on a temporary contract to help clear the backlog of samples for the region. We are in the process of setting up the contract/advertising etc. If we are successful in obtaining someone then Devon area should (rainfall permitting) complete in time. Without this contract we are likely to have a shortfall of 65 samples and therefore miss the deadline by 2-3 weeks.

#### 5.5.7 Thames Region

1 How is autumn sampling progressing, and are you on target?

*South East:* On target up till now, however sampling has been halted over the last few weeks due to the floods (& for the immediate future).

*North East:* We've done all we can given the current state of our rivers. As soon as flows reduce we'll be out again.

*West:* On target for sampling, We need about six dry days before end November.

2 How many samples do you still have to sort and identify to complete the survey and how many of these are spring samples?

*South East:* Still have 34 autumn samples to collect, sort & identify (all spring samples completed). Collection of the remaining samples by the end of November deadline is dependent on flows dropping significantly.

*North East:* The situation is much the same as for the South East Area with 44 samples to collect, sort and ID which are dependent on the flows reducing.

*West:* A bit off target for sorting and adding to B4W. This latter bit is the most pressing problem.

3 Has the weather affected rivers in your Area this Autumn (if it has, please indicate the severity and extent) and is any impact evident in samples analysed so far?

*South East:* Floods have currently halted sampling. Of the samples collected so far, scores are slightly depressed on main river sites with a reduction in middle scorers, however this difference is very slight.

*North East:* flows have halted sampling but scores and results are much the same as expected.

*West:* Many of our rivers have been affected by weather. Not too much flooding, but bad enough to make sampling dangerous. However, in anticipation (and panic) I worked hard to get everyone to sample as early as possible in the season so things aren't too bad.

4 Are there any major issues that you think should be raised at this stage?

*South East:* Completion of the sampling programme by the end of November is now in question (even if we can gain access to the sites, the ecology may be severely impacted by the floods). It would be better to look to extend the sampling window through to December.

*West:* Speed of input to B4W and Christmas (two week holiday!) is coming of course.

#### 5.5.8 Wales

1 How is autumn sampling progressing, and are you on target?

*South East Area:* 5 sites left to sample

*South West Area:* 20 sites left to sample

*Northern Area:* 122 sites left to sample. Northern Area are behind on sampling because of rain however, many of the rivers will fall very quickly once it stops raining, by deploying three field teams all the remaining samples could be collected in a window of four or five days.

Total for Region: 148 sites left to sample

2 How many samples do you still have to sort and identify to complete the survey and how many of these are spring samples?

*South East Area:* 470 samples left to sort of which 138 are spring samples

SE Area have the biggest backlog to process, samples will sent to the other two areas and the remaining project budget will pay for some overtime to get back on target.

*South West Area:* 340 samples left to sort of which 70 are spring samples

*Northern Area:* 199 samples left to sort of which none are spring samples

Total for Region: 1009 samples left to sort of which 208 are spring samples. 61 samples behind target for sorting at end of October.

3 Has the weather affected rivers in your Area this Autumn (if it has, please indicate the severity and extent) and is any impact evident in samples analysed so far?

Some sites sampled in high flows possibly on gravels that have only recently become submerged. If it appears that these samples are depleted they will be re-sampled if flows allow!

SW Area have sorted some of the autumn samples from spatey rivers and the fauna is impoverished but in a similar way to previous years so this could be quite normal. No obvious effect of high flows on North area samples sorted so far.

4 Are there any major issues that you think should be raised at this stage?

#### 5.5.9 Isle of Man

1 How is autumn sampling progressing, and are you on target?

Not on target, about 3 weeks behind.

2 How many samples do you still have to sort and identify to complete the survey and how many of these are spring samples?

70 samples to take, 80 to process for autumn, all spring work complete.

3 Has the weather affected rivers in your Area this Autumn (if it has, please indicate the severity and extent) and is any impact evident in samples analysed so far?

Turbidity causes problems with visual inspections, also obvious problems with inaccessibility

4 Are there any major issues that you think should be raised at this stage?

I'm a bit concerned that scores may be low due to scouring, very steeply graded rivers here, I'll know soon when starting to process and keep you informed

#### 5.5.10 Northern Ireland

1 How is autumn sampling progressing, and are you on target?

We are quite a long way behind the Autumn schedule as it continues to rain and our rivers flood. Unlike the southerners nobody mentions this on the national news.

2 How many samples do you still have to sort and identify to complete the survey and how many of these are spring samples?

Spring and summer sampling were completed on schedule but we still have over half of the autumn stuff to get and analyse.

3 Has the weather affected rivers in your Area this Autumn (if it has, please indicate the severity and extent) and is any impact evident in samples analysed so far?

The weather has been a major problem. I guess due to this we have had to resample a much larger proportion of our stations in order to validate whether or not there is a genuine pollution problem.

(Update, 7 November) The situation over here is critical. The rivers have now been in flood for 7 weeks and you can guess the impact on the sampling programme. If the situation eases we may well be in a last resort situation.

4 Are there any major issues that you think should be raised at this stage?

My major issue is still WFD and lakes + other standing waters. We will have to cope with the rivers floods and all.

## **5.6 Full notes of a meeting held on 12 December 2000.**

These comprehensive notes were not circulated outside the group that met. A summary of the conclusions was circulated more widely, see Section 5.7.

### **2000 GQA Survey Where to from Here Meeting Fobney Mead Rose Kiln Lane Reading**

11:00 a.m. – 3:30 p.m.

**Present:** John Murray-Bligh, Paul Logan, Brian Hemsley-Flint, Graeme Storey

**Apologies:** Bob Dines

Recommendations to NBTG and 2000 GQA survey group.

#### **1. What to do about the floods**

##### **Sampling**

Up to a quarter of autumn samples have not been collected by each Regions.

We will use both season's data from sites where two samples have been collected. Where only a single sample exists, we will base the classification on that and accept wider error bands.

We rejected the suggestion that data from 1998/99 be used where data from 2000 was not available, because such data was not available for all sites. If we used it, some results would be affected by conditions in 2000 and some would not, which would be confusing: some sites would appear to be impacted by flood and others not. The group considered it best to be consistent.

The high flows may impact the ecology of some sites. Such ecological effect is likely to be more severe where flood defences prevent rivers from flooding over the floodplain. The effect is compatible with what the Agency has been saying about damage caused by constricting watercourses to prevent floodplains from flooding.

A biological quality map can be produced using one or two seasons data. RIVPACS can cope with the comparison of 2 seasons and 1 season samples. Assuming no seasonal stress, the only difference would be the wider error band.

Where classification is based on a single sample, we will be less likely that we can report (or detect) a change in quality. We will be less able to detect the impact of floods in larger rivers. We will be less likely to wrongly up or downgrade where we have single sample.

DETR are interested in km river monitored, what their class is, and what the percentage upgrade and downgrade is.

Regional and Area reporting may need to compare quality (the classification) in 2000 with that in 1998/99 to explain why particular sites have improved or degraded. Such classifications will be undertaken within Areas and Regions. Differences cannot all necessarily be ascribed to floods. The compare module of RIVPACS provides information for Areas and Regions to defend changes in class at individual sites. In its raw form, output from the compare module output is not user friendly. BH-F demonstrated graphical output derived from results produced by this module before the meeting.

Not all Regions and Areas have data for 1998/99.

A national need for this type of analysis depends on the detail of the national report. The booklet produced in 1995 and Tony Warn's unpublished report did need this type of analysis. Tony's report homed in on the top 10% of major changes. These would have been changes of more than one class. The comparison of biology and chemistry didn't take error into account.

Summary: We use what data we have, 2 or single season. We explain reasons for any changes in class.

### **Sample Analysis**

Between none and just less than half the samples have to be sorted in each Region/Area.

Some Areas have asked for more time for sorting and analysis. Most often, extra time has been requested because of problems with staff resources. The group concluded that these problems often arose because insufficient priority had been given to the 2000 GQA survey in the laboratory or Area. Staff changes are a constant feature of biological laboratories.

Some Regions indicated that problems inputting data onto B4W was a cause of them being behind schedule. However, two Regions (Anglian and North East) have entered a large amount of data onto B4W already and have not experienced substantial problems. BH-F finds that B4W is as fast as the previous database. We therefore concluded that the problem was not a fundamental shortcoming of B4W.

Problems could have arisen because of the patchy take-up of the training of trainers. Refer back to NBTG recommendation. Putting all the data onto B4W in one go, rather than in small chunks during analysis, can be boring. Suggest that Areas and Regions with a problem speak to Regions that do not have problems to resolve the cause of these problems.

The floods are not expected to have substantial impact on the deadlines for the survey, because where floods are severe and samples cannot be collected, time will be saved in not having to sort and analyse them. Areas should not waste time trying to collect samples that cannot be collected.

The conclusion was that the deadline for completing analyses should remain as the end of February.

Regional Biologists should ensure that autumn audit samples are sent to the auditors in good time and not all in one batch at the end of the survey. They should bear in mind that the auditors have very little time in which to complete the audit and cannot be expected to audit

the remaining samples in one go. Regional Biologists must ensure that audit samples are sent in good time. It is likely that the last one or two audit samples from each of their laboratories will have to be sent to the auditors individually. Regional Biologists should remind the Areas that every sample should have an equal chance of being selected for audit and that the methods in BT003 must be followed.

## **2. Remaining items to complete the survey Project Plan**

The problem of how we deal with bias caused by contractor's quality needs to be addressed. Also, what to do when samples from one laboratory are analysed by another. Contractor's quality can differ substantially from Agency laboratory quality. In 1995 a single value was used for each Region to account for bias. Variations between laboratories were not taken into account. Very few samples, if any, were analysed by contractors in 1995, in contrast to autumn 2000.

If we follow what was done in 1995, we can ignore this.

Checking the quality of data on B4W is difficult. NBTG need to decide how this should be done. Guidelines are needed. Areas and Regions are responsible for the quality of their data. However, some do not do this. It would be useful to share tools for checking data quality. For checking grid references, mapping tools can be used (ArcView or MapInfo). BH-F has some tools, as do Twerton, for checking NGR.

The data quality section at Twerton might be able to help.

The only way to check the quality of biological data is to check a proportion of the raw data.

Environmental data used for GQA is fixed, so errors don't carry across into the classification. Using fixed environmental data assumes that environmental data does not change (drift), which has been demonstrated to be untrue. In some instances, data from 1995 was atypical.

Should Twerton or the Areas run the GQA classification. If Twerton, how do Areas/Regions check the classification in order to sign it off.

In 1995, NBTG decided that only sites with RIVPACS suitability codes 1 or 2 would be classified. However, all sites were classified. Some canals were classified and reported. BHF suggests we classify the data, look at the suitability codes, then re-run without alkalinity, check differences. JMB suggested that we analyse suitability codes to determine river types for which we need additional reference sites for RIVPACS. Who would do such an analysis?

A useful enhancement of B4W to be to make it calculate LIFE and automatically update grade.

Reporting is the responsibility of the Environmental Reporting Group. There is no plan for reporting. Biologists cannot plan reporting until we know what is required.

We should consider what reporting biology wants.  
Action JMB: ask NBTG this question.

Putting audit & AQC data onto B4W is not a requirement of the GQA survey. We need rules for doing this.

### **Time-scales**

At present, the only deadlines are:

28 Feb            completion of sample analysis, sending last few audit samples to CEH and  
                  having validated data on B4W  
31 July           Reporting deadline

We need a date for GS to run the data and return to Areas for checking and sign-off. GS will work on how long classification will take.

Need to link the tasks into sequence and put sizes to them. (JMB got MS Project last week, but not on laptop.)

### **Delegation/working-groups**

JMB will identify what must be done and what is merely desirable to complete the survey. This will enable items that could benefit from delegation to be identified.

### **Other**

Ralph's Clarke's comment. It would be worth considering allowing samples to be collected in summer as a matter of course. Collecting samples from summer does not affect the classification: there is no reason (other than seasonal pollution/stress) to have to compare like with like. RIVPACS enables any season pair to be compared. Precision is not affected by which pair of seasons are used. However, having only one sample does affect precision. Allowing sampling in summer would reduce the chance of samples being missed because of bad weather, as well as helping laboratories (including the auditors) to spread the workload more evenly throughout the year.

**5.7 Summary notes of a meeting held on 12 December 2000.**

This summary of conclusions was circulated to NBTG and the 2000 Survey Steering Group. More comprehensive notes were produced but were not circulated outside the group that met (see Section 5.8).

**2000 Biological GQA Survey  
Where to from Here Meeting  
Fobney Mead  
Rose Kiln Lane  
Reading**

11:00 a.m. – 3:30 p.m.

**Summary Notes**

The main conclusions drawn at the meeting.

**Sampling**

Sampling should cease at the end of December.

For sites where 2 samples have been collected, we will use data from both to determine the GQA class. At site where only a single sample has been collected in 2000, we use that on its own and accept wider error bands. Floods are one of the impacts that may be shown.

**Analysis**

The deadline for completing analysis should remain the 28th February 2000. This includes data entry onto B4W, including audit data. Re-prioritisation of other work may be necessary to meet this deadline.



## 5.8 Survey progress, and number of samples collated on 19 December 2000

Work remaining on 2000 GQA biology survey (at 29 November to 8 December 2000)

|                    | Total sites         | Sites not sampled |                     | Samples not sorted |                     | Collected samples to sort |
|--------------------|---------------------|-------------------|---------------------|--------------------|---------------------|---------------------------|
|                    |                     | Spring            | Autumn              | Spring             | Autumn *            |                           |
| <b>Anglian</b>     |                     |                   |                     |                    |                     |                           |
| Central            | 254                 | 0                 | 120**               | 0                  | 120                 |                           |
| Eastern            | 290                 | 0                 | 0                   | 0                  | 140                 |                           |
| Northern           | 200                 | 0                 | 30                  | 0                  | 100                 |                           |
| <i>Total</i>       | <i>774</i>          | <i>0</i>          | <i>&gt;150**</i>    | <i>0</i>           | <i>360</i>          |                           |
| <b>Midlands</b>    |                     |                   |                     |                    |                     |                           |
| U Trent            | 215 (+60c)          | 0                 | c30                 | 0                  | 111 (+59c)          | 140                       |
| L Trent            | 395 (+23c)          | 2c                | 15 (+15c)           | 0                  | c338                | 308                       |
| U Severn           | 270 (+16c)          | 0                 | 84                  |                    | 91***               | 7                         |
| L Severn           | 288                 | 0                 | 118                 | 0                  | 158                 | 40                        |
| <i>Total</i>       | <i>1168 (+99c)</i>  | <i>2c</i>         | <i>247 (+15c)</i>   | <i>0</i>           | <i>c698 (+59c)</i>  | <i>495</i>                |
| <b>North East</b>  |                     |                   |                     |                    |                     |                           |
| Dales              | 192                 | 0                 | 90                  | 0                  | 116                 | 36                        |
| Northumbria        | 221                 | 0                 | 85                  | 0                  | c190                |                           |
| Ridings            | 405                 | 0                 | 35                  | 0                  | 363                 |                           |
| <i>Total</i>       | <i>818</i>          | <i>0</i>          | <i>210</i>          | <i>64</i>          | <i>c745</i>         |                           |
| <b>North West</b>  |                     |                   |                     |                    |                     |                           |
| Northern           | 278                 | 0                 | c110                | 78                 | 266                 |                           |
| Central            | 252                 | 0                 | 68                  | 0                  | 224                 |                           |
| South              | 365                 | 0                 | 110                 | 0                  | 302                 |                           |
| <i>Total</i>       | <i>898</i>          | <i>0</i>          | <i>288</i>          | <i>78</i>          | <i>792</i>          |                           |
| <b>Southern</b>    |                     |                   |                     |                    |                     |                           |
| Hants & IoW        | 156                 | 0                 | 40                  | 0 (6 by Kent)      | 130                 |                           |
| Sussex             | 129                 | 0                 | 43                  | 0                  | 73                  | 30                        |
| Kent               | 239                 | 0                 | 85                  | 6 (for IoW)        | 155                 | 70                        |
| <i>Total</i>       | <i>524</i>          | <i>0</i>          | <i>300</i>          | <i>6</i>           | <i>434</i>          |                           |
| <b>South West</b>  |                     |                   |                     |                    |                     |                           |
| Cornwall           | 305                 | 1                 | 20                  | 4                  | 272                 | 252                       |
| Devon              | 312                 | 0                 | c90                 | 0                  | 282                 | 192                       |
| N Wessex           | 371                 | 0                 | 49                  | 0                  | 253                 | 204                       |
| S Wessex           | 187                 | 5                 | 4                   | 29                 | 123 (+50****)       | 119 (+50)                 |
| <i>Total</i>       | <i>870</i>          | <i>0</i>          | <i>163</i>          | <i>51</i>          | <i>930 (+ 50)</i>   | <i>767 (+50)</i>          |
| <b>Thames</b>      |                     |                   |                     |                    |                     |                           |
| West               | 286                 | 0                 | 2                   | c200 (contractor)  | 170                 | 168                       |
| North East         | 124 (+20c)          | 0                 | 6                   | 39                 | 20                  | 14                        |
| South East         | 122                 | 0                 | 0                   | 0                  | 0                   | 0                         |
| <i>Total</i>       | <i>532 (+20c)</i>   | <i>0</i>          | <i>8</i>            | <i>c239</i>        | <i>190</i>          | <i>182</i>                |
| <b>Wales</b>       |                     |                   |                     |                    |                     |                           |
| Northern           | 209                 | 0                 | 116                 | 0                  | 146                 | 30                        |
| South West         | 285                 | 0                 | 0                   | 70                 | 194                 | 194                       |
| South East         | 343                 | 0                 | 5                   | 138                | 300                 | 295                       |
| <i>Total</i>       | <i>837</i>          | <i>0</i>          | <i>121</i>          | <i>208</i>         | <i>640</i>          | <i>519</i>                |
| <b>Grand Total</b> | <b>6385 (+119c)</b> | <b>1 (+2c)</b>    | <b>c2580 (+28c)</b> | <b>c646</b>        | <b>c5323 (+23c)</b> |                           |

Notes:

- \* Autumn samples not sorted includes samples for sites not yet sampled; c300 = approximately 300; 150 (+12c)  
= 150 river sites plus 12 canal sites
- \*\* Central Area expect all samples to be collected by end December
- \*\*\* includes some spring samples
- \*\*\*\* contracted-out to Unicor Marine

## 5.9 Survey progress, and number of samples collated on 16 January 2000



ENVIRONMENT AGENCY

BTG Working Document 50

### NATIONAL BIOLOGY TECHNICAL GROUP

Work remaining on 2000 GQA biology survey (at 16 January 2001)

|                   | Total sites         | Sites not sampled |            | Samples to sort    | Samples to B4W | Audit (8 Jan) |           |
|-------------------|---------------------|-------------------|------------|--------------------|----------------|---------------|-----------|
|                   |                     | Spring            | Autumn     |                    |                | Total         | To send   |
| <b>Anglian</b>    |                     |                   |            |                    |                |               |           |
| Central           | 254                 | 0                 | 0          | <5                 |                | 20            | 5         |
| Eastern           | 292                 | 0                 | 0          | 0                  |                | 20            | 0         |
| Northern          | 200                 | 0                 | 0          | 0                  |                | 20            | 0         |
| <b>Total</b>      | <b>746</b>          | <b>0</b>          | <b>0</b>   | <b>&lt;5</b>       |                | <b>60</b>     | <b>5</b>  |
| <b>Midlands</b>   |                     |                   |            |                    |                |               |           |
| U Trent           | 215 (+60c)          | 0                 | 0          | 35 (+59c)          |                | 20            | 3         |
| L Trent           | 395 (+22c)          | 2c                | 6          | 145 (+20c)         |                | 20            | 3         |
| U Severn          | 235 (+23c)          | 0                 | 79         | 14 (+34c)          |                | 20            | 3         |
| L Severn          | 270 (+17c)          | 0                 | 118        | 13                 |                | 20            | 7         |
| <b>Total</b>      | <b>1115 (+122c)</b> | <b>2c</b>         | <b>203</b> | <b>207 (+113c)</b> |                | <b>80</b>     | <b>16</b> |
| <b>North East</b> |                     |                   |            |                    |                |               |           |
| Dales             | 195                 | 0                 | 72         | 0                  |                | 20            | 0         |
| Northumbria       | 221                 | 0                 | 83         | 15                 |                | 20            | 1         |
| Ridings           | 405                 | 0                 | 34         | 90                 |                | 20            | 5         |
| <b>Total</b>      | <b>821</b>          | <b>0</b>          | <b>189</b> | <b>105</b>         |                | <b>60</b>     | <b>6</b>  |
| <b>North West</b> |                     |                   |            |                    |                |               |           |
| Northern          | 278                 | 0                 | 51         | 22                 |                | 20            | 7         |
| Central           | 254                 | 0                 | 12         | 45                 |                | 20            | 4         |
| South             | 365                 | 0                 | 6          | 60                 |                | 20            | 8         |
| <b>Total</b>      | <b>897</b>          | <b>0</b>          | <b>69</b>  | <b>127</b>         |                | <b>60</b>     | <b>19</b> |
| <b>Southern</b>   |                     |                   |            |                    |                |               |           |
| Hants & IoW       | 156                 | 0                 | 0          | 85                 |                | 20            | 7         |
| Sussex            | 129                 | 0                 | 26         | 28                 |                | 20            | 4         |
| Kent              | 239                 | 0                 | 26         | 64                 |                | 20            | 0         |
| <b>Total</b>      | <b>524</b>          | <b>0</b>          | <b>52</b>  | <b>177</b>         |                | <b>60</b>     | <b>11</b> |
| <b>South West</b> |                     |                   |            |                    |                |               |           |
| Cornwall          | 295                 | 1                 | 23         | 137                |                | 20            | 10        |
| Devon             | 311                 | 0                 | 91         | 153                |                | 20            | 3         |
| N Wessex          | 370                 | 0                 | 47         | 148                |                | 20            | 6         |
| S Wessex          | 184                 | 5                 | 5          | 73                 |                | 20            | 10        |
| <b>Total</b>      | <b>1160</b>         | <b>6</b>          | <b>166</b> | <b>511</b>         |                | <b>80</b>     | <b>29</b> |
| <b>Thames</b>     |                     |                   |            |                    |                |               |           |
| West              | 286                 | 0                 | 2          | 50 (+224*)         |                | 20            | 0         |
| North East        | 124 (+20c)          | 0                 | 4          | 12**               |                | 20            | 0         |
| South East        | 122                 | 0                 | 0          | 12**               |                | 20            | 0         |
| <b>Total</b>      | <b>532 (+20c)</b>   | <b>0</b>          | <b>6</b>   | <b>74 (+224*)</b>  |                | <b>60</b>     | <b>0</b>  |
| <b>Wales</b>      |                     |                   |            |                    |                |               |           |
| Northern          | 209                 | 0                 | 100        | 101                |                | 20            | 11        |
| South West        | 285                 | 0                 | 0          | 129                |                | 20            | 7         |
| South East        | 343                 | 0                 | 5          | 181                |                | 20            | 10        |

|                               |                      |                |     |     |  |            |            |
|-------------------------------|----------------------|----------------|-----|-----|--|------------|------------|
| <i>Total</i>                  | 837                  | 0              | 105 | 411 |  | 60         | 28         |
| <b>Grand Total for Agency</b> | <b>6385 (+ 119c)</b> | <b>1 (+2c)</b> |     |     |  | <b>520</b> | <b>152</b> |
| N. Ireland                    |                      |                | 2   | 0   |  | 60         | 0          |
| Isle of Man                   |                      | 0              | 3   | 29  |  | 6          | 3          |
|                               |                      |                |     |     |  |            |            |

Notes: c = canal sites \* = contracted out. \*\* = for West Area



## 6 DATA ANALYSIS

The original plans were for a biological data analysis and classification to be undertaken in Regions using the Agency's new national biological database, Biology for Windows (B4W) developed by the Agency's Computer Information Services (CIS). The National Centre for Environmental Data and Surveillance (NCEDS) at Twerton were asked to run the initial classifications, to ensure that the systems in B4W worked. Because of problems with B4W and a lack of adequate staff resources in many Regions, all the data analysis was undertaken by NCEDS. A few Regions that were capable of manipulating databases undertook their own analyses and reporting, in addition to this.

Graham Storey at NCEDS undertook the analysis, with help from Emily Orr.

### 6.1 Evaluation of the results: progress

In January 2001, Graham Storey sent a list of sites and stretches that had gaps where NCEDS was unsure of which stretch these biological sites represented. This information was needed to link the chemistry and biological data. NCEDS still had gaps in this list in January 2002, despite numerous requests to the Regions. It appears that some laboratories still do not know which stretches certain biological sites belong to South West Region. Because of the continuing problem with stretches and GQA surveillance sites, a project has been established in 2002 to produce and manage a definitive database of stretch definitions and site locations and associations.

Despite information collated on the number of samples collected, see Sections 5.8 and 5.9, the number of samples identified on B4W as belonging to the 2000 biological GQA survey did not correspond to these numbers for some time. Information about the number of sites and samples that were expected to undergo classification and analysis were a continual problem in 2001. Canal sites, which were to be excluded from the survey in 2000, caused a problem, particularly as some of these had been classified in 1995.

Graham Storey wanted to test the classification and data analysis software at the end of 2000, or early in 2001, but was unable to do so because B4W was not working because of continuing development and support problems.

NCEDS were unaware of precisely what data was to be used for classification because no record was left from Anglian Region about what was done in 1995. Initial analyses were undertaken based on solely 2 seasons data (specifically spring and autumn), including alkalinity and other RIVPACS variables. This information was not available for all sites, and it took some time for NCEDS to realise the reason. Also, they were unaware that bias should be taken into account in the classification.

Data problems became apparent when the first set of data was analysed. These occurred because there were no validation rules in B4W (although they had been part of the original specification).

Other serious data problems were revealed in these initial analyses:

- Missing environmental sample data
- Many missing 'ticks' in B4W that identify samples as belonging to the GQA survey

- Missing site information (such as distance from source)
- Multiple samples (more than two samples from some sites were 'ticked' as being GQA samples)
- Out of range data. This included both '9999', used in RIVPACS to denote 'no data' as well as genuinely out of range data (for example some river depths in North West Region)

These problems were thought to have arisen because of :

- a) Lack of training in how to use B4W when entering data (such as not filling fields that should be filled)
- b) Failure to follow instructions given in training
- c) Failures in data migration from historical databases to B4W.

Some of the data problems were identified by working through RIVPACS and using RIVPACS' output fields to identify where problems occurred.

Graham Storey sent-out a draft classification so that Regions could identify where errors were. South West Region used this draft data operationally, despite being told not to. Tables were sent to Regions indicating where holes were and what the likely reasons for the absence of a classification were. Regions were asked to resolve these holes.

Graham asked Regions to provide values for RIVPACS environmental sample variables for spring, summer and autumn and asked John Steel at Thames Region's biology laboratory in Wallingford to load these data into B4W. Twerton then calculated the averages that RIVPACS used.

In about July 2001, the biological data analyses and classifications were undertaken again. This classification included bias and was based on data from only two seasons (spring and autumn only). The compare module was not used.

These results were sent to Regions, together with summary statistics, as a first draft classification. From this it was evident that there were still data problems in some Regions. The National Centre attempted to link the biological sites to stretches. From this, they found out that some sites were without stretches, and some stretches were without sites. They tried to resolve the missing links by asking Regions to resolve the holes in the data.

The National Centre then started to investigate running the 'Compare' module of RIVPACS, to investigate biological changes compared to the results of the previous national surveys of 1990 and 1995. Their first problem was to decide what data from previous surveys they should base the comparison with 2000 data on. The GQA Survey Steering Group agreed that the comparison should be with what was published in 1990 and 1995, regardless of any corrections that were made to the data subsequently. The National Centre has a copy of the Thames GQA database, which was managed by John Steel and Julie Jeffrey and was written in Microsoft Access. This data matched that reported by Tony Wam in Environment Agency (1997c).

Graham Storey ran the compare module on a stretch by stretch basis. Unfortunately, the compare module gave different results (GQA grades for each year) every time that it was run. This was because compare re-classifies each site each year based on the most probable grade, not the face value grades, and it does this in the basis of a relatively small number of Monte-

Carlo simulations (500). These differences caused problems in some Regions. Unfortunately, it is not possible to increase the number of simulations without converting RIVPACS from DOS to Windows operating platform (see Section 9)

Graham tried to produce Environmental Quality Indices (EQIs or observed/expected ratios – see Murray-Bligh (1999a, BT001, Section 3.15) for 1990. Not all the data that was needed was available on the GQA database. (This database was provided by Julie Jeffery from the old Thames Biology System database, and archive data from Tony Warn.) Most of the important items were present. They had, after all, yielded the same results as reported in Environment Agency (1997a & c). However, the season codes were absent (only number of samples was present). There was no time to generate the season codes from the individual sample dates. The NCEDS intend to generate this data, which they need in order to classify the 1990 data with bias and to compare it probabilistically in RIVPACS with subsequent years' data.

Graham Storey undertook what he thought was the final classification. This took account of bias, involved two seasons (spring and autumn), included links between sites and stretches, and included summary statistics.

Anglian Region was the first to raise concerns with these results, specifically the absence of summer samples from the analyses. Regions had not noted their absence in preliminary classifications and NCEDS had not realised that summer samples were permissible in the 2000 GQA biology survey (see Section 2.7.8). This problem affected three Regions. With the agreement of the affected Regions, some but not all Regions' data was amended.

The data from 2000 was re-analysed and classified. Comparisons between 1995 and 2000 and between 1990 and 2000 were re-generated (again without bias or probabilities).

Simon Bingham of the National Assessment and Reporting Section then raised some further problems:

1. South West Region Regional Water Quality (Andy Rodgers) said that the gaps in the links between some of the biological sites and the monitoring stretches were unacceptable. NCEDS made several attempts to get definitive site-stretch links from the Region's biologists (who were responsible for locating the biological sites and delivering the survey data). Following intervention by Regional Water Quality, a more complete list was obtained. Although there are still gaps and errors in the links, Regional Water Quality was satisfied.
2. Bias. Despite what had been reported in descriptions of the method, the results of the 1995 GQA survey that were published did not take account of bias. Bias was only used to compare 1990 and 1995
3. NCEDS found differences between the stretches recorded for chemistry and biology.
4. The stretch lengths on which the biological classification was generated could not be divided according to the political boundary between England and Wales to provide total river lengths that matched the chemistry. The Rivers Group maintained a list of stretches in England and Wales.

Only face-value GQA grades were published for the 2000 biology survey. This was the same data that was published in 1995.



## **6.2 Evaluation of the results: the effect of single season samples**

Because of concern that the large number of sites for which only a single sample was obtained in 2000 affected comparisons with the results of the 1995 biological survey, CEH Dorset were commissioned to undertake an investigation. Ralph Clarke at CEH Dorset provided the results of his analysis in summary form to the Agency as soon as they were available. Appendix A is the summary of results that was produced on 4 December 2000, and was circulated to NBTG shortly thereafter. The final report (Clarke, 2000) differs little except for pagination and layout.

Further concerns were raised about the impact of having only a single season's data at many sites in Southern Region by Phil Smith (Team Leader for Sussex Area, Southern Region). This followed an examination of the results of the survey, which indicated an improvement in quality when none was expected. CEH Dorset were commissioned to produce another report to investigate whether the large proportion of single season results compared to 1995 could have been the cause of the unexpected improvement in quality. CEH's report (Clarke, 2001) was completed in August 2001 and is presented here in Appendix B.

## **6.3 Calculation of survey results based on political boundaries**

Calculation of political results caused problems for both Emily Orr and Graeme Storey. The main reason was that different reach lengths were used for biology and chemistry results, and the fact that the "double counting" of shared reaches used the chemistry lengths. In the end, a compromise was adopted by scaling the reach length split. Graeme and Emily undertook a considerable amount of work on this problem and hopefully it will be less of a problem for reporting the next national survey.

If reach lengths change, based on then historical results will change (based on both political and non-political river lengths). Careful consideration needs to be given to how this is managed. Chemists are likely to decide to revise the historical results to prevent inconsistencies. These changes need to be explained carefully in public documents so that it is clear that the refinements correct errors in the archives.

## 7 REPORTING METHODS

Reporting methods were discussed by NBTG. There were some concerns about what was proposed (see Section 7.1). Comments on this, and a request to NBTG from Simon Bingham of the National Reporting Section about how single season samples should be reported are reproduced in Section 7.2.

### 7.1 Biological GQA 2000, causes for concern.



ENVIRONMENT AGENCY

BTG Working Document No. 81a

### NATIONAL BIOLOGY TECHNICAL GROUP

Biological GQA 2000, causes for concern.

Brian Hemsley-Flint, 23 August 2001

I have carried out a comparison between data produced by Graeme and by myself for the three GQA surveys. Whilst the data for 2000 are fairly well in agreement, there are some one-grade differences due to RIVPACS calculating the grade and these all have probabilities in the 50% area, so I am not concerned too much. Where I have concerns are with the 1995 and 1990 data, where there is a much greater degree of difference. This is because I have re-worked the 1990 and 1995 data using Area bias data, whilst Graeme has used the pre-published data which may or may not have had bias applied. Also, the data produced by Graeme for comparison of 1995 with 2000 has had no bias applied for 1995. This has led to different classes for some sites being allocated within the compare module to that in the reported database.

I am also concerned that Simon Bingham is still keen to publish the data on overall change in grade of one grade or more as the indicator, whereas we all know that a change of one grade may only be due to chance due to the site having a 50% probability of being in either of two grades. I maintain that the figures to be reported should be those sites that have a probability of 95% change and of 75% probability of change. The former indicate definite changes and the latter indicate sites that need to be viewed as either needing to be maintained in quality or need to be re-instated.

Table 9 River length (km) showing net upgrade/downgrade between 1995 and 2000 at varying probability of change

| Region     | 50     | 75     | 90    | 95    | 2 grade | 1 grade |
|------------|--------|--------|-------|-------|---------|---------|
| Anglian    | 1751.9 | 998.6  | 562.8 | 385.3 | 319.8   | 1802.3  |
| Midlands   | 1358.6 | 818.3  | 414   | 253.6 | 202.3   | 1255.1  |
| North East | 734.8  | 518.4  | 354.1 | 335.1 | 200.3   | 609.9   |
| North West | 33     | 33.4   | 334   | -5.3  | 26.7    | 0.8     |
| Southern   | 31.3   | -1.1   | 47.1  | -15.2 | -6.3    | 51.1    |
| South West | 291.8  | 109.6  | 36.1  | 24.7  | 26.5    | 278     |
| Thames     | 944    | 698.1  | 448.3 | 342.7 | 243.2   | 955.7   |
| Wales      | -519.5 | -312.5 | -74.9 | -45.9 | -1      | -464.4  |

England and Wales    4625.9   2862.8   2121.5   1275            1011.5   4488.5

**Table 10 Percentage of river length showing net upgrade/downgrade between 1995 and 2000 at varying probability of change**

| Region            | 50    | 75   | 90   | 95   | 2 grade | 1 grade |
|-------------------|-------|------|------|------|---------|---------|
| Anglian           | 38.4  | 21.9 | 12.3 | 8.4  | 7.0     | 39.5    |
| Midlands          | 23.5  | 14.1 | 7.2  | 4.4  | 3.5     | 21.7    |
| North East        | 13.3  | 9.4  | 6.4  | 6.1  | 3.6     | 11.1    |
| North West        | 0.7   | 0.8  | 7.5  | -0.1 | 0.6     | 0.0     |
| Southern          | 1.4   | 0.0  | 2.1  | -0.7 | -0.3    | 2.3     |
| South West        | 5.4   | 2.0  | 0.7  | 0.5  | 0.5     | 5.2     |
| Thames            | 26.0  | 19.2 | 12.3 | 9.4  | 6.7     | 26.3    |
| Wales             | -10.7 | -6.4 | -1.5 | -0.9 | 0.0     | -9.5    |
| England and Wales | 12.7  | 7.9  | 5.8  | 3.5  | 2.8     | 12.3    |

The above tables have been produced from Graeme's Compare\_v1.xls file sent out earlier in the month.

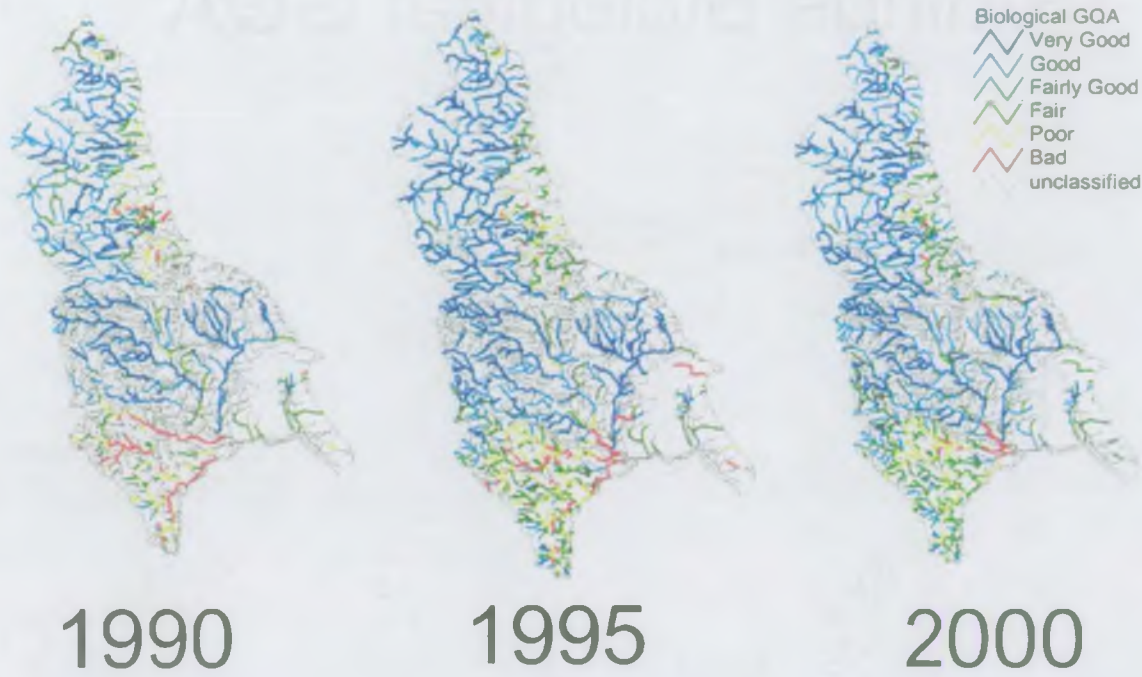
On the basis of these data, I have produced a series of charts and maps showing grades, lengths and changes which I think should be available for all Regions and Reported Nationally, Regionally and at an Area Level (see below and BTGWD81b.xls). I am concerned that all this hard work will eventually be condensed to a Smiley or Sad face in a National Report.

We really need to address the issue of data storage, retrieval and manipulation, since for most of the data I had results at the end of March. It was only the problems in amending B4W datasets that has caused the delay in reporting on the few new sites and those which were missing data. I know other Regions had slightly different problems but given the right levels of access and the proper systems, all this data could have been available a lot sooner.

I am also greatly concerned that the flak for late reporting is going to be laid at our door and not at CIS's door, when it is a lack of investment into the Biology system software and development that lies at the heart of the problem.



# Biological GQA Northeast Region



# Ridings Biological GQA

1990



Biological GQA

- Very Good
- Good
- Fairly Good
- Fair
- Poor
- Bad
- unclassified

1995

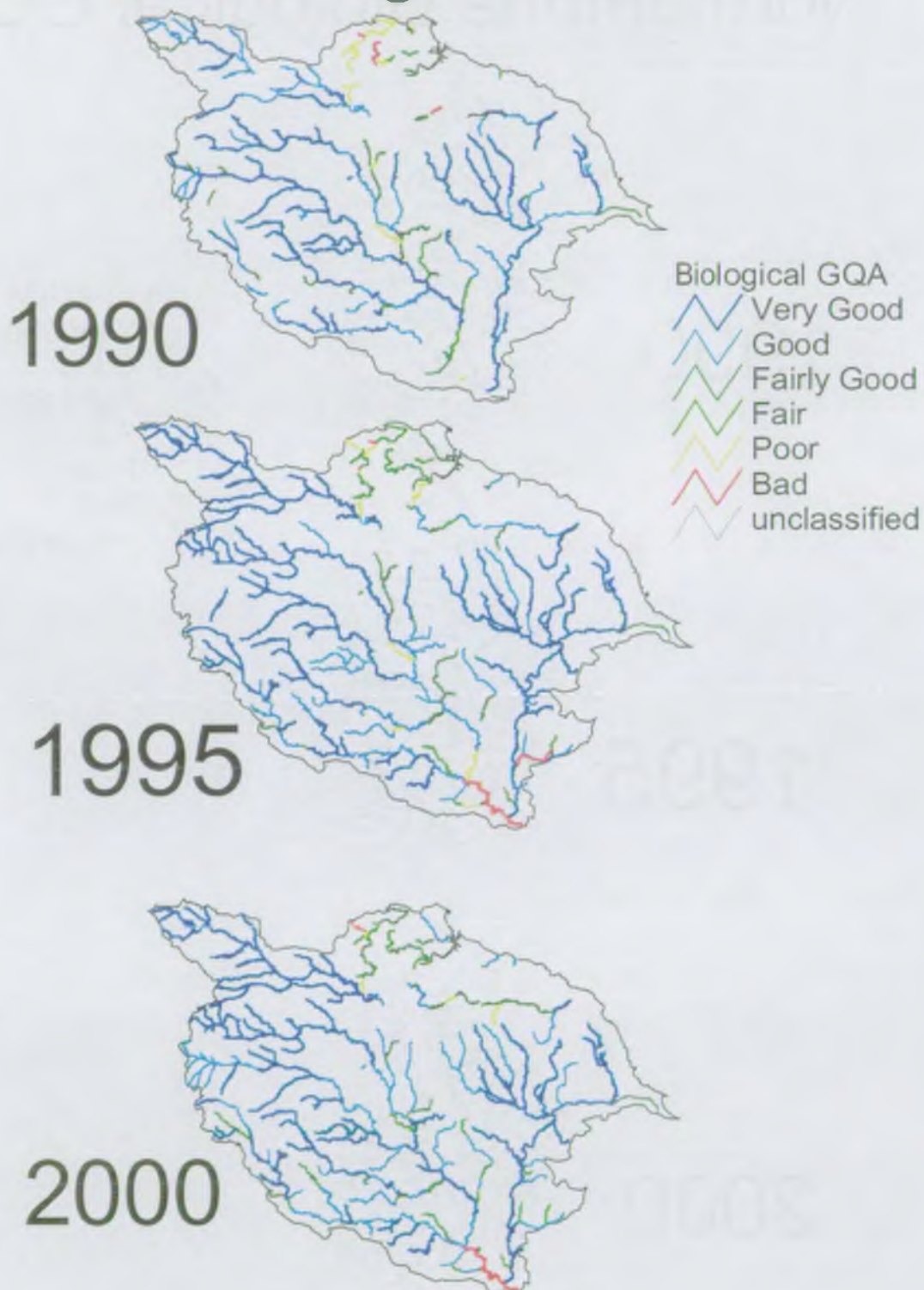


2000





# Dales Biological GQA



# Northumbria Biological GQA

1990



Biological GQA

- Very Good
- Good
- Fairly Good
- Fair
- Poor
- Bad
- unclassified

1995

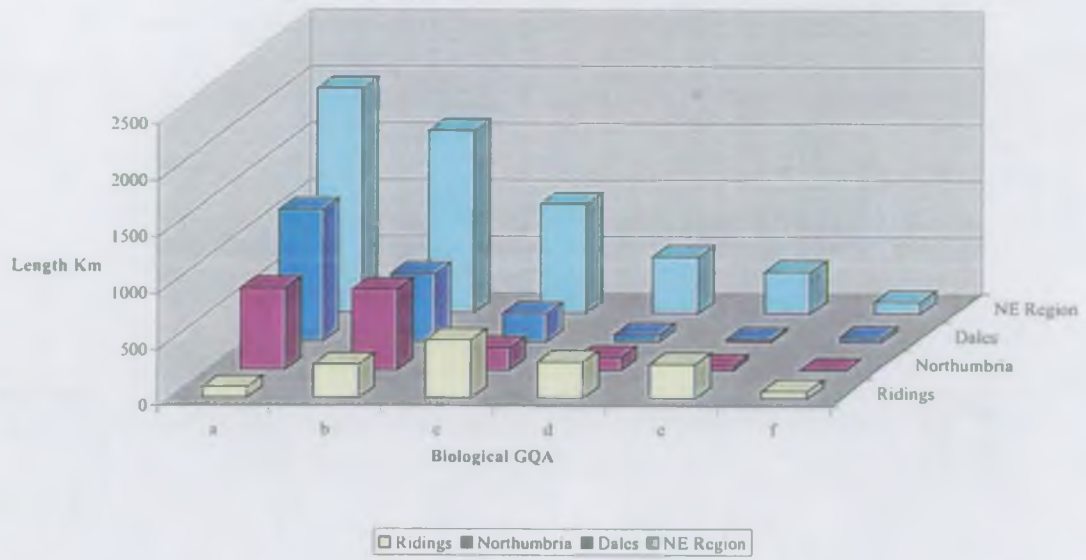


2000

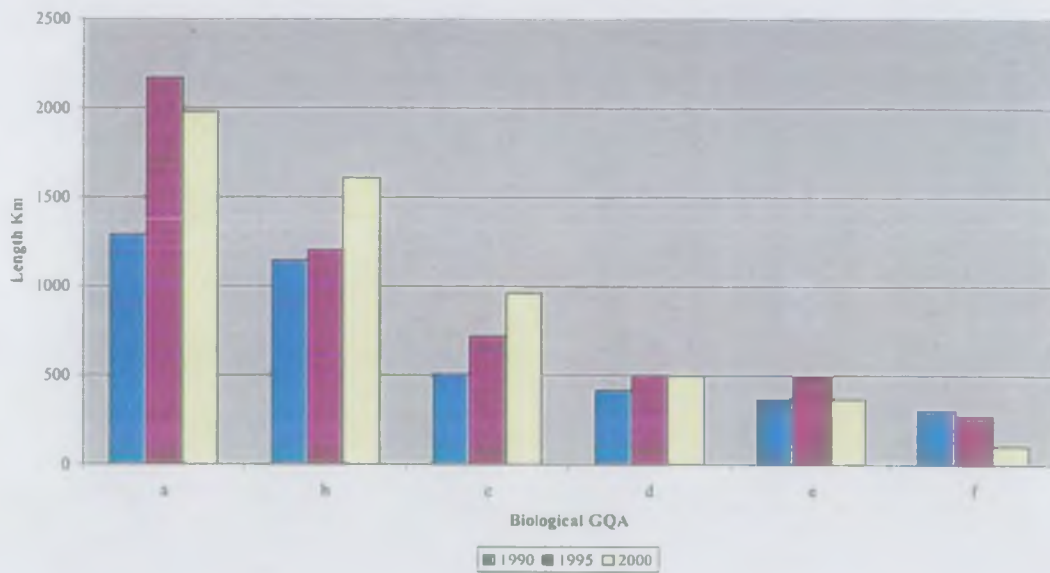




### Biological GQA 2000

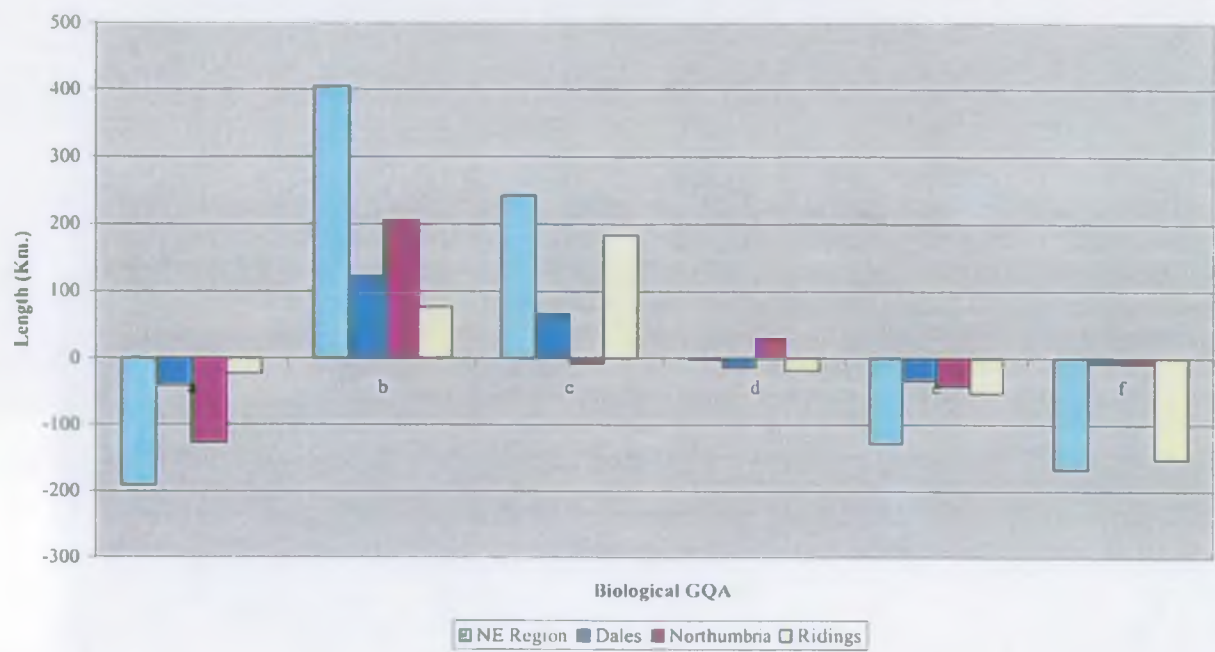


### Biological GQA Northeast Region 1990-2000





Change in Biological GQA 1995-2000



## 7.2 Compilation of comments on reporting the 2000 GQA biology survey



ENVIRONMENT AGENCY

**BTG Working Document No. 118**

### **NATIONAL BIOLOGY TECHNICAL GROUP**

**Compilation of comments on reporting the 2000 GQA biology survey**

**John Murray-Bligh, 30 September 2001**

This document includes responses to a request from Simon Bingham on 29 August on how we should deal with single season samples in the report of the 2000 GQA survey, and responses to Brian Hemsley-Flint's paper NBTGWD81 about some concerns about what was planned for reporting.

Simon Bingham's request was

"The question we need to answer for the GQA report is how to deal with the single season sites. The options seem to be:

- I. Report all the grades in each region, but run compare only on the sites with two seasons data. This means that 20% of the sites are not used.
- II. Use all the sites but only report change based on probability of change.
- III. Perhaps we could compare all the sites, but just compare the sites with spring data in 2000 to spring data in 1995 and 1990. I have not discussed with Graeme whether this is possible.

It seems to be the preferred option. I am not sure yet. We would not have an overall figure for net change. How well does the relatively small number of sites with a 95% significant change represent the overall change in biological quality?

#### **Chairman**

**From:** Martin Stark **Date:** 28/08/01

The comparison against 1995 needs to be done against the published information available, which was used then. I do not know if that information included bias figures. What we mustn't be accused of is manipulation of the data again to show changes, which look better than they really are. I accept that if bias figures weren't used for 1995 and we use them for 2000, we won't compare like with like but to incorporate bias figures now for 1995 seems a bit late.

#### **Southern Region**

**From:** Bob Dines **Date:** 24/08/01

I am surprised that biases have not been used for 95 and 90 - I think they should have been. I agree that a smiley face is not much of an output, but even that should be based in significant change and not on face values.

### Wales

**From:** Richard Hemsworth **Date:** 24/08/01

I think Brian is absolutely right - we should only consider changes that are 95% or more certain, by definition everything else is not significant.

The data difficulties are certainly demoralising for biology staff who busted a gut to produce the raw info and clearly our customers are not impressed!

Perhaps Graeme Storey, who clearly has done a great job in difficult circumstances could be provided with more assistance and clout.

**From:** Richard Hemsworth **Date:** 30/08/01

Initially, I would have said that iii) was the best option and I thought this had been discussed at NBTG but was seen as too much work for Graeme. Having skimmed the CEH report however, it seems valid to compare one season in 2000 with two seasons in previous years.

I also think that only significant changes should be reported. This was done in the excellent 1990-1995 combined chemistry, biol., nutrients report (map4 and Fig. 10) which showed only a small (450km) downgrade and a 4,200km upgrade.

I will circulate your memo in Wales and if different opinions are expressed I will let you know.

### Head Office

**From:** Simon Bingham **Date:** 28/08/01

Thanks for the email you sent earlier this month and the discussion in your paper for the Biology Group.

I do have a copy of the document "The quality of Rivers in England and Wales 1990-1995". Curiously, my reading of the section from page 17 to 21 is that it is an explanation and justification of using the overall change in one grade or more. Page 18 suggests that it is a "categoric demonstration that river quality has improved", and it is this statistic that "we put forward as our estimate of the true change in quality".

For an individual site a grade change of a single grade may not be significant. But because there are so many sites (>6000) these random fluctuations cancel out.

We are planning to use this statistic to report the GQA for biology, chemistry and nutrients. It seems to be the most effective single statistic to summarise overall change and it is straightforward to understand. The report will also include all the tables for each region with different confidence of change.

Your tables 9 and 10 are an excellent way to present the data. Wales has poorer quality and this is shown in all the statistics. North West and Southern fluctuate between -ve and +ve, but with only small lengths. My conclusion would be that there really is not much change overall for

these 2 regions. Both have a larger length change over 2 or more grades than for one or more grades, which is not expected. If we wanted to use only confidence data we would need to take care in interpreting the data. What level of confidence would we use? How well does the length that changes with a high degree of confidence indicate the overall change in quality? What does the downgrade at 95% confidence for North West show?

It might be that looking at grade changes is not the best way to monitor change. It would be possible to look at the change dissolved oxygen mean for chemistry, and the change in EQI for biology. It is too late for this report but we could think about it in the future.



## 8 REPORTS

### 8.1 National Reporting

The following national reports were produced by the Environment Agency:

- 1) *Rivers and estuaries - a decade of improvement*, a 16 page booklet distributed in printed format as well as electronic pdf file from the Agency's web site (Environment Agency, 2002a).



Figure 8.1 Front cover of *Rivers and estuaries - a decade of improvement*.

- 2) *General quality assessment of rivers and classification of estuaries in England and Wales 2000*: Technical Report (Environment Agency, 2002b). This was distributed within the Agency but not outside, although there are no restrictions to distributing it outside.
- 3) *Fact Sheet: River and Estuary quality in 2000* (Environment Agency, undated). This 2-side A-4 fact sheet included a summary graph showing percentage river length of rivers of good and fair quality in 1990, 1995 and 2000, and chapters explaining why biological and chemical quality has improved since 1990, how quality varies across the country and whether it will continue to improve. The fact sheet that was produced after the 1995 survey explaining the biological GQA classification *Assessing Water Quality – General Quality Assessment (GQA) Scheme for Biology* (Environment Agency, 1997b) was still available.

The results were also published on the Internet:

- The *Environmental Facts and Figures, Water Quality* page had an overview of the GQA results and also the GQA methodology. The *Wildlife* page of *Environmental Facts and Figures* had a section on invertebrates
- The results of the survey were displayed in *What's in Your Backyard*. This showed monitoring sites on a small map, the location and scale for which was chosen on screen, and the monitoring sites could be interrogated to provide information about river quality.
- And there is the indicator.

Four examples are given in Figures example Agency web pages:



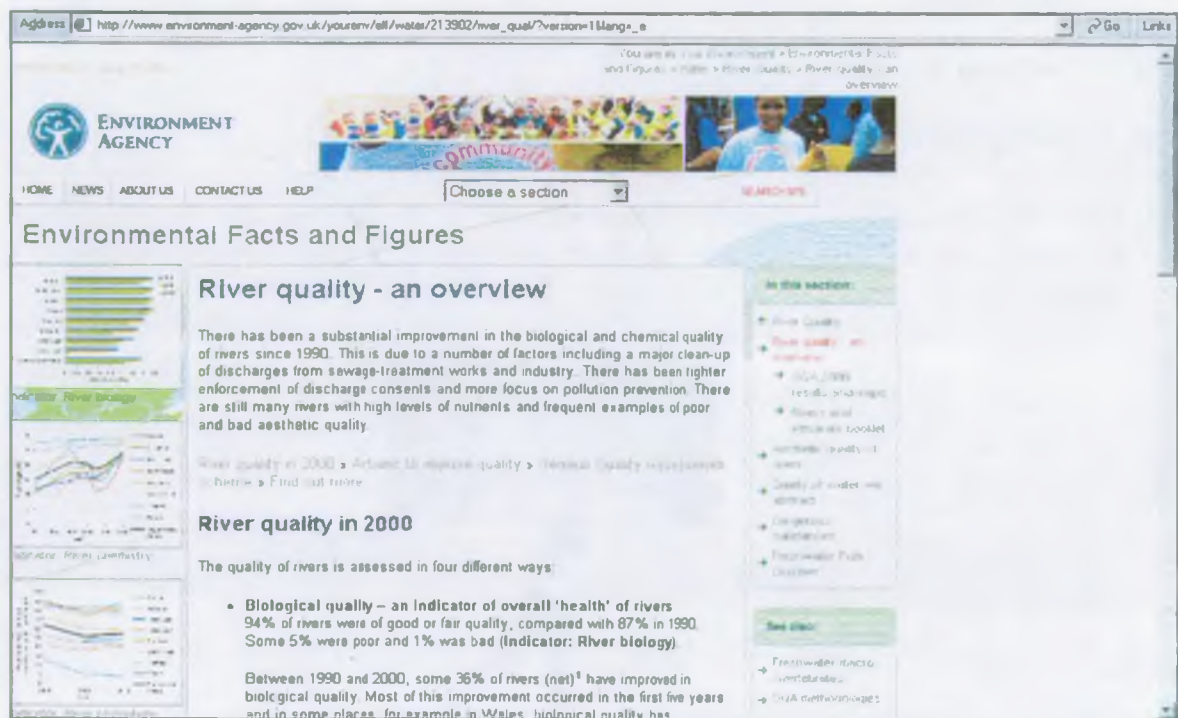


Figure 8.2. The home page of the Environment Agency's Environmental Facts and Figures section of the Environment Agency's Intranet site: [http://www.environment-agency.gov.uk/yourenv/eff/water/213902/river\\_qual/?version=1&lang=e](http://www.environment-agency.gov.uk/yourenv/eff/water/213902/river_qual/?version=1&lang=e)

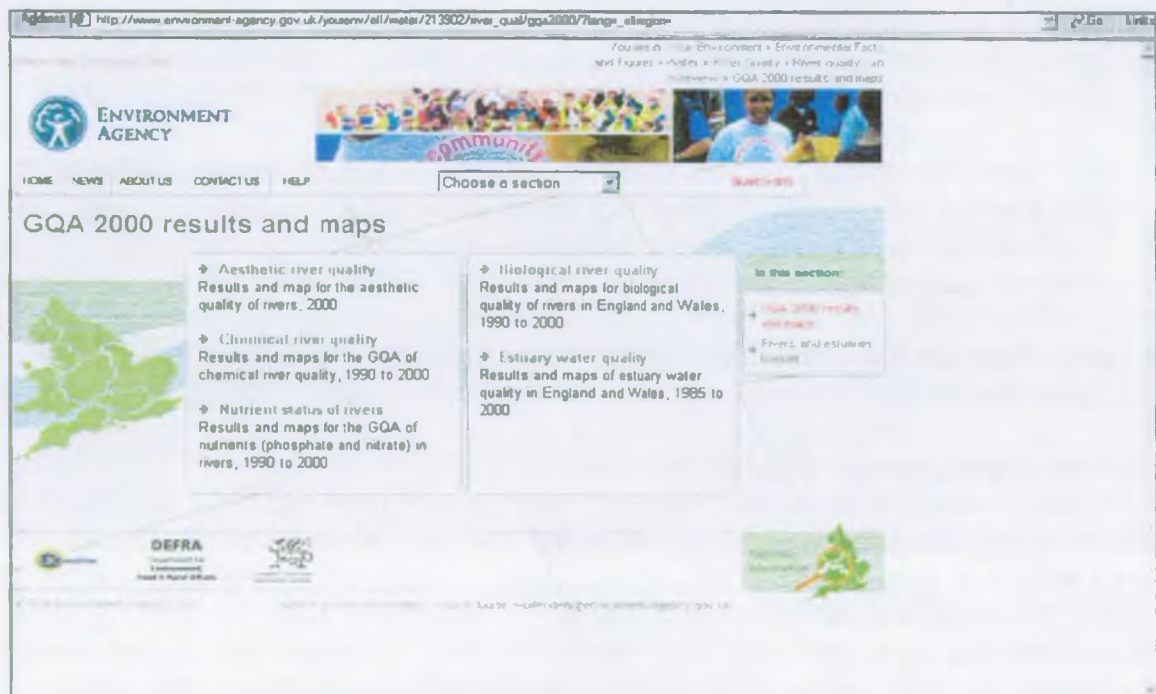


Figure 8.3 The *GQA 2000 results and maps* page of the Environment Agency's Environmental Facts and Figures section of the Environment Agency's Intranet site: [http://www.environment-agency.gov.uk/yourenv/eff/water/213902/river\\_qual/gqa2000/?lang=e&region=](http://www.environment-agency.gov.uk/yourenv/eff/water/213902/river_qual/gqa2000/?lang=e&region=)

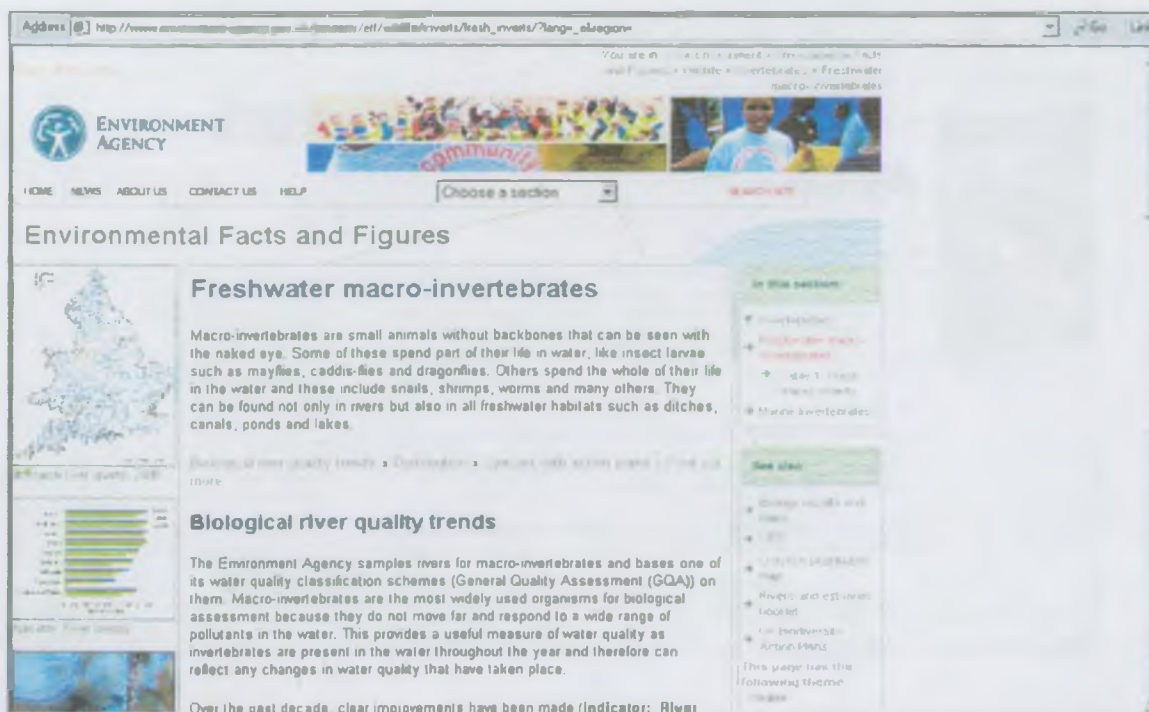


Figure 8.4 The *Freshwater Macro-Invertebrates* page of the Environmental Facts and Figures section of the Environment Agency's Intranet site: [http://www.environment-agency.gov.uk/yourenv/eff/wildlife/inverts/fresh\\_inverts/?lang=e&region=](http://www.environment-agency.gov.uk/yourenv/eff/wildlife/inverts/fresh_inverts/?lang=e&region=)

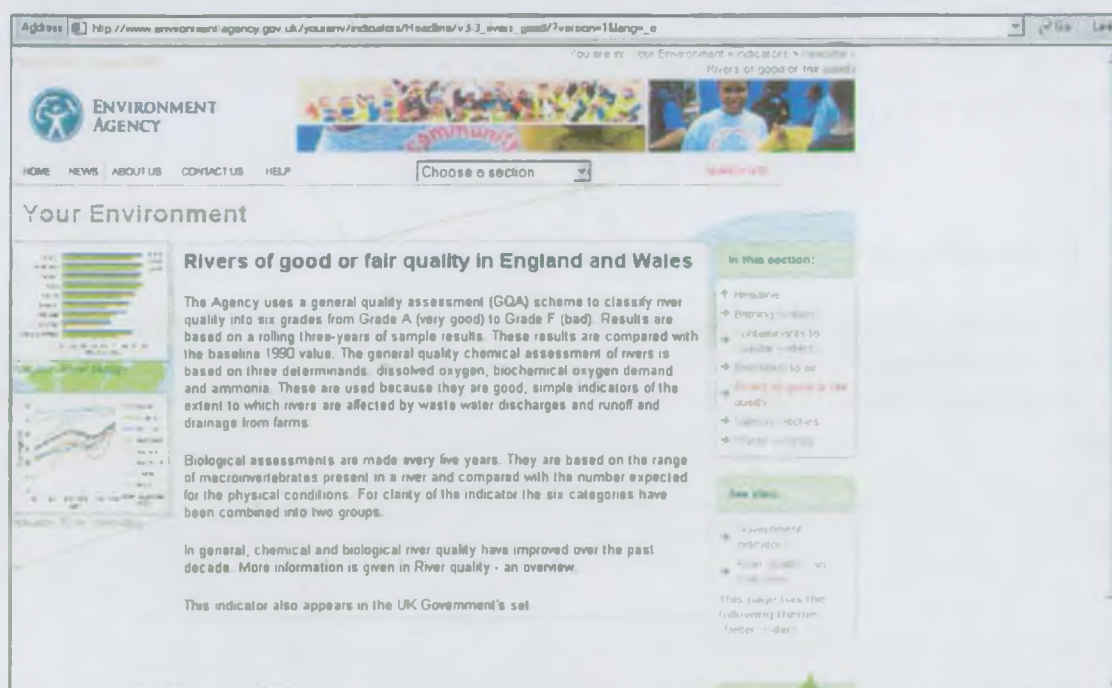


Figure 8.5. The *Rivers of Good or Fair Quality in England and Wales* page of the Environment Agency's Environmental Facts and Figures section of the Environment Agency's Intranet site: [http://www.environment-agency.gov.uk/yourenv/indicators/Headline/v3-3\\_rivers\\_good/?version=1&lang=e](http://www.environment-agency.gov.uk/yourenv/indicators/Headline/v3-3_rivers_good/?version=1&lang=e)



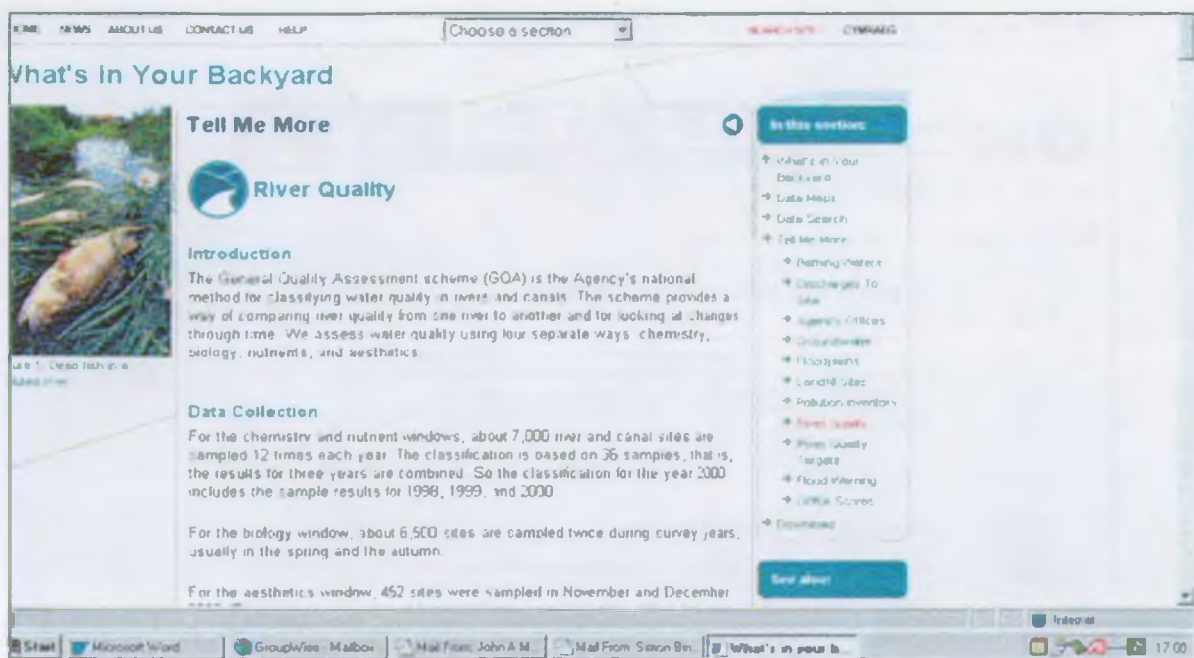


Figure 8.6. The *Tell me More* page of the What's in your Backyard section of the Environment Agency's Intranet site: [http://www.environment-agency.gov.uk/yourenv/indicators/Headline/v3-3\\_rivers\\_good/?version=1&lang=e](http://www.environment-agency.gov.uk/yourenv/indicators/Headline/v3-3_rivers_good/?version=1&lang=e)

DEFRA reported the results in the form of their headline indicator; Environment in Your Pocket (a booklet) and the Digest of Environmental Statistics (which is a web based directory of data).

In addition there was a press release in November 2001.

## 8.2 Regional Reporting in North East Region

Example screens of Biological data provided for NE Region. These databases have been placed on the Regional and office servers on the Group share drive so that all staff can now access the biological data. Also summary data and graphs have also been made available on this drive.

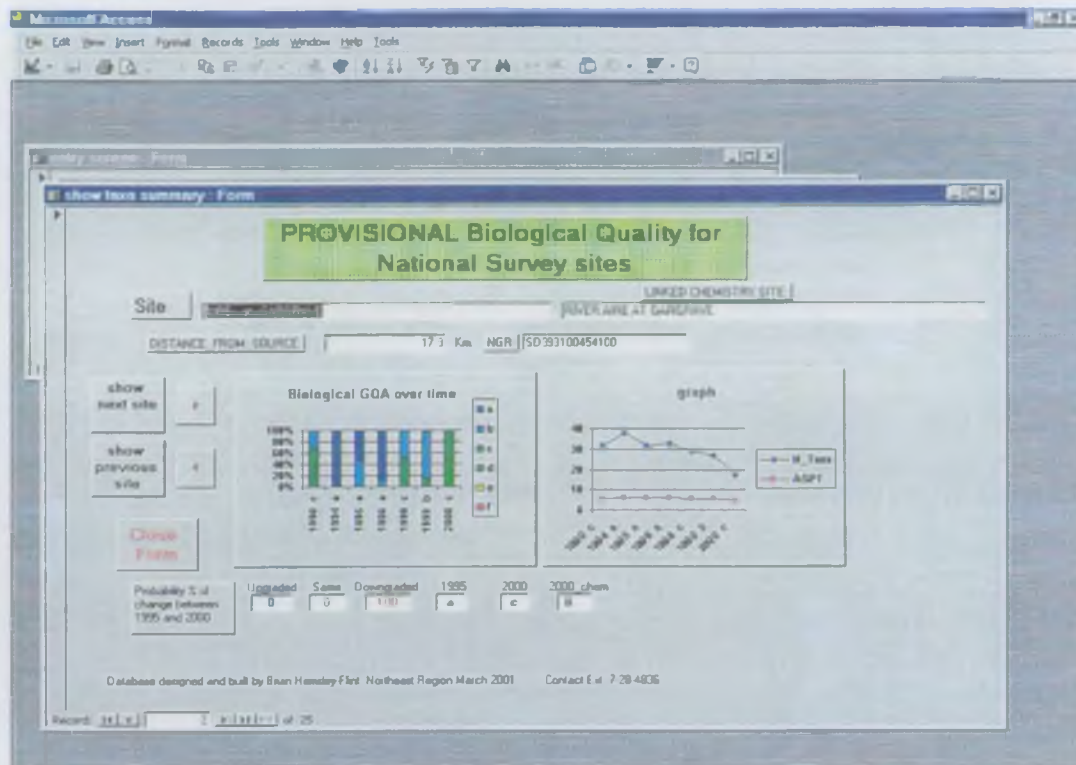


Figure 8.7 Example of database form display of Probability of Grade for each site and the basic biological BMWP data for that site.

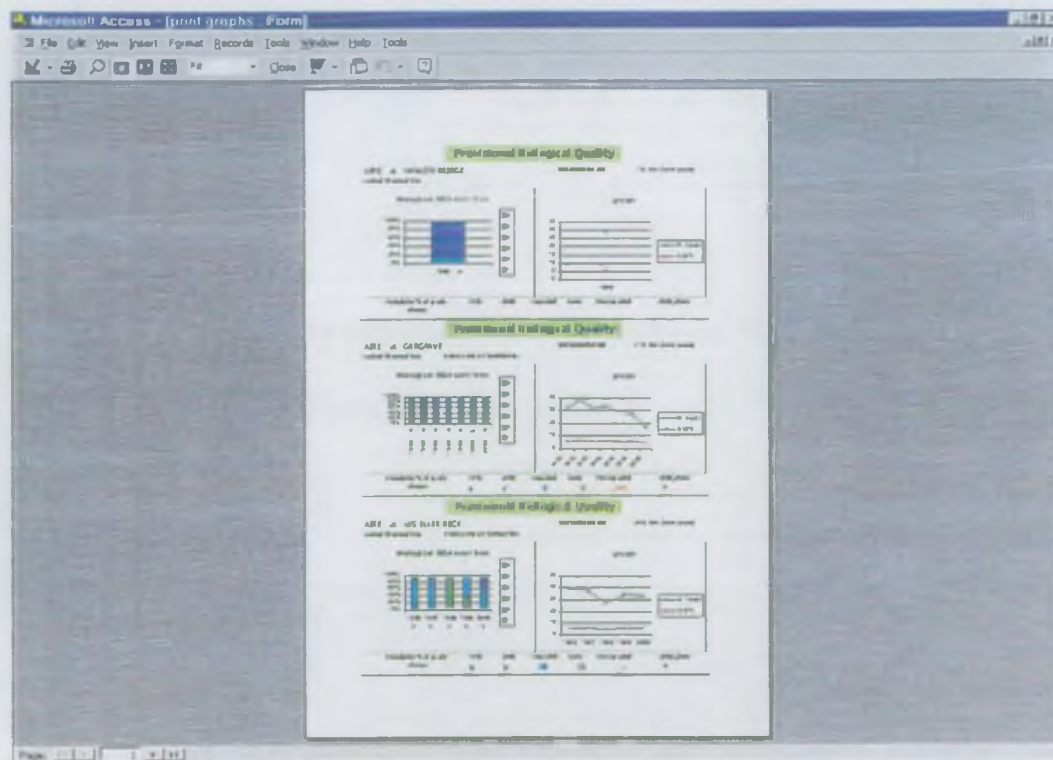


Figure 8.8 Example of print preview page of data for a river



Microsoft Access - [stretch site link 1998 1995 2000]

File Edit View Insert Format Records Tools Window Help Tools

### GQA Stretch sample associations following stretch network review 2001 Version 2

Area:  Stretch length:  1.5 Km

| Year | Site ID  | Site Name  | Site Location |
|------|----------|------------|---------------|
| 1998 | MR100411 | EARLS DYKE | FRAISTHORPE   |
| 1995 | MR100411 | EARLS DYKE | FRAISTHORPE   |
| 2000 | MR100411 | EARLS DYKE | FRAISTHORPE   |
| 2001 | MR100411 | EARLS DYKE | FRAISTHORPE   |
| 2000 | MR100411 | EARLS DYKE | FRAISTHORPE   |

previous record   next record

To view stretches for any one Area use 'filter by form' button then type 'n', 'd', or 'r' in Area box then 'apply filter'

Created by Brian Hemmley - First 21st July 2001 and amended 12th July 2001, further amendments to Northumbria data carried out on 30th July. Please do NOT amend any data. Any enquiries relating to this database, or requests for changes should be directed to Brian on 7-26-4836

Record: 141 of 2532

Figure 8.9 Example of the stretch database showing the audit of sites associated with a particular stretch

Microsoft Access

File Edit View Insert Format Records Tools Window Help Tools

### NE National GQA Results

Biological GQA defined by National with Provisional Regional Grades for comparison

Stretch Code:  River:  The Earls Dyke Stretch:  Earls Dyke North Sea LENGTH:  1.5 Km

Year:  1998  1995  2000

| Year | Site ID  | Site Name  | Site Location | National Grade | Compare Grade | Probability |
|------|----------|------------|---------------|----------------|---------------|-------------|
| 1998 | MR100411 | EARLS DYKE | FRAISTHORPE   | 1              | 1             | 100         |
| 1995 | MR100411 | EARLS DYKE | FRAISTHORPE   | 1              | 1             | 100         |
| 2000 | MR100411 | EARLS DYKE | FRAISTHORPE   | 1              | 1             | 100         |

2000 at least 2 band worse:  14 2000 at least 1 band worse:  55 2000 same grade as 1995:  75 2000 at least 1 band better:  1 2000 at least 2 band better:  1

This form was produced (14th August 2001) by Brian Hemmley - First Phoenix House Ext. 4836

The National and Compare grades were supplied by Greenes Storey, Twickenham. The Provisional Regional grades were produced by Brian Hemmley - First.

Scroll through stretch by stretch or Use 'Filter by Form' to query the data to your specific needs

Record: 141 of 2535

Figure 8.10 Example of the stretch database showing Biological data for the three Quinquennial Biological GQA surveys with the confidence of change between 1995 and 2000

### **8.3 Regional Reporting in Welsh Region**

Individual reports of the results of the 2000 GQA Survey were produced for each catchment by each Area. Examples from Northern and South West Areas are shown in Appendix C and D.



## **9 POST-SURVEY APPRAISAL AND FURTHER USE OF SURVEY RESULTS**

Post-survey considerations have concentrated on four areas:

R&D

Development of GQA surveys

Development of biological quality objectives

### **R&D**

Meeting the needs of the Water Framework Directive is the principal objective for the R&D topic Ecological Monitoring. The 2000 GQA survey results have been considered for use in two projects. One is development of classification and predictions systems based on artificial intelligence methods, developed in previous projects. Funding for this project was not secured until autumn 2002. The work is to be undertaken as an extension to an existing R&D project E1-056 (Diagnosing and Predicting River Health from Biological Survey Data Using Pattern Recognition and Plausible Reasoning). The second is the collation of information about environmental stresses at every biological monitoring site. This has been funded, but was delayed for 18 months because the roll-out of Windows 2000 delayed testing and integration of software developed for collating the information about stresses. Further delays were caused by changes in CIS software strategies. The software has been tested and integrated. At the time of writing, (January 2003) the software was not available to all Areas and this was to be resolved before a request was made to Operations for a Work Instruction for biologists to provide stress information.

Further development of RIVPACS has been proposed for the 2003.04 R&D programme to convert RIVPACS from DOS to Windows. This will remedy the problem of rounding errors causing differences in classification results in the compare module that were described in Section 6.1.

One of the few papers reviewing the lessons learnt from the 2000 GQA survey was produced by Jane Kinniburgh of the Reporting section. This is copied in full in Section 9.1.

### **9.1 GQA Assessment: Policy and R&D Questions to be Answered – paper by Jane Kinniburgh**

This paper was produced by Jane Kinniburgh, Manager, Environmental Assessment and Reporting  
19 December 2001

Reporting of the 2000 GQA survey raised a range of technical issues that need to be addressed. They are listed below with recommendation about how these should be addressed and relative priorities. Highest priorities have been allocated to what needs to be done in order to understand the 2000 survey results and in preparation for the next annual reporting cycle. This list has been compiled by the Environmental Assessment and Reporting team (EAR) with input from the Biology Technical Group, Rivers Group, the National Centre for Environmental Data and Surveillance (NCEDS) and GQA steering group.

#### **HIGHEST PRIORITY ISSUES**

We need to assess the data that has been reported in more depth and in an integrated way. The deterioration in some areas, particularly Wales, seen in 2000 needs to be investigated – can we

identify causes? Suggestions are sheep dips, mine-waters, flood affects, the impact of the 1996-1998 drought, or "searching" around the class boundaries. How much are biology results affected by weather? Some say 1995 was a "particularly good year". These "hypotheses" need testing scientifically

Is there any link between increased nitrate concentrations and biological deterioration in places where nitrate concentrations are low? This question arises out of the observation that Wales had an increase in nitrate concentrations and a decrease in biological quality. Are these two factors linked in any way? Both could be just related to flows (J Murray-Bligh suggests that this could be investigated using the Bayesian Belief Network software. We need to understand this more)

To what extent are the nitrate and phosphate trends due to changes in flows? Should we "normalise" in some way? This could also apply to the chemistry and biology datasets. What would be the benefits / dis-benefits in doing this? Do seasonal results e.g. winter peak nitrate show any trends which could be a better measure? There is another hypothesis that the increasing nitrate concentrations relate to increases in nitrate in the baseflows to rivers. This whole issue needs exploring using the GQA data.

The classification method for nitrate has been adopted as a robust way of looking at trends. There is no direct link between this and the 95 percentile limits of the Directives. This distinction is not well understood and a background paper needs to be written to outline the different needs and approaches.

**Recommended approach, 1-4.** Look at what R&D is currently being done and apply for further R&D funding as necessary to address these issues. (I understand that Southern Region biologists have some R&D in place already which may be relevant. Also NE region have done some drought related R&D. C Extence's LIFE work may also be relevant (contact C Hopper. The National Groundwater Centre is interested in collaborating about the nitrate trends). There is also R&D ongoing re the impact of flows on chemistry GQA). Environmental Assessment team to lead with input from other teams as necessary.

In chemistry and biology GQA, we assess "net improvement" on face value to link in with how classifications are done. This is a difficult "statistic" to explain and was not used in the 2000 press release. What alternatives are there for expressing change at a national level? For example the national wild birds indicators looks at trends in species; it doesn't use grades at all. At what scale do the assumptions in 'net improvement' break down? "Confidence of change" results do not match the net improvement statistics. Face value classifications are used in the data put onto 'In Your Backyard' on the web. Presentation is part of this issue so any R&D would need to include expertise in this.

Statistically significant changes in the nutrients need to be reported. The method needs to be programmed to run automatically on the datasets. A time-series analysis approach may be better than comparing GQA grades. Such could be applied to the other datasets too. (There may still be a need to look at grade changes for planning purposes but indicator development is a different need)

How much could "class boundary" searching (i.e. to-ing and fro-ing between two grades) affect results statistically (for all windows)? Does it really exist? Is it more important at local level than nationally? An R&D report by Ralph Clarke looked at this for biology.

**Recommended approach, 5-7.** Secure R&D funding if needed. NCEDS are already working on the software to report significant nutrient changes. Environmental Assessment team to take lead re drafting specification etc.

The 1990 data for biology need to be adjusted for bias to give a longer-term series for this data set and to allow calculation of statistically significant changes. When this has been done, then the classifications for 1990, 1995 and 2000 and the associated indicator should be expressed using the adjusted data. There are some concerns about the validity of the 1990 data, which needs to be reported with any use of the data.

The three-month lateness of the confirmation of the biology results in 2000 affected the whole of the survey assessment and reporting process. Development work is needed to make sure that the whole process leading to the confirmation of results can be done within six months after sampling. Much of this was due to software problems (see next item) but there is also a need for better validation of data at regional level. There is also a need to get more of the biology data handling processes automated, including the ability to report on any boundary set (linked to item 12 below). A process to rectify 'poor database control' needs to be implemented as part of the development work.

The "Biology for Windows" software needs sorting out. The software needs further verification against the old software and regions need to confirm data before classification software is run. The software must include the mandatory fields required for GQA reporting.

The compare module of RIVPACS does not seem to work consistently. This needs some attention.

**Recommended approach, 8-11** NCEDS to attempt to do 8 by end March 2002; EAR to look at problems re validity of reporting with input from Biology Technical group (but this should not delay the bias-adjustment work).

Item 10: the development of the B4W software is led by the Biology Technical group but there must be input from staff responsible for GQA reporting. Any priorities for fixing the software need to be determined by a client group and need to recognise that indicator reporting is one of the Agency's highest priorities, required by DEFRA. Additional funding may be required to ensure that the issues are fixed.

Item 11: RIVPACS. This would require input from CEH (owners) but need to be managed by someone who understands the issue and needs.

The same river lengths need to be used for chemistry, biology and nutrients. The stretch data need sorting out. This should apply to water quality data for whatever purposes it may be needed (e.g. GQA, RQO, and WFD eventually). It seems that there is some work going on related to the Fish Directive stretches. Maybe these should be combined? (Contact A Nowosielski)

**Recommended approach for 12** NCEDS to lead with input from all regions via the Rivers Group. A project is being scoped in early 2002 which should resolve this issue. Funding is being requested.



More frequent biological sampling is due to start in 2002; one-third of the network each year. By the end of 2004, all sites will have been done which means the first year for GQA indicator reporting will be 2005. There may be a need to report the results of the sampling for 2002 and 2003. How this will be done needs to be considered taking into account technical and political considerations.

**Recommended approach to 13.** There need to be more discussion between Reporting team and the relevant biology group. EMA to make this happen.

#### LOWER PRIORITIES

In Midlands, some of the sites surveyed in 2000 aesthetically were also surveyed in 1995. These need to be compared and the differences accounted for; flooding effects in 2000 should be considered. There may be other regions to which this applies.

Interrogate the aesthetics database and find sites with sewage-related litter problems. How do these relate to the location of CSOs earmarked for improvement in AMP3 where sewage-litter was one of the criteria used to identify sites (i.e. do we expect any of these sites to show an improvement in the next five years)? It could also be used to help inform the AMP4 process.

Investigate the potential of volunteers to assess river aesthetic quality.

**Recommended approach, 14-16.** These investigations to be led by the Aesthetics and Freshwater Scientists at NCEDS. Item 14 will require liaison with the AMP teams in Water Quality who should know how to get this information. Item 15 may be helped by the output of an existing R&D project (E1-101)

The estuary results need to be mapped as stretches, not spots. This should be done so that they can be added to the river maps. (Some regions were surprised at this comment because they do have u/s and d/s NGRs so thought that stretches could be shown easily).

The estuary database needs to include all historic data. It needs to be expanded to include the scores for each element and not just the total score. This would add more information; needed if going to go on the web. Even though there is a lot of criticism with the estuary classification scheme, it is the only one we have despite years of talk of changing it so we must make this information more widely available. (There seems to be some problem over the Severn and Trent data sets which would need to be resolved).

**Recommended approach.** Issues 17 and 18 have been looked at to a certain extent by the Marine scientist at NCEDS. Further progress will require the help of regions.

There is a need for an agreed national reference spreadsheet with AMP investment from 1990 to date, which is available for everyone to use. This does not need details of every scheme but broad expenditure on various categories such as freshwater sewage works, marine works etc.

#### RECOMMENDED APPROACH FOR 19. WATER QUALITY FUNCTION TO CONSTRUCT.

Can we pull out the rivers in NVZs and in Eutrophic Sensitive Areas to assess the trends in these re nitrate and phosphate respectively to show whether policies are making any difference? This may require looking at seasonal data. Land use changes and fertilisers may also be important.

**Recommended approach for 20.** Environmental Assessment to find out what further may need to be done bearing in mind existing on-going work by the group responsible for NVZ and the eutrophication strategy.

Nationally, biology and chemistry results gave similar messages. Are we sure that we need both in such detail? So much resource is put into collecting these two datasets, and probably more than any other EU country. Time to review again? Or leave for the Water Framework Directive work to solve (but are they considering national indicators in this?) There has been much debate about this in the past and the view that biology provides a more holistic measure (the chemistry using only three determinands). Any review would need to take into account other uses of the information at regional and area level. There is so much that we don't report on environmentally and we should be sure that we are using resources wisely. (The data is also used by regions and areas but we still need to be sure that we need to do all this sampling. Risk based sampling may be an alternative approach for solving local issues). ((This seems to be reopening a big can of worms. A lot of defending the monitoring system from water quality for AMP planning and in terms of who is paying for it)

There has been some discussion about how much the one-sample biology results affected the overall picture and whether they should have been included? If not much, as some say, why do we do sampling twice? If this is not the case and we need to sample twice, how could we report with a fifth of sites only having one sample? The answer to this seems to hinge on what level of confidence is acceptable. Investment decisions will need a higher level of confidence that indicator reporting but these two needs should not get mixed in deciding how much to invest in monitoring. There may not be a need to monitor the whole network to the same level of precision. This needs to be taken into account in moving towards the monitoring programmes for the Water Framework Directive.

Is the present macro-invertebrate system for assessing biological quality a valid description of good ecological quality? Presumably the Water Framework Directive team is looking at this but they need to be aware of the existing reporting requirements too and how any reporting systems will relate to each other.

Monitoring for the Water Framework Directive is due to start in Dec 2006 with a report in 2009. How will this affect GQA reporting? One scheme would be ideal but there would be a need to compare with historic reports. This needs to be considered in the planning phase.

There are different approaches to reporting in Scotland, Northern Ireland, England and Wales. Should we proactively try to move towards some commonality? DEFRA lead on UK indicators and would be best placed to drive this. Will the Water Framework Directive act as a driver?

**Recommended approach, 21-25.** These issues need to be taken on board in the planning for the implementation of the Water Framework Directive.

## **9.2 Comparison of biological and chemical results for development of Water Framework Directive Methods**

One of the principal aims of monitoring should be to assist with the development of new methods. The 2000 GQA survey has played its part, particularly as this was the last complete national survey before the development of methods for the Water Framework Directive started.

An example of this use was the map shown in Figure 9.1, which was produced by the National Centre for Data and Surveillance at Twerton. It was based on biological and chemical GQA for the 5-year period 1996-2001. A large proportion of the biological data in this period was from the 2000 survey. Grades a and b were considered to be the closest to "good status" as defined by the Directive, everything else was not. It shows four possible scenarios:

biology good, chemistry good  
biology good, chemistry bad  
chemistry good, biology bad  
chemistry bad, biology bad

The map shows the distribution of these, and gave an interesting insight into the possible causes of not achieving good status in rivers (albeit for these two windows). There were obvious areas where the pressures could be attributed to agriculture, high population density, industry and even where RIVPACS was perhaps not performing as well as it could.

# GQA rivers in England and Wales (1995 & 2000)



Figure 9.1 Comparison of biological and chemical data derived from GQA surveys.



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## **Appendix A Preliminary report from CEH Dorset on the effect of having only spring samples on the results of the survey.**

This report was produced on 4 December 2000.

### **GQA Biological Survey 2000: Consequences of having only Spring biological samples for 2000 because of the Autumn floods.**

Assessment carried out by Ralph Clarke (CEH Dorset) in November 2000 under the Environment Agency's Technical Services Agreement with CEH.

#### **Summary**

*If assessments of site biological quality for one year are based on one single season sample (i.e. Spring) rather than a two seasons combined sample (i.e. Spring and Autumn), then*

- *the 95% confidence limits for the values of the Ecological Quality Indices (EQI), based on RIVPACS O/E ratios of number of BMWP taxa and Average Score Per taxon (ASPT) are, on average, 33-50% wider*
- *the likelihood of detecting a change in EQI value of a particular size as statistically significant (i.e.  $p < 0.05$ ) is less*
- *24-30% fewer sites are detected as having a statistically significant ( $p < 0.05$ ) change in  $EQI_{TAXA}$  or  $EQI_{ASPT}$*
- *larger changes in EQI values are required to have the same power (e.g. 50% or 90%) to detect the changes as statistically significant*
- *for only about two-thirds as many sites would there be high confidence (i.e. with  $> 95\%$  probability) of either an improvement or deterioration in overall GQA grade.*
- *Basing assessments on single season samples therefore mostly makes it more difficult to be very confident that real changes in biological grade have occurred*

#### **1. Introduction**

The widespread very high flows and floods in Autumn 2000 have caused major disruptions to the Autumn programme of taking RIVPACS biological samples. This report summarises an investigation by CEH Dorset (formerly IFE River Lab) to assess the effect of basing assessments of the biological quality of GQA river sites in 2000 on Spring only samples.

The analyses are based on the large subset of 3018 GQA sites used by Clarke *et al* (2000) and Davy-Bowker *et al* (2000) to analyse changes in biological quality between 1990 and 1995. Although the changes in quality between 1995 and 2000 will not be the same as for 1990-95, this dataset enables us to assess the effects of using only one season's samples instead of two on the ability to detect changes in quality of any given size.

For the current study, the 1990 estimates of biological quality for each site were based on the Spring and Autumn 1990 combined season samples. Three methods were used to assess the quality of the sites in 1995:

M1: using Spring and Autumn combined season samples

M2: using Spring season samples only

M3: using the observed, expected and O/E ratios for number of taxa (NTAXA) and ASPT based on the Spring and Autumn combined season samples, but treating them as Spring

only samples in RIVPACS III+ assessments of 95% confidence limits for quality in 1995 and for change in quality and grade.

Method M3 is included because the estimates of quality for a site, uncorrected for bias, will be identical for assessment methods M1 and M3, so any differences in the ability to detect change will be solely due to differences in precision of using only one season compared to two seasons in 1995. The effect of sampling variation on the observed NTAXA and ASPT is greater for single season sample than for two season samples and this is incorporated in RIVPACS III+ simulations of the uncertainty in O/E values.

The region-specific sample processing errors (i.e. the bias = average net under-estimation of number of taxa present in the sample) were the best available estimates for each of 1990 and 1995, derived from the IFE/CEH audit for those years and as used in Clarke *et al* (2000) and Furse *et al* (2000) (Table 1).

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

| Regions in 1990 | Bias in 1990 | Regions in 1995 | Bias in 1995 |
|-----------------|--------------|-----------------|--------------|
| Anglian         | 3.40         | Anglian         | 1.98         |
| Northumbrian    | 2.67         | North East      | 1.45         |
| Yorkshire       | 1.13         |                 |              |
| North West      | 3.13         | North West      | 2.18         |
| Severn-Trent    | 3.77         | Midlands        | 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         |

It must be remembered that using different seasons or combinations of seasons within a year will give different estimates of the quality of a site. Apart from the differences due to errors and uncertainty in estimating site quality by EQIs, the 'true' site qualities of many sites are changing with time. The average value of  $EQI_{TAXA}$  for all sites in 1995 was 0.87 when based on Spring+Autumn combined season samples but only 0.83 when based on Spring samples only; 60% of sites had a lower  $EQI_{TAXA}$  for Spring and only 37% had higher values compared to the Spring+Autumn combined season value. Thus, on average, site quality was slightly poorer in Spring 1995 than later in the year.

## **2. Effect on precision of EQI values**

The width of the 95% confidence limits for  $EQI_{TAXA}$ , as estimated by RIVPACS III+, increases with the estimated 'face' value of  $EQI_{TAXA}$  for all three assessment methods M1-M3 (correlation  $r = 0.75 - 0.84$ ). In contrast, the width of the 95% confidence limits for  $EQI_{ASPT}$  decreases with the estimated value of  $EQI_{ASPT}$  (correlation  $r = -0.61 - -0.45$ ). The width of the 95% confidence limits for  $EQI_{TAXA}$  expressed as a percentage of the estimated 'face' value of  $EQI_{TAXA}$  also decreases with the estimated value (correlation  $r = -0.77 - -0.68$ ). However, the

width of the confidence limits for assessment methods M2 or M3 relative to the corresponding width for assessment method M1 does not depend on the estimated 'face' value of either  $EQI_{TAXA}$  or  $EQI_{ASPT}$  and so may be used to give a single average figure for the relative precision of each assessment method for each of the two EQIs. (Table 2).

**Table 2. Median width of the 95% confidence limits for an EQI value based on each assessment method M1-M3 and the median of the width based on methods M2 or M3 relative to that based on method M1 for the same GQA site in 1995.**

| assessment method | $EQI_{TAXA}$ |                | $EQI_{ASPT}$ |                |
|-------------------|--------------|----------------|--------------|----------------|
|                   | Median width | relative to M1 | Median width | relative to M1 |
| M1                | 0.27         |                | 0.14         |                |
| M2                | 0.41         | 1.50           | 0.20         | 1.42           |
| M3                | 0.36         | 1.32           | 0.18         | 1.33           |

If Spring only samples are used to estimate EQI values their confidence limits are, on average, 33-50% wider than the equivalent confidence limits based on Spring and Autumn combined season samples.

### 3. Effect on detecting changes in EQI values

24-30% fewer sites were detected as having statistically significant ( $p < 0.05$ ) changes in  $EQI_{TAXA}$  or  $EQI_{ASPT}$  between 1990 and 1995 if the 1995 EQI values were assumed to be based on single season (i.e. Spring) samples (i.e. comparing methods M3 and M1 in Table 3)

**Table 3. Percentage of the 3018 GQA sites for which there was a statistically significant ( $p < 0.05$ ) change in  $EQI_{TAXA}$  and  $EQI_{ASPT}$  values between 1990 and 1995 based on assessment methods M1-M3 of estimating biological quality in 1995.**

| assessment method | change in $EQI_{TAXA}$ |        | change in $EQI_{ASPT}$ |        |
|-------------------|------------------------|--------|------------------------|--------|
|                   | worse                  | better | worse                  | better |
| M1                | 5.3%                   | 19.7%  | 1.6%                   | 13.2%  |
| M2                | 8.1%                   | 12.5%  | 2.0%                   | 9.0%   |
| M3                | 3.5%                   | 15.5%  | 1.0%                   | 9.4%   |

The likelihood of detecting a change in EQI value of a particular size as statistically significant (i.e.  $p < 0.05$ ) is less when based on single season (e.g. Spring) samples than when based on two season combined (e.g. Spring+Autumn) samples (Figure 1).

Single season samples give less precise EQI values and hence require larger changes in EQI values to have the same power (e.g. 50% or 90%) to detect the changes as statistically significant (Table 4).

For example, using Spring only samples would only have a high power (i.e.  $> 90\%$ ) of detecting changes as statistically significant for about two-thirds (60-72%) as many sites compared to using Spring+Autumn combined season samples (Table 4).



**Table 4. Minimum sizes of differences ( $D_m$ ) in  $EQI_{TAXA}$  and  $EQI_{ASPT}$  values between 1990 and 1995 which have either at least a 50% or at least a 90% chance (i.e. power) of being detected as statistically significant ( $p < 0.05$ ) for the assessment methods M1-M3 of estimating biological quality in 1995. %sites denotes the percentage of the 3018 GQA sites with bias-corrected differences  $> D_m$  (based on Spring+Autumn combined season samples in both years).**

| assessment method | based on $EQI_{TAXA}$ |        |           |        | based on $EQI_{ASPT}$ |        |           |        |
|-------------------|-----------------------|--------|-----------|--------|-----------------------|--------|-----------|--------|
|                   | 50% power             |        | 90% power |        | 50% power             |        | 90% power |        |
|                   | $D_m$                 | %sites | $D_m$     | %sites | $D_m$                 | %sites | $D_m$     | %sites |
| M1                | 0.20                  | 24.8   | 0.24      | 18.4   | 0.11                  | 16.4   | 0.16      | 7.4    |
| M2                | 0.25                  | 17.3   | 0.30      | 11.2   | 0.14                  | 11.8   | 0.20      | 4.7    |
| M3                | 0.23                  | 21.1   | 0.27      | 14.4   | 0.13                  | 12.0   | 0.20      | 4.7    |

#### **4. Detecting changes in biological grade**

The estimated (termed 'face') overall grade for sites in 1995 will change for some sites according to the season(s) samples involved. If autumn samples were unavailable in 1995 then 25.7% of all sites would have been assigned a lower overall grade, 5.9% a higher grade and only 68.6% the same grade when based on just their Spring 1995 sample (Table 5). This large difference is partly due to the weather conditions in Spring 1995, but also shows the inherent uncertainty in assessing site quality on just one single season sample.

**Table 5. Comparison of overall biological grade for the 3018 sites in 1995 based on Spring sample (method M2) compared to Spring+Autumn combined season samples (method M1).**

| Overall grade based on Spring+Autumn combined sample (M1) | Overall grade based on Spring sample (M2) |      |      |     |     |      | Total |
|---|---|------|------|-----|-----|------|-------|
|   | a   | b    | c    | d   | e   | f    |       |
| a   | 23.5                                      | 7.2  | 0.7  | 0.1 |     |      | 31.5  |
| b   | 4.3                                       | 21.7 | 6.9  | 0.4 | 0.2 |      | 33.4  |
| c   |   | 1.7  | 13.7 | 4.0 | 1.2 | 0.1  | 20.7  |
| d   |   |      | 0.5  | 5.1 | 3.5 | 0.2  | 9.2   |
| e   |   |      |      | 0.3 | 3.0 | 1.2  | 4.5   |
| f   |   |      |      |     | 0.1 | 10.6 | 0.7   |
| Total   | 27.7                                      | 30.6 | 21.7 | 9.8 | 8.0 | 2.2  | 100.0 |

Table 6 shows the percentage of sites which were estimated to have more likely than not (i.e. with  $>50\%$  probability) improved or deteriorated in quality between 1990 and 1995 for each of the assessment methods M1-M3. Because there was some tendency for site quality to be lower in Spring 1995 than throughout the year as a whole, more sites (18.1%) were classed as more likely than not to have gone down in grade based on just their Spring 1995 sample (M2) than when based on the standard (M2) Spring+Autumn combined season sample (8.4%). Method M3, which has the same  $EQI$  values for each site as M1, but assumes they were based on Spring only samples therefore provides a better comparison.

The percentage of sites deemed more likely than not (i.e. with  $>50\%$  probability) to have change overall grade is about the same irrespective of whether the uncertainty in  $EQIs$  was

assumed to be based on Spring only (M3) or Spring+Autumn samples (M1) (Tables 6 and 7). However, using Spring only samples gives only two-thirds as many sites for which we can be very confident (i.e. with >95% probability) that there has been either an improvement or deterioration in overall GQA grade.

Basing assessments on single season samples therefore mostly makes it more difficult to be very confident that real changes in biological grade have occurred.

**Table 6. Percentage of sites which were either downgraded or upgraded in 1995 from 1990 with >50%, >75% or >95% probability for each of the assessment methods M1-M3 for overall grade in 1995.**

| 1995<br>assessment<br>method | downgraded |      |      | same<br>grade | upgraded |      |      |
|------------------------------|------------|------|------|---------------|----------|------|------|
|                              | >95%       | >75% | >50% |               | >50%     | >75% | >95% |
| M1                           | 0.6        | 2.5  | 8.4  | 56.5          | 35.1     | 17.6 | 6.0  |
| M2                           | 1.8        | 7.6  | 18.1 | 55.0          | 26.9     | 11.4 | 3.4  |
| M3                           | 0.4        | 2.3  | 8.3  | 57.6          | 34.0     | 15.6 | 4.1  |

**Table 7. Comparison of the estimated probability of a change in overall GQA grade between 1990 and 1995 between assessment methods M1 (Spring+Autumn) and M3 (Spring only).**

|   |             |        | Probability of change in grade by method M3 |        |        |            |          |        |      | Total |
|---|-------------|--------|---|--------|--------|------------|----------|--------|------|-------|
|   |             |        | downgraded                                  |        |        | same grade | upgraded |        |      |       |
|   |             |        | >95%  | 76-95% | 50-75% |            | 50-75%   | 76-95% | >95% |       |
| Probability of change in grade by method M1 | down graded | >95%   | 0.4   | 0.2    |        |            |          |        |      | 0.6   |
|   |             | 76-95% |   | 1.5    | 0.4    |            |          |        |      | 1.9   |
|   |             | 50-75% |   | 0.1    | 5.2    | 0.6        |          |        |      | 5.9   |
|   | same grade  |        |   |        | 0.6    | 55.1       | 0.7      |        | 56.5 |       |
|   | up graded   | 50-75% |   |        |        | 1.9        | 15.2     | 0.3    |      | 17.5  |
|   |             | 76-95% |   |        |        |            | 2.4      | 9.1    | 0.1  | 11.6  |
|   |             | >95%   |   |        |        |            |          | 2.0    | 4.0  | 6.0   |
|   | Total       |        | 0.4   | 1.9    | 6.0    | 57.6       | 18.4     | 11.5   | 4.1  | 100.0 |

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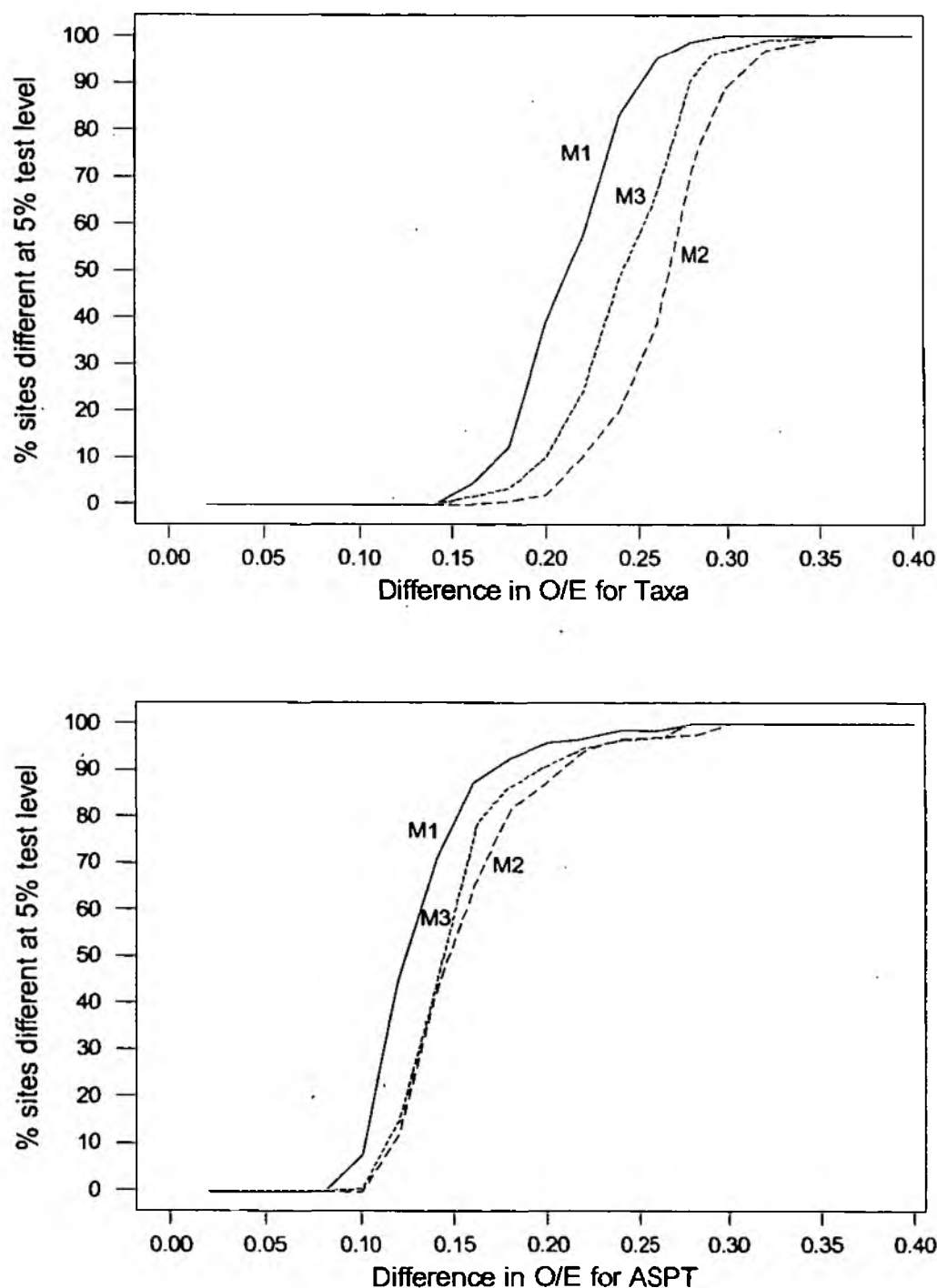
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Figure 1 Percentage of sites with a statistically significant ( $p < 0.05$ ) difference in EQI (i.e. O/E) for (a) number of taxa and (b) ASPT between 1990 and 1995 GQA surveys in relation to the size of the bias-corrected estimated difference for 1995 assessment methods M1, M2 and M3.



**Appendix B Full report from CEH Dorset on the effect of single season samples on the results of the survey**

Note: the pagination has been removed in this project report.

**Single season GQA:  
Effect of using single season as opposed to combined  
spring and autumn samples for biological GQA**

**Assessment carried out by Ralph Clarke (CEH Dorset) in July  
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|                 |                    |
|-----------------|--------------------|
| Project Leader: | R T Clarke         |
| Report to:      | Environment Agency |
| CEH Project No: | C00047             |
| Date:           | July 2001          |



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## SUMMARY

In terms of the original question for this study, we conclude:

- For the GQA sites in 1995, there was no overall tendency for the EQI values based on spring or autumn single season samples to both be less than the EQI value based on their combined season sample.
- There is no systematic tendency for EQI values based on single season samples to be lower than those based on combined season samples

- The increased sampling errors and uncertainty in EQI values based on single season rather than combined season samples can lead to a smaller proportion of sites being assigned to the high quality 'face' grades.
- If trends in river quality from GQA surveys are to be summarised only by reference to the percentages of sites in each 'face' GQA grades then it is important that comparisons between surveys are made on the same number of seasons samples per site.
- In particular, it is recommended that comparisons between the 1995 and 2000 GQA surveys are made using just those sites for which spring and autumn combined season samples were available in both years.
- If it was acceptable for the Environment Agency to summarise trends in river quality from their surveys using estimates of the likelihood of change, then the problem of having differing levels of uncertainty in single season versus combined season sample assessments might be overcome.
- It is recommended that the use of probabilistic assessments of reporting change (available within RIVPACS III+) be investigated.

For most Regions in the 1995 GQA survey, there appears to have been some general tendency for the EQI<sub>TAXA</sub> values to be lower for spring 1995 than for autumn 1995, even after correcting for region-specific sample processing biases. This was investigated.

- An assessment of the differences in average bias between spring and autumn samples across the Regions in 1995 showed that the lower estimated site quality in spring 1995 was not due to higher spring biases (i.e. greater under-estimation of the number of BMWP taxa present)
- There were no major consistent inter-seasonal differences in the size of sample processing errors and average biases for the GQA surveys in either 1995 or 2000.



## 1. INTRODUCTION

In the Environment Agency's General Quality Assessments (GQA) of river quality, the biological assessment is based on two Ecological Quality Indices (EQI). These indices are the ratios (O/E) of the observed (O) to expected (E) values of ASPT and number of BMWP taxa, where the expected values are predicted from RIVPACS (Clarke *et al.* 1997). They are often referred to as EQI<sub>ASPT</sub> and EQI<sub>TAXA</sub>. In the quinquennial national GQA surveys of 1995 and 2000, the aim was to base site assessments on the macroinvertebrate taxa obtained from combining a spring and autumn RIVPACS sample. In RIVPACS "spring" is March-May (including February if necessary), "summer" is June-August, and "autumn" is September-November inclusive.

The widespread very high flows and floods in Autumn 2000 caused major disruptions to the Autumn programme of taking RIVPACS biological samples. For this and other reasons, only a spring or autumn sample was taken at some sites and GQA assessment then must be based on a single season sample. RIVPACS predictions of the expected fauna are both site specific and specific to the season or combination of seasons involved in the observed data.

Preliminary analyses by Phil Smith on a small number of sites in the Agency's Southern Region suggested that EQI values and subsequent GQA grades based on either spring or autumn samples tend to imply poorer biological quality than when based on the combination of those same two samples. The preliminary analyses were on data from only one region and did not allow for the variable effects of adjusting EQI values for sample processing errors, referred to as 'biases' in RIVPACS III+ terminology (Clarke *et al.* 1997). This report summarises an investigation by CEH Dorset (formerly IFE River Lab) to assess the reality and extent of this potential problem and suggests possible remedies, where necessary.

The analyses here are based on the large subset of 6016 sites from the 1995 GQA survey used by Clarke *et al.* (2000), Davy-Bowker *et al.* (2000) and Furse *et al.* (2000) in their analyses and appraisal of the 1995 biological GQA survey and assessments of changes in quality since the 1990 River Quality Survey (RQS).

Sample processing errors lead to some taxa not being recorded when present in the sample (referred to in the CEH audit as "gains") and a generally much smaller number of taxa recorded as present when they are not actually in the sample (referred to as "losses"). The net under-estimation in the number of taxa present in the sample (i.e. "gains" minus "losses") is referred to as the sample processing "bias".

The effect of sample processing errors leading to under-estimation of EQI<sub>TAXA</sub> is likely to be greater for EQI assessments based on single season samples than for those based on two or three season combined samples for the following reasons. In their re-analysis of sample audit data, Furse *et al.* (1995) showed that of the BMWP taxa missed in the sorting and identification process for any one sample, on average, roughly half (49%) are recorded as present in a sample from another season in the same year at the same site. (Roughly two-thirds (63%) of the taxa missed in any one sample are recorded as present in at least one of the samples taken in the other two seasons at the same site.). Thus the net under-estimation in the observed number of taxa in a sample, is on average, the same regardless of whether the sample is a single season sample or a two or three season combined sample. However, both the average observed number of taxa and RIVPACS expected number of taxa are almost always higher for a two (and three) season combined sample than for any one of the single season samples on which the combined season sample is based. Therefore a particular size of bias will lead to less under-estimation of EQI<sub>TAXA</sub> when based on two-season combined samples than when based on single season samples.

As an example, suppose the bias for a Region, Area or laboratory is 2.0 taxa and that the true  $EQI_{TAXA}$  at a site is 0.8 for both single and spring and autumn combined samples. In the spring sample, 20 taxa are expected, 16 are in the sample, giving a true  $EQI_{TAXA}$  value of 0.80; but because of sample processing errors, two taxa are missed, giving a recorded 'face' value  $EQI_{TAXA}$  of 0.70.

In the spring and autumn combined sample, 25 taxa are expected, 20 are in the sample, again giving a true  $EQI_{TAXA}$  value of 0.80. The effect of sample processing errors still leads to missing two taxa present in the combined sample, but now the recorded 'face' value  $EQI_{TAXA}$  is 18/25 or 0.76. Thus if sample processing errors are present but ignored, then the estimated value of  $EQI_{TAXA}$  for a site will tend to be less when based on either a spring or autumn single season samples than when based the same two samples combined. The potential problem identified by Phil Smith may therefore be entirely due to these variations in the effect of ignored biases on  $EQI$  values according to the number of seasons involved.

The effect of sample processing errors on observed ASPT and hence  $EQI_{ASPT}$  is much less clear. Furse *et al.* (1995) found that with average biases of 1-3 taxa, observed ASPT tends to be underestimated by, on average, 0.04, with most errors within  $\pm 0.2$  of the true ASPT for the sample, but occasional errors of up to  $\pm 0.5$ . The relative effect of biases on single season  $EQI_{ASPT}$  compared to spring and autumn season  $EQI_{ASPT}$  are assessed in this report.

The region-specific sample processing errors (i.e. the bias = average net under-estimation of number of taxa present in the sample) were the best available estimates for each region in 1995, derived from the IFE/CEH audit for those years and as used in Clarke *et al* (2000) and Furse *et al* (2000) (Table 1).

**Table 1** Estimates of average net under-estimation of the number of BMWP taxa (termed the bias) in single season samples taken from each NRA/Agency Region in the 1990 RQS and 1995 GQA surveys

| Regions in 1990 | Bias in 1990 | Regions in 1995 | Bias in 1995 |
|-----------------|--------------|-----------------|--------------|
| Anglian         | 3.40         | Anglian         | 1.98         |
| Northumbrian    | 2.67         | North East      | 1.45         |
| Yorkshire       | 1.13         |                 |              |
| North West      | 3.13         | North West      | 2.18         |
| Severn-Trent    | 3.77         | Midlands        | 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         |

It is very important to remember that for any high, medium or low quality river site, its biological quality, however defined, is not constant, but changes over time. Using different seasons or combinations of seasons to represent quality at a site within a year can be expected to give different estimates of the quality of a site. Some of the differences will be due to sampling variation, sample processing errors and uncertainty in estimating site quality by  $EQIs$ , but part may be due to real differences in biological quality between the season(s) involved in the overall sample.

Using a two season combined sample rather than a single season sample is also subtly changing the definition of site quality for the year. If a pollution incident or environmental stress occurs at a previously high quality site in summer, then the spring sample  $EQI$  will be high and the autumn

sample EQI will be much lower. However, the combined spring and autumn sample's observed taxonomic richness will not be so grossly below the RIVPACS expected number of taxa for a combined spring and autumn sample from that type of site because a large proportion of the taxa expected will have been found in the spring sample. This is one potential criticism of using combined season samples.

However, in such situations, we would expect to find spring EQI values greater than combined season EQI values and autumn EQI values less than combined season EQI values. If large regions of the country were subject to flooding or drought in just one season, then we might expect there to be widespread tendency for EQI values in that season to be lower than EQI values obtained for combined season samples which involved that season.

The specific potential problem to be assessed here is whether there is any tendency for the EQI values for BOTH single season samples to be less than the EQI for their combined sample.





## 2. SEASONAL COMPARISON OF EQI VALUES FOR GQA SITES IN 1995

Figure 1 shows the range of differences (single minus combined) between EQI values for single season samples and the equivalent EQI values for the spring and autumn combined season samples at the same 1995 GQA sites. For spring 1995 samples, the median difference in  $EQI_{TAXA}$  was  $-0.03$  both uncorrected and corrected for bias, whilst for autumn 1995 samples the median difference was  $+0.01$  uncorrected and  $+0.02$  corrected for bias (Table 2). This suggests that there may be some minor tendency for  $EQI_{TAXA}$  to be less for spring samples and more for autumn samples than for the spring and autumn combined season sample. The median differences in values of  $EQI_{ASPT}$  was either zero or only  $\pm 0.01$  in all cases, suggest no general tendency for values of  $EQI_{ASPT}$  to be less in single season samples than in spring and combined season samples.

**Table 2** Median difference (single minus combined) between values of  $EQI_{TAXA}$  and  $EQI_{ASPT}$  for spring or autumn single season samples and those for spring and autumn combined season samples for GQA sites in 1995

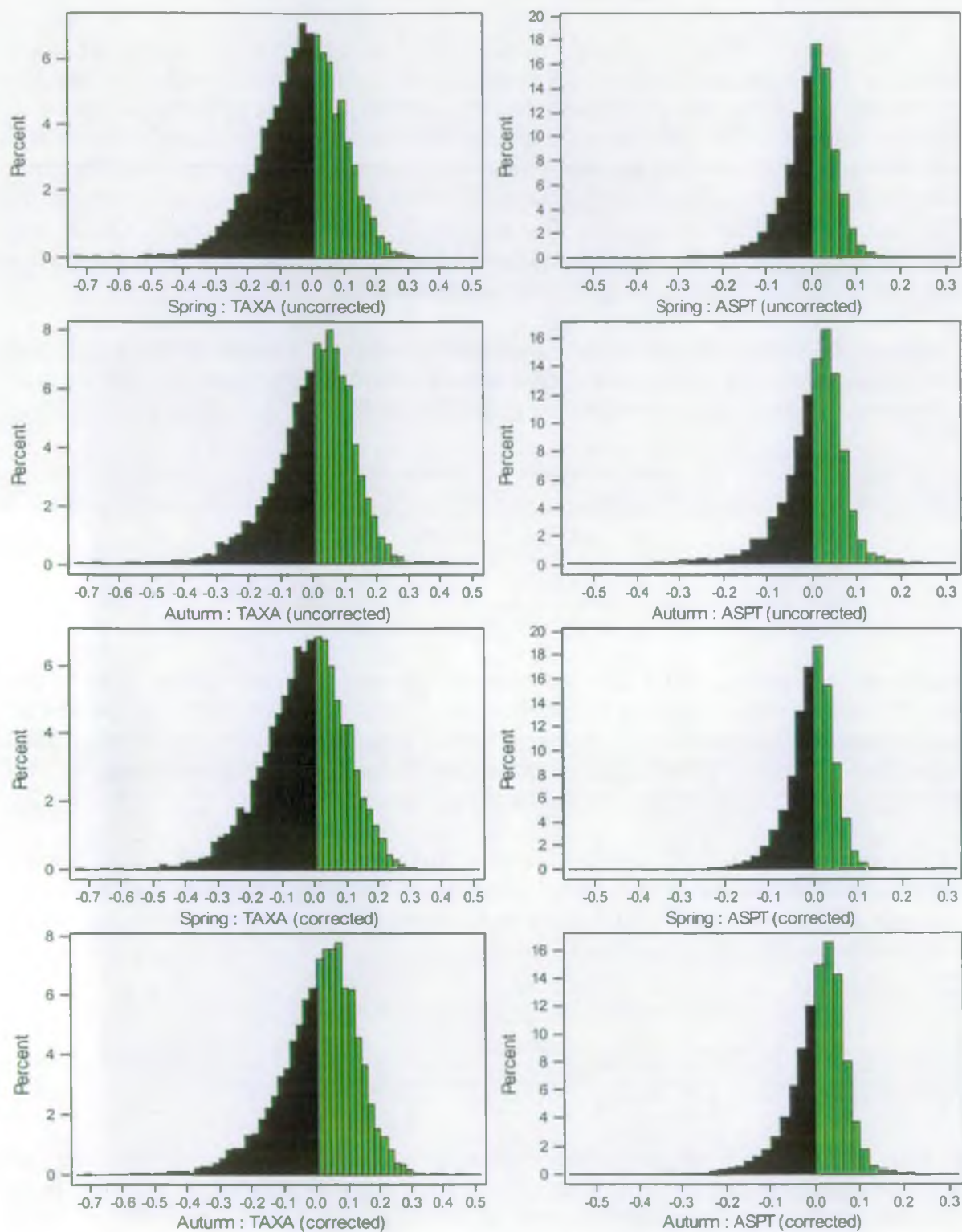
|              | uncorrected for bias |        | corrected for bias |        |
|--------------|----------------------|--------|--------------------|--------|
|              | spring               | autumn | spring             | autumn |
| $EQI_{TAXA}$ | -0.03                | +0.01  | -0.03              | +0.02  |
| $EQI_{ASPT}$ | 0.00                 | +0.01  | -0.01              | +0.01  |

EQI values are recorded by RIVPACS III+ software to only two decimal places. Within this recording precision, up to 4% of sites had no differences in  $EQI_{TAXA}$  between their single season and spring and autumn 1995 combined season sample values; up to 10% of sites had no equivalent differences in values of  $EQI_{ASPT}$ . After excluding these sites, Table 3 shows the percentage of sites for which the single season EQI is less than the combined season EQI.

**Table 3** Percentage of 1995 GQA sites with either spring, autumn or both single season sample EQI values less than the EQI value based on spring and autumn combined samples; both uncorrected and corrected for sample processing biases (excludes sites with no differences in EQI values).

|              | uncorrected for bias |        |      | corrected for bias |        |      |
|--------------|----------------------|--------|------|--------------------|--------|------|
|              | spring               | autumn | both | spring             | autumn | both |
| $EQI_{TAXA}$ | 62                   | 46     | 20   | 60                 | 44     | 18   |
| $EQI_{ASPT}$ | 54                   | 44     | 16   | 56                 | 43     | 17   |

If biological quality at a site had not changed throughout 1995, then merely through sampling and other errors we would expect roughly half of all sites to have a lower EQI value for their single season sample than for their combined season sample. However, roughly 60-62% of sites had lower  $EQI_{TAXA}$  in spring than for the spring and autumn combined season sample, even after correcting all samples for region-specific sample processing biases. In contrast, less than half (44-46%) of the sites had lower values for autumn samples compared to their combined season sample EQI. The pattern for  $EQI_{ASPT}$  is similar but much less dramatic (Table 3).



**Figure 1** Histograms of the difference (single minus combined) between values of  $EQI_{TAXA}$  and  $EQI_{ASPT}$  for spring or autumn single season samples and those for spring and autumn combined season samples for the 1995 GQA sites; values uncorrected and corrected for sample processing biases.

When uncorrected for bias, more than 50% of GQA sites in each Environment Agency region had lower EQI<sub>TAXA</sub> for spring 1995 than for spring and autumn 1995 combined season sample (Table 4). In contrast, in all eight regions, slightly less than half of all GQA sites had lower EQI<sub>TAXA</sub> for autumn 1995 than for the combined season sample. The pattern is less consistent across regions for EQI<sub>ASPT</sub>. Once corrected for bias, the tendency for spring EQI values to be lower and autumn EQI values to be higher remains across most regions for both EQI<sub>TAXA</sub> and EQI<sub>ASPT</sub> (Table 4).

**Table 4** Percentage of 1995 GQA sites in each Region with either spring, autumn or both single season sample EQI values less than the EQI values based on spring and autumn combined samples; both uncorrected and corrected for sample processing biases (excludes sites with no differences in EQI values).

|            | n sites | uncorrected for bias |        |                     |        | corrected for bias  |        |                     |        |
|------------|---------|----------------------|--------|---------------------|--------|---------------------|--------|---------------------|--------|
|            |         | EQI <sub>TAXA</sub>  |        | EQI <sub>ASPT</sub> |        | EQI <sub>TAXA</sub> |        | EQI <sub>ASPT</sub> |        |
|            |         | spring               | autumn | spring              | autumn | spring              | autumn | spring              | autumn |
| Anglian    | 636     | 61                   | 48     | 56                  | 30     | 57                  | 45     | 56                  | 27     |
| North East | 759     | 61                   | 32     | 64                  | 39     | 61                  | 31     | 69                  | 39     |
| North West | 844     | 72                   | 49     | 54                  | 55     | 66                  | 44     | 55                  | 52     |
| Midlands   | 1011    | 68                   | 46     | 64                  | 35     | 67                  | 44     | 66                  | 32     |
| Southern   | 471     | 54                   | 48     | 49                  | 46     | 54                  | 49     | 52                  | 45     |
| South West | 1022    | 53                   | 48     | 45                  | 49     | 52                  | 47     | 49                  | 51     |
| Thames     | 477     | 51                   | 49     | 52                  | 37     | 49                  | 46     | 49                  | 33     |
| Welsh      | 796     | 65                   | 49     | 42                  | 56     | 62                  | 46     | 46                  | 55     |

If there was some tendency for both single season sample EQI to be less than their two season combined sample EQI more than 25% (= 50% X 50%) of sites would be expected to have the EQI values for both spring and autumn samples less than the combined sample EQI. However, 20% or less of the GQA sites in 1995 had lower EQI for both single season samples, where uncorrected or corrected for bias or based on EQI<sub>TAXA</sub> or EQI<sub>ASPT</sub> (Table 5).

**Table 5** Percentage of 1995 GQA sites with spring and/or autumn sample EQI values less than (-) or greater than (+) their spring and autumn combined season sample EQI value (sites with zero differences in values excluded) ; (a) uncorrected and (b) corrected for bias.

| (a)<br>uncorrected<br>for bias |        | EQI <sub>TAXA</sub> |        |    |     |
|--------------------------------|--------|---------------------|--------|----|-----|
|                                |        |                     | autumn |    |     |
|                                |        |                     | -      | +  | all |
|                                | spring | -                   | 20     | 41 | 61  |
|                                |        | +                   | 26     | 13 | 39  |
|                                |        | all                 | 46     | 54 | 100 |

|  |        | EQI <sub>ASPT</sub> |        |    |     |
|--|--------|---------------------|--------|----|-----|
|  |        |                     | autumn |    |     |
|  |        |                     | -      | +  | all |
|  | spring | -                   | 16     | 38 | 54  |
|  |        | +                   | 27     | 19 | 46  |
|  |        | all                 | 43     | 57 | 100 |

| (b)<br>corrected<br>for bias |        | EQI <sub>TAXA</sub> |        |    |     |
|------------------------------|--------|---------------------|--------|----|-----|
|                              |        |                     | autumn |    |     |
|                              |        |                     | -      | +  | all |
|                              | spring | -                   | 18     | 41 | 59  |
|                              |        | +                   | 25     | 16 | 41  |
|                              |        | all                 | 43     | 57 | 100 |

|  |        | EQI <sub>ASPT</sub> |        |    |     |
|--|--------|---------------------|--------|----|-----|
|  |        |                     | autumn |    |     |
|  |        |                     | -      | +  | all |
|  | spring | -                   | 17     | 39 | 56  |
|  |        | +                   | 25     | 19 | 44  |
|  |        | all                 | 42     | 58 | 100 |

## Conclusion:



- In terms of the original question for this study, we conclude:
- There is no overall tendency for both spring and autumn single season sample EQI values to be less than their combined season sample EQI value.

However, there appears to have been some general tend for the  $EQI_{TAXA}$  values to be lower for spring 1995 than autumn 1995, in each region (Table 6). Although not strictly part of this Technical Services research, CEH have tried to follow this up to perhaps get further insights.

**Table 6**      **Percentage of the GQA sites for which the spring 1995 EQI values were less than the autumn 1995 EQI values; both uncorrected and corrected for sample processing biases (excludes sites with no differences in EQI values).**

|                      | $EQI_{TAX}$ | $EQI_{ASPT}$ |
|----------------------|-------------|--------------|
|                      | A           |              |
| uncorrected for bias | 59          | 55           |
| corrected for bias   | 59          | 58           |

There are four possible explanations for these seasonal patterns:

- (i) There was some general tendency for sites across England and Wales to be in slightly poorer condition in spring 1995 than in autumn 1995.
- (ii) RIVPACS has some unforeseen systematic tendency to over- or under- estimate site quality, as represented by EQI values, for particular seasons or combination of seasons.
- (iii) The sample processing errors (biases) in a region are greater for the spring samples processed early in the year than for autumn sample processed at the end of the year. This may be especially true in GQA years where new staff have recently been taken on.
- (iv) The biologists may be less efficient at collecting the raw samples in the field (or river !) in spring than in autumn following months of recent experience. As for (iii), this may be especially true in GQA years where new staff have recently been taken on.

Explanation (ii) is assessed in section 4 by testing it on the RIVPACS reference sites. We cannot assess (iv) as we only have the sample material that was collected. However, in section 5, we have used CEH's database of the primary audit results for each year from 1995 onwards to assess whether biases tend to be greater on average for samples taken in spring than for samples taken in autumn (regardless of when they were sorted and identified).

### 3. SEASONAL COMPARISON OF GQA GRADES FOR GQA SITES IN 1995

In the previous section, it was concluded that there does not appear to be any systematic tendency for both the spring sample and the autumn sample EQI values to be less than their combined season spring and autumn sample EQI values. In this section we check whether there is still any tendency for the GQA grade based on EQI<sub>TAXA</sub> or EQI<sub>ASPT</sub>, or the overall GQA grade to be lower for both single season samples than for the combined season sample.

Table 7 compares the grade of the 1995 GQA sites based on their single season sample (spring or autumn) with their grade based on the spring and autumn combine season sample; both grades uncorrected for sample processing biases. Table 8 gives the equivalent comparison for the grades based on EQI values corrected for region-specific biases.

As an illustrative example, based on their EQI<sub>TAXA</sub>, uncorrected for bias, 54.6% of sites were assigned grade 'a' based on their combined season sample; of which 47.0% were also graded 'a' based on their autumn sample, but 5.9%, 1.5% and 0.2% were graded 'b', 'c' and 'd' respectively based on their autumn sample (Table 7(a)). This highlights one problem which is discussed below.

**Table 7 Comparison of the percentage of 1995 GQA sites assigned to each grade (a-f) based on either their spring or autumn sample compared with their grade based on the spring and autumn combined season sample; grades based on EQI<sub>TAXA</sub>, EQI<sub>ASPT</sub> or the overall GQA grade, all uncorrected for bias.**

| (a) TAXA grade uncorrected     |   | spring |      |      |     |     |     | autumn |      |      |     |     |     | All   |
|--------------------------------|---|--------|------|------|-----|-----|-----|--------|------|------|-----|-----|-----|-------|
| spring<br>+ autumn<br>combined |   | a      | b    | c    | d   | e   | f   | a      | b    | c    | d   | e   | f   |       |
|                                | a | 43.9   | 8.3  | 2.1  | 0.2 | 0.0 | 0.0 | 47.0   | 5.9  | 1.5  | 0.2 | 0.0 | 0.0 | 54.6  |
|                                | b | 3.0    | 5.7  | 4.7  | 1.0 | 0.4 | 0.0 | 4.4    | 7.1  | 3.9  | 0.8 | 0.2 | 0.0 | 16.4  |
|                                | c | 0.0    | 1.8  | 6.2  | 3.4 | 2.0 | 0.2 | 0.1    | 3.2  | 7.3  | 1.9 | 0.9 | 0.1 | 13.6  |
|                                | d | 0.0    | 0.0  | 0.8  | 2.5 | 2.8 | 0.5 | 0.0    | 0.0  | 2.2  | 2.7 | 1.4 | 0.2 | 6.6   |
|                                | e | 0.0    | 0.0  | 0.0  | 0.6 | 3.9 | 2.0 | 0.0    | 0.0  | 0.1  | 1.6 | 3.8 | 1.1 | 6.5   |
|                                | f | 0.0    | 0.0  | 0.0  | 0.0 | 0.2 | 2.1 | 0.0    | 0.0  | 0.0  | 0.0 | 0.3 | 1.9 | 2.3   |
| All                            |   | 46.9   | 17.4 | 13.8 | 7.7 | 9.3 | 4.8 | 51.5   | 16.2 | 15.0 | 7.2 | 6.7 | 3.4 | 100.0 |

| (b) ASPT grade uncorrected     |   | spring |      |      |      |     |     | autumn |      |      |      |     |      | All   |
|--------------------------------|---|--------|------|------|------|-----|-----|--------|------|------|------|-----|------|-------|
| spring<br>+ autumn<br>combined |   | a      | b    | c    | d    | e   | f   | a      | b    | c    | d    | e   | f    |       |
|                                | a | 25.7   | 4.9  | 0.2  | 0.0  | 0.0 | 0.0 | 24.8   | 5.3  | 0.7  | 0.0  | 0.0 | 0.0  | 30.8  |
|                                | b | 6.7    | 18.0 | 5.2  | 0.3  | 0.0 | 0.0 | 6.9    | 17.0 | 5.7  | 0.6  | 0.1 | 0.0  | 30.2  |
|                                | c | 0.1    | 2.6  | 12.8 | 4.2  | 0.4 | 0.0 | 0.1    | 4.2  | 11.8 | 3.3  | 0.6 | 0.0  | 20.0  |
|                                | d | 0.0    | 0.0  | 0.9  | 7.1  | 3.5 | 0.2 | 0.0    | 0.0  | 2.5  | 7.2  | 1.8 | 0.2  | 11.7  |
|                                | e | 0.0    | 0.0  | 0.0  | 0.4  | 4.7 | 1.4 | 0.0    | 0.0  | 0.0  | 1.4  | 4.6 | 0.6  | 6.6   |
|                                | f | 0.0    | 0.0  | 0.0  | 0.0  | 0.0 | 0.6 | 0.0    | 0.0  | 0.0  | 0.0  | 0.2 | 10.5 | 0.7   |
| All                            |   | 32.4   | 25.5 | 19.1 | 12.0 | 8.7 | 2.3 | 31.8   | 26.5 | 20.6 | 12.5 | 7.2 | 1.3  | 100.0 |

| (c) GQA grade uncorrected      |   | spring |                    |      |      |      |     | autumn |      |      |                    |     |     | All   |
|--------------------------------|---|--------|--------------------|------|------|------|-----|--------|------|------|--------------------|-----|-----|-------|
| spring<br>+ autumn<br>combined |   | a      | b                  | c    | d    | e    | f   | a      | b    | c    | d                  | e   | f   |       |
|                                | a | 21.0   | App<br>endi<br>x A | 0.7  | 0.0  | 0.0  | 0.0 | 21.4   | 5.5  | 0.9  | 0.1                | 0.0 | 0.0 | 27.9  |
|                                | b | 4.6    | 18.3               | 6.4  | 0.5  | 0.1  | 0.0 | 5.8    | 16.8 | 6.3  | 0.9                | 0.2 | 0.0 | 29.9  |
|                                | c | 0.0    | 2.1                | 12.3 | 4.7  | 1.6  | 0.1 | 0.1    | 4.0  | 12.0 | 3.7                | 1.0 | 0.1 | 20.8  |
|                                | d | 0.0    | 0.0                | 0.7  | 5.8  | 3.8  | 0.3 | 0.0    | 0.0  | 2.1  | App<br>endi<br>x A | 2.3 | 0.3 | 10.7  |
|                                | e | 0.0    | 0.0                | 0.0  | 0.5  | 5.3  | 2.5 | 0.0    | 0.0  | 0.0  | 1.5                | 5.4 | 1.3 | 8.2   |
|                                | f | 0.0    | 0.0                | 0.0  | 0.0  | 0.2  | 2.1 | 0.0    | 0.0  | 0.0  | 0.0                | 0.3 | 2.0 | 2.4   |
| All                            |   | 25.7   | 26.5               | 20.1 | 11.5 | 11.1 | 5.1 | 27.3   | 26.3 | 21.3 | 12.2               | 9.2 | 3.7 | 100.0 |

**Table 8 Comparison of the percentage of 1995 GQA sites assigned to each grade (a-f) based on either their spring or autumn sample compared with their grade based on the spring and**

autumn combined season sample; grades based on EQI<sub>TAXA</sub>, EQI<sub>ASPT</sub> or the overall GQA grade, all corrected for region-specific bias.

| (a) TAXA grade corrected |   | spring |      |      |      |      |     | autumn |      |      |      |            |     | All   |
|--------------------------|---|--------|------|------|------|------|-----|--------|------|------|------|------------|-----|-------|
|                          |   | a      | b    | c    | d    | e    | f   | a      | b    | c    | d    | e          | f   |       |
| spring + autumn combined | a | 50.9   | 7.5  | 1.8  | 0.3  | 0.1  | 0.0 | 53.7   | 5.0  | 1.7  | 0.1  | 0.0        | 0.0 | 60.6  |
|                          | b | 2.8    | 59.2 | 5.3  | 0.8  | 0.4  | 0.0 | 4.2    | 66.4 | 3.9  | 0.5  | 0.2        | 0.0 | 15.3  |
|                          | c | 0.1    | 1.5  | 58.8 | 2.7  | 2.0  | 0.1 | 0.1    | 2.6  | 69.1 | 1.5  | 1.0        | 0.1 | 12.1  |
|                          | d | 0.0    | 0.0  | 0.8  | 57.7 | 2.8  | 0.4 | 0.0    | 0.0  | 2.3  | 20.1 | 1.3        | 0.1 | 5.8   |
|                          | e | 0.0    | 0.0  | 0.1  | 0.3  | 32.2 | 1.3 | 0.0    | 0.0  | 0.1  | 0.9  | 33.3       | 0.7 | 4.9   |
|                          | f | 0.0    | 0.0  | 0.0  | 0.0  | 0.2  | 1.1 | 0.0    | 0.0  | 0.0  | 0.0  | 0.2        | 1.1 | 1.3   |
| All                      |   | 53.8   | 14.9 | 13.8 | 5.8  | 8.6  | 3.0 | 58.0   | 14.1 | 14.9 | 5.0  | Appendix A | 2.0 | 100.0 |

| (b) ASPT grade corrected |   | spring |      |      |      |      |     | autumn |      |      |      |     |     | All   |
|--------------------------|---|--------|------|------|------|------|-----|--------|------|------|------|-----|-----|-------|
|                          |   | a      | b    | c    | d    | e    | f   | a      | b    | c    | d    | e   | f   |       |
| spring + autumn combined | a | 26.4   | 5.7  | 0.2  | 0.0  | 0.0  | 0.0 | 26.2   | 5.4  | 0.6  | 0.1  | 0.0 | 0.0 | 32.3  |
|                          | b | 6.4    | 18.4 | 5.7  | 0.3  | 0.0  | 0.0 | 7.5    | 17.2 | 5.6  | 0.5  | 0.0 | 0.0 | 30.8  |
|                          | c | 0.0    | 2.2  | 13.7 | 4.0  | 0.3  | 0.0 | 0.1    | 3.8  | 12.9 | 2.9  | 0.6 | 0.0 | 20.3  |
|                          | d | 0.0    | 0.0  | 0.9  | 70.1 | 3.4  | 0.2 | 0.0    | 0.0  | 2.5  | 7.3  | 1.5 | 0.1 | 11.4  |
|                          | e | 0.0    | 0.0  | 0.0  | 0.3  | 39.9 | 0.9 | 0.0    | 0.0  | 0.0  | 1.2  | 3.6 | 0.3 | 5.1   |
|                          | f | 0.0    | 0.0  | 0.0  | 0.0  | 0.0  | 0.1 | 0.0    | 0.0  | 0.0  | 0.0  | 0.0 | 0.1 | 0.1   |
| All                      |   | 32.8   | 26.3 | 20.4 | 11.6 | 7.6  | 1.3 | 33.9   | 26.4 | 21.6 | 11.9 | 5.8 | 0.5 | 100.0 |

| (c) GQA grade corrected  |   | spring |      |      |      |      |     | autumn     |      |      |      |     |     | All   |
|--------------------------|---|--------|------|------|------|------|-----|------------|------|------|------|-----|-----|-------|
|                          |   | a      | b    | c    | d    | e    | f   | a          | b    | c    | d    | e   | f   |       |
| spring + autumn combined | a | 22.3   | 6.9  | 0.4  | 0.0  | 0.0  | 0.0 | 22.8       | 5.8  | 1.0  | 0.0  | 0.0 | 0.0 | 29.6  |
|                          | b | 4.3    | 19.2 | 6.9  | 0.4  | 0.1  | 0.0 | Appendix A | 17.0 | 6.5  | 0.7  | 0.1 | 0.0 | 31.0  |
|                          | c | 0.0    | 1.5  | 12.9 | 4.5  | 1.3  | 0.1 | 0.0        | 3.2  | 12.9 | 3.3  | 0.9 | 0.1 | 20.3  |
|                          | d | 0.0    | 0.0  | 0.6  | 55.6 | 4.3  | 0.3 | 0.0        | 0.0  | 2.0  | 6.4  | 2.2 | 0.1 | 10.8  |
|                          | e | 0.0    | 0.0  | 0.0  | 0.3  | 47.7 | 1.8 | 0.0        | 0.0  | 0.0  | 1.2  | 4.9 | 0.7 | 6.9   |
|                          | f | 0.0    | 0.0  | 0.0  | 0.0  | 0.1  | 1.3 | 0.0        | 0.0  | 0.0  | 0.0  | 0.2 | 1.2 | 1.4   |
| All                      |   | 26.6   | 27.6 | 20.9 | 11.0 | 10.5 | 3.5 | 28.9       | 26.5 | 22.5 | 11.7 | 8.3 | 2.2 | 100.0 |

**Table 9** Percentage of 1995 GQA sites assigned to a higher (+), lower (-) or the same grade (a-f) based on their spring or autumn sample than when based on their spring and autumn combined season sample; grades based on EQI<sub>TAXA</sub>, EQI<sub>ASPT</sub> or the overall GQA grade, uncorrected and corrected for bias.

| TAXA grade uncorrected |      | autumn |      |      |       |
|------------------------|------|--------|------|------|-------|
|                        |      | +      | same | -    | All   |
| spring                 | +    | 1.1    | 2.8  | 2.6  | 6.5   |
|                        | same | 5.0    | 48.9 | 11.9 | 65.8  |
|                        | -    | 5.8    | 18.3 | 3.6  | 27.7  |
| All                    |      | 11.9   | 70.0 | 18.2 | 100.0 |

| TAXA grade corrected |      | autumn |      |      |       |
|----------------------|------|--------|------|------|-------|
|                      |      | +      | same | -    | All   |
| spring               | +    | 1.2    | 2.4  | 2.3  | 5.9   |
|                      | same | 3.8    | 54.2 | 10.6 | 68.5  |
|                      | -    | 5.5    | 16.8 | 3.3  | 25.6  |
| All                  |      | 10.5   | 73.4 | 16.2 | 100.0 |

| ASPT grade uncorrected |      | autumn |      |      |       |
|------------------------|------|--------|------|------|-------|
|                        |      | +      | same | -    | All   |
| spring                 | +    | 2.7    | 5.6  | 2.3  | 10.7  |
|                        | same | 9.4    | 45.7 | 13.8 | 68.9  |
|                        | -    | 3.1    | 14.6 | 2.6  | 20.4  |
| All                    |      | 15.3   | 65.9 | 18.8 | 100.0 |

| ASPT grade corrected |      | autumn |      |      |       |
|----------------------|------|--------|------|------|-------|
|                      |      | +      | same | -    | All   |
| spring               | +    | 2.8    | 5.0  | 2.0  | 9.8   |
|                      | same | 9.5    | 47.2 | 12.8 | 69.5  |
|                      | -    | 2.9    | 15.2 | 2.7  | 20.7  |
| All                  |      | 15.2   | 67.3 | 17.5 | 100.0 |

| GQA grade uncorrected |      | autumn |      |      |       |
|-----------------------|------|--------|------|------|-------|
|                       |      | +      | same | -    | All   |
| spring                | +    | 1.8    | 4.2  | 2.2  | 8.2   |
|                       | same | 8.1    | 41.4 | 15.3 | 64.8  |
|                       | -    | 3.9    | 18.2 | 4.9  | 27.0  |
| All                   |      | 13.8   | 63.8 | 22.4 | 100.0 |

| GQA grade corrected |      | autumn |      |      |       |
|---------------------|------|--------|------|------|-------|
|                     |      | +      | same | -    | All   |
| spring              | +    | 1.5    | 3.6  | 1.6  | 6.7   |
|                     | same | 7.9    | 43.2 | 15.0 | 66.1  |
|                     | -    | 3.3    | 19.0 | 4.9  | 27.2  |
| All                 |      | 12.7   | 65.8 | 21.5 | 100.0 |

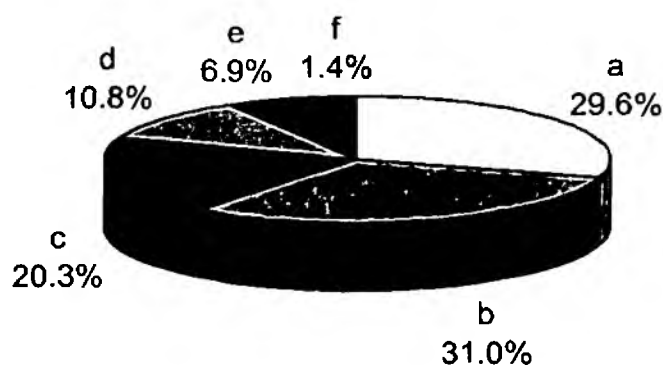
The EQI values used to make any site assessments are prone to greater levels of uncertainty due to the effects of sampling variation, sampling and sampling processing errors when based on one single season sample than when based on a two or three season combined sample. A combined season sample gives a form of averaging and hence is more accurate.

Clarke (2000) showed that using EQIs based on one rather than two seasons samples made it more difficult to be confident of any observed changes in EQI and grade between surveys (as assessed by RIVPACS III+) because of the increased effects of sampling variation.

Thus, even if the true quality of a site had not changed between seasons over a year, a site assessment based on a single season sample would have greater uncertainty. This is not a major problem in terms of EQI values as the EQI is as likely to be above as it is to be below the true value, if the sample was taken correctly. Thus there should be no systematic bias up or down in EQI values because of the use of single rather than combined season samples.

However, if the true quality placed the site in grade 'b', a single season assessment would be more likely than a two or three season combined sample assessment to incorrectly place the site in grade 'a' or 'c' or even lower. If the true quality of a site place it in grade 'a', then errors and uncertainty in the EQI values have different effect on the assigned grade according to whether the EQI value is over- or under-estimated, although over- and under- estimates are roughly equally likely. In such cases, over-estimates (which occur half of the time) have not effect on grade, whereas under-estimates may lead to the site being placed in grade 'b' or lower. At the other extreme of quality, uncertainty in assessments of sites whose true quality is grade 'f' can only lead to the sites being graded correctly or given too high a quality grade. Thus in terms of the overall reporting of the percentage of sites in each grade, uncertainty might not be expected to cause a problem; perhaps "it's all swings and roundabouts".

However, under the Environment Agency's GQA grade system there is a much higher percentage of river sites in grade 'a' than in grade 'f' (Figure 2). Thus across all sites, increased uncertainty due to using single season rather than combined season samples is likely to lead to relative more sites being assigned a lower quality grade. This is seen in Table 9, especially for grade based on EQI<sub>TAXA</sub> both uncorrected and corrected for bias.



**Figure 2** Percentage of 6016 GQA sites in each (bias-corrected) overall biological GQA grade in 1995 (from Clarke *et al.* 2000)

For example, after correcting for bias, only 5.9% of sites had a higher 'face' grade based on their spring EQI<sub>TAXA</sub> compared to their combined season grade, while 25.6% had a lower 'face' grade. Using the autumn EQI<sub>TAXA</sub> values, 10.5% of sites had higher 'face' grades, compared to 16.2% with lower 'face' grades, even though autumn EQI<sub>TAXA</sub> values had no overall systematic tendency to be less than the combined season EQI<sub>TAXA</sub> values (Table 3).



There is also a second separate more important systematic effect resulting from increased uncertainty. This is due to the overall GQA grade being defined as the lower of the two grades based on  $EQI_{TAXA}$  and  $EQI_{ASPT}$ . Increased uncertainty in single sample EQI values will make it more likely that the 'face' grade based on each EQI value is either an over- or under-estimated of the true grade. But because the 'face' overall GQA grade is the lower of the two 'face' grades based on  $EQI_{TAXA}$  and  $EQI_{ASPT}$ , there are, in a sense, two chances to under-estimate the true grade, and each of these two chances will be higher when based on the less precise single season EQI values.

This is shown in the right hand side of Table 9, which compares grades after correcting for bias. Using the autumn sample rather than the spring and autumn combined season sample gave 16.2% and 17.5% of sites a lower 'face' grade when based on  $EQI_{TAXA}$  and  $EQI_{ASPT}$  respectively, but even more (21.5%) had a lower 'face' overall GQA grade compared to that based on their combined season sample.

## Conclusions

- The increased sampling errors and uncertainty in EQI values based on single season rather than combined season samples can lead to a smaller proportion of sites being assigned to the high quality 'face' grades.
- If trends in river quality from GQA surveys are to be summarised only by reference to the percentages of sites in each 'face' GQA grades then it is important that comparisons between surveys are made on the same number of seasons samples per site.
- In particular, it is recommended that comparisons between the 1995 and 2000 GQA surveys is made using just those sites for which spring and autumn combined season samples were available in both years.
- In the freshwater component of CS2000 (Haines-Young et al, 2000), trends in river quality between 1990 and 1998 were summarised by using the probabilistic assessments of uncertainty in RIVPACS III+ to give the percentage of sites which had "more likely than not" (i.e. with probability >50%) and "almost certainly" (i.e. with probability >95%) improved in GQA grade or deteriorated in GQA grade. This approach avoids reporting all the many changes in 'face' GQA grade which are most likely spurious.
- If it was acceptable for the Environment Agency to summarise trends in river quality from their surveys using such probabilistic approach, then the problem of having differing levels of uncertainty in single season versus combined season sample assessments might be overcome.
- It is recommended that this be examined in further detail, but it is beyond the scope of this current small Technical Services contract.

#### 4. INTER-SEASONS COMPARISON OF EQI FOR THE RIVPACS REFERENCE SITES

The best way to assess the existence of any systematic seasonal problems with RIVPACS predictions is to test it on the 614 RIVPACS reference sites which are all supposed to be of high quality and whose reference samples were collected over a range of years. There is no need to correct for sample processing errors as the reference site samples were all processed and the taxa identified by IFE experts assumed to make negligible mistakes.

Approximately half (48%) of the RIVPACS reference sites have lower  $EQI_{TAXA}$  values for spring or autumn samples than when based on their spring and autumn combined season sample. Moreover, roughly one quarter (24%) of reference sites had lower  $EQI_{TAXA}$  for each of the spring and autumn single season samples than for the combined sample; this is exactly as would be expected if there was no systematic seasonal problems with RIVPACS prediction (Table 7). However, slightly more than half (55-58%) of the reference sites had lower  $EQI_{ASPT}$  for spring or autumn single season samples than for their spring and autumn combined season sample and 33% of sites had lower  $EQI_{ASPT}$  for both single season samples. Chi-square tests of independence showed no tendency for reference sites with spring sample EQI less than combined sample EQI to be more likely to also have autumn sample EQI less than combined sample EQI (Chi-square test  $p = 0.34$  and  $0.22$  for  $EQI_{TAXA}$  and  $EQI_{ASPT}$  respectively). The median difference in both  $EQI_{TAXA}$  and  $EQI_{ASPT}$  for the reference sites for single compared to combined season samples was only  $\pm 0.01$ .

**Table 7** Percentage of RIVPACS reference sites with spring and/or autumn sample EQI values less than (-) or greater than (+) their spring and autumn combined season sample EQI value (sites with zero differences in values excluded).

|        | EQI <sub>TAXA</sub> |        |    |     |
|--------|---------------------|--------|----|-----|
|        |                     | autumn |    |     |
|        |                     | -      | +  | all |
| spring | -                   | 24     | 24 | 48  |
|        | +                   | 24     | 28 | 52  |
|        | all                 | 48     | 52 | 100 |

|        | EQI <sub>ASPT</sub> |        |    |     |
|--------|---------------------|--------|----|-----|
|        |                     | autumn |    |     |
|        |                     | -      | +  | all |
| spring | -                   | 33     | 25 | 58  |
|        | +                   | 22     | 20 | 42  |
|        | all                 | 55     | 45 | 100 |

#### Conclusion:

- There is no systematic tendency for EQI values based on single season samples to be lower than those based on combined season samples.



## 5. COMPARISON OF SPRING AND AUTUMN SAMPLE PROCESSING BIASES

Sample processing bias is defined as the net under-estimation of the number of BMWP taxa present in the sample. The CEH database of the results of the continuing CEH primary audit of a proportion of the Environment Agency's samples was used to assess the average sample processing biases for the GQA sites in 1995 and for those in the GQA 2000 survey (Table 8).

In 1995, the average bias for spring samples was not dramatically greater than the average bias for autumn samples in any of the eight Environment Agency Regions. Average bias was higher in spring than in autumn for North West, Midlands and Southern regions, but lower in spring than in autumn for Anglian, South West, Thames and Welsh regions.

**Table 8** Average bias (i.e. net under-estimation of the number of BMWP taxa) for spring and autumn single season samples for each Region in 1995 and 2000; *n* = number of audited samples on which average is based.

|             | 1995         |        |          |        | 2000         |        |          |        |
|-------------|--------------|--------|----------|--------|--------------|--------|----------|--------|
|             | average bias |        | <i>n</i> |        | average bias |        | <i>n</i> |        |
|             | spring       | autumn | spring   | autumn | spring       | autumn | spring   | autumn |
| Anglian     | 1.77         | 2.15   | 24       | 34     | 1.54         | 1.66   | 24       | 32     |
| North East  | 1.45         | 1.43   | 29       | 30     | 0.94         | 1.10   | 36       | 21     |
| North West  | 2.48         | 1.90   | 29       | 31     | 0.75         | 1.08   | 32       | 26     |
| Midlands    | 1.84         | 1.39   | 32       | 28     | 1.51         | 1.25   | 43       | 36     |
| Southern    | 1.69         | 1.19   | 29       | 31     | 1.02         | 0.62   | 58       | 37     |
| South West  | 0.84         | 1.30   | 37       | 23     | 1.61         | 1.43   | 38       | 21     |
| Thames      | 1.53         | 2.03   | 30       | 30     | 2.14         | 2.17   | 28       | 30     |
| Welsh/Wales | 1.54         | 1.91   | 28       | 32     | 1.97         | 1.14   | 30       | 29     |

For the recent GQA 2000 survey, the average bias was roughly the same in both spring and autumn samples for all Regions except Wales, and to a lesser extent Southern Region, for which spring biases were on average slightly higher in spring.

### Conclusions:

- The observed inconsistent pattern of small differences in average bias between spring and autumn samples across the Regions in 1995 is not the cause of the tendency for  $EQI_{TAXA}$  values to be lower in spring 1995 than in autumn 1995.
- There were no major consistent inter-seasonal differences in the size of sample processing errors and average biases for the GQA surveys in 1995 and 2000.



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**Northern Area**  
**2000 General Quality Assessment**

NEAT/02/23  
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## **Dee Rivers**

### **1.0 INTRODUCTION**

The Environment Agency is responsible for water quality monitoring in England and Wales and has a specific duty to do so under the Water Resources Act 1991. The water quality of rivers and canals are classified by the General Quality Assessment (GQA) which provides an assessment of current water quality status and any changes that may have occurred over time. The scheme consists of four separate reporting windows; chemistry, biology, nutrients and aesthetics. The biological monitoring component of the General Quality Assessment (GQA) is carried out once every five years. It is the aim of this report to summarise the findings of the biological assessment carried out in 2000 and to compare quality with that found in 1995.

The results of the 1995 and 2000 biological survey will be presented for each of the river catchments in Wales as defined by LEAPS and an overview of significant changes given. This will provide readily available information on the biological quality of the LEAP areas for Environment Protection and Conservation staff that can aid future targeting of work for area operational purposes. Data for the chemical River Ecosystem (RE) scheme has also been incorporated for information and where necessary to aid in the interpretation of biological results.

A total of 831 sites were sampled in Environment Agency Wales (EAW): 208 sites in North Area, 343 in South East Area and 280 in South West Area. All of these sites were sampled in the Spring (March-May) and due to flooding events, 105 in North area and 5 sites in South East were not able to be sampled in the Autumn (September-November).

This report describes the biological quality of the Dee catchment, North Wales. As the largest single catchment in the region, the Dee has a range of land uses. Agriculture is a main land use throughout the catchment, with arable farming and extensive dairy farming dominating in the Upper and lower reaches of the river catchment. Industry is also an important land-use, especially amongst the main populated areas of Chester, Wrexham, Buckley, Connah's Quay, Flint and Mold. Tourism is also important in the area. The historic town of Chester draws in many visitors, both local and overseas. Llyn Tegid, as Wales' largest freshwater lake attracts many tourists and sailing enthusiasts. Both Llyn Tegid and the Dee Estuary are designated as Ramsar sites, and much of the river is designated as Sites of Special Scientific Interest (SSSI's) or candidate for Special Areas of Conservation (cSACs) due to their wide range of both wetland and riverine habitats. The source of the Dee, Llyn Tegid, lies within Snowdonia National Park.

### **2.0 METHODS**

Each stretch of river (in some cases multiple stretches) has a representative biological and chemical sampling site allocated to it. Although the biological and chemical sites are not necessarily at exactly the same location they are subject to the same water quality, and are as far as possible, not separated by tributaries, discharges or other potential influences on water quality.



Sites were sampled using the standard Institute for Freshwater Ecology (IFE) now the Centre for Ecology and Hydrology (CEH) methodology which involves a three minute kick or sweep sample followed by a one minute marginal search. The samples were then fixed in the field to achieve a final concentration of 4% formaldehyde. At a later date the samples were sorted in the laboratory and macroinvertebrates identified to family level and Biological Monitoring Working Party (BMWP) scores were calculated. The number of different scoring taxa present is recorded as is the average score per taxon (ASPT) which is calculated by dividing the BMWP score by the number of taxa.

The ASPT and number of taxa observed from the samples collected are compared with those expected to be at a site given pristine water conditions. The River Invertebrate Prediction and Classification System (RIVPACS), a mathematical model, is used to predict the invertebrate fauna expected to be present under conditions of good environmental quality using physical data measurements and alkalinity from each site. Results collected from the spring and autumn samples are combined to take account of seasonal variations. The biological quality of a river is expressed as a ratio of the actual value from the sampling compared with that predicted. This is known as the Environmental Quality Index (EQI) and is calculated for both the number of taxa and the ASPT. A sample with an EQI of 1 or more has a similar number of taxa or ASPT to that expected under conditions of natural water quality. Biological grades are based on the EQI values set out in Table 1 below. The lower of the grades is assigned to a site, if they differ for the two indices.

**Table 1. Biological Grading Scheme**

| Grade           | EQI for ASPT | EQI for Taxa | Outline description   |
|-----------------|--------------|--------------|---|
| A - Very good   | 1.00         | 0.85         | Biology similar/better than expected. High diversity of taxa, usually with several species in each.   |
| B - Good        | 0.90         | 0.70         | Biology falls slightly short of expected. Small reduction in the number of taxa that are sensitive to pollution and moderate increase in the number that are tolerant to pollution. |
| C - Fairly good | 0.77         | 0.55         | Biology worse than expected. Many sensitive taxa absent/reduced in number. Marked increase in tolerant taxa.  |
| D - Fair        | 0.65         | 0.45         | Sensitive taxa scarce and sparse numbers. A range of pollution tolerant taxa, some with high numbers of individuals.  |
| E - Poor        | 0.50         | 0.30         | Sensitive taxa rare/absent. Dominated by tolerant taxa.   |
| F - Bad         | <0.50        | <0.30        | Restricted to a small number of very tolerant taxa, present in very high numbers. In the worst case, there may be no life present.  |

Chemical information has been based on the data obtained from the chemical River Ecosystem (RE) class and compliance with these. The RE class for 1995 and 2000 are based on the sampling years 1993-1995 and 1998-2000 respectively. Definitions of the RE grading scheme are summarised in Table 2 below.

**Table 2: Chemical River Ecosystem Grading Scheme**

| RE Class | Description  |
|----------|--|
| RE1      | Water of very good quality suitable for all fish species               |
| RE2      | Water of good quality suitable for fish species                        |
| RE3      | Water of fair quality suitable for high class coarse fish populations  |
| RE4      | Water of fair quality suitable for coarse fish populations             |
| RE5      | Water of poor quality which is likely to limit coarse fish populations |

### 3.0 RESULTS AND DISCUSSION

The Dee LEAP area is split into four main areas, the Dee Estuary, Lower Dee, Middle Dee and Upper Dee. A total of 83 sites were sampled in the spring but only 27 in the autumn of 2000 because of flooding in the Dee catchment.

The results of the 2000 survey compared to those obtained during 1995 are presented in Appendix 1, results of RE classifications for water quality have also been included in Appendix 1 for information. Figures 1(a-d) illustrate the sites surveyed and comparisons between biological quality in 1995 and 2000.

Reasons behind any changes have been based on comparison with chemical data, examination of taxon lists and local knowledge.

#### 3.1 SITES INDICATING BIOLOGICAL UPGRADES SINCE 1995

Thirteen sites in the Dee LEAP area showed an upgrade in biological class, one significantly (>95%) (Table 3).

**Table 3: Summary of Upgrades Recorded for the Dee LEAP area**

| SITE REF. | RIVER NAME        | SITE NAME         | Class 1995 | Class 2000 | Change in Class | % Prob of change in class |
|-----------|-------------------|-------------------|------------|------------|-----------------|---------------------------|
| N129      | Aldford           | At Aldford        | c          | b          | +1              | 72                        |
| N236      | Alyn / Alun       | At B5102 Rosset   | c          | b          | +1              | 80                        |
| N143      | Black Brook       | At Penyffordd St  | d          | c          | +1              | 25                        |
| N125      | Dee               | At Iron Bridge    | c          | b          | +1              | 52                        |
| N126      | Dee               | At Farndon        | d          | a          | +3              | 100                       |
| N131      | Isycoed Brook     | U/S Wych Brook    | b          | a          | +1              | 59                        |
| N258      | Worthenbury Brook | D/S Isycoed Brook | c          | b          | +1              | 16                        |
| N132      | Dee               | At Corwen         | b          | a          | +1              | 72                        |
| N201      | Glyn              | Llangower         | b          | a          | +1              | 47                        |
| N204      | Lliw (Dee)        | At Pen-y-Bont     | b          | a          | +1              | 27                        |
| N192      | Llynor            | At Hendre         | b          | a          | +1              | 70                        |
| N182      | Medrad            | U/S Ceirw         | b          | a          | +1              | 35                        |
| N173      | Morlas Brook      | D/S Glyn Morlas   | b          | a          | +1              | 64                        |

NB: Significant % change in class highlighted in red

The Dee at Farndon showed a significant increase in biological grade of three biological classes from 'd – fair' to 'a – very good'. Scores from this site in 1995 seem particularly low compared with 1990 and 2000. The 2000 score is higher than in previous years which could be related to the change in sampling technique. Prior to the 2000 survey this site was sampled using a sweep net. In 2000 a dredge was used to obtain the sample, this should have obtained a more representative sample than the sweep which is more difficult. In contrast with biological quality, the stretch failed the RQO targets in 2000 for both BOD and Dissolved oxygen.

Twelve other sites showed non-significant upgrades in biological class. This could be due to the uncertainty brought about by using only one seasons (spring) data for comparisons with 1995.

### 3.2 SITES INDICATING BIOLOGICAL DOWNGRADES SINCE 1995

36 downgrades in biological class were recorded in the Dee LEAP area, 14 of which were significant (Table 4).

Table 4: Summary of Downgrades Recorded for the Dee LEAP area

| SITE REF. | RIVER NAME        | SITE NAME            | Class 1995 | Class 2000 | Change in Class | % Prob of change in |
|-----------|-------------------|----------------------|------------|------------|-----------------|---------------------|
| N247      | Sandycroft Drain  | At Hawarden Castle   | C          | d          | -1              | 68                  |
| N209      | Wepre Brook       | Civic Centre         | B          | c          | -1              | n/a                 |
| N252      | Aldford           | At Lea Hall          | B          | c          | -1              | 65                  |
| N133      | Alyn / Alun       | At Fagl Lane         | B          | c          | -1              | 87                  |
| N135      | Alyn / Alun       | At Llong             | A          | c          | -2              | 99                  |
| N136      | Alyn / Alun       | At Lead Mills        | B          | c          | -1              | 100                 |
| N138      | Alyn / Alun       | At Loggerheads       | A          | c          | -2              | 100                 |
| N255      | Alyn / Alun       | At Ithel's Bridge    | B          | c          | -1              | 94                  |
| N257      | Alyn / Alun       | At Gwersyllt Park    | A          | b          | -1              | 98                  |
| N250      | Caldy Brook       | At Huntingdon        | D          | e          | -1              | 38                  |
| N163      | Black Brook       | At Erddig Park       | B          | c          | -1              | 55                  |
| N144      | Nant Brook        | At Pont Blyddyn      | D          | e          | -1              | 61                  |
| N139      | Nant Y Felin      | Ffrwd                | A          | b          | -1              | 93                  |
| N189      | Nug               | U/S Ceirw            | B          | c          | -1              | 81                  |
| N146      | Worthenbury Brook | At Worthenbury       | C          | e          | -2              | 99                  |
| N147      | Worthenbury Brook | Sam Bridge           | B          | c          | -1              | 99                  |
| N172      | Ceiriog           | U/S Teirw            | A          | c          | -2              | 97                  |
| N162      | Clywedog (Dee)    | AT Five Fords Bridge | A          | d          | -3              | 99                  |
| N164      | Clywedog (Dee)    | U/S Gwenfro          | A          | b          | -1              | 94                  |
| N179      | Cyflymen Brook    | At Llangollen        | A          | b          | -1              | 46                  |
| N153      | Dee               | At Bangor On Dee     | A          | b          | -1              | 95                  |
| N245      | Dee               | At Erbistock         | A          | b          | -1              | 81                  |
| N176      | Eitha             | At Ruabon            | B          | c          | -1              | 98                  |
| N167      | Gwenfro           | Croes Newydd         | D          | e          | -1              | 86                  |
| N260      | Shell Brook       | U/S Kilhendre Brook  | A          | c          | -2              | 100                 |
| N175      | Teirw             | U/S Ceiriog          | A          | c          | -2              | 99                  |
| N177      | Tref-y-Nant Brook | D/S Monsanto         | B          | c          | -1              | 87                  |
| N178      | Tref-y-Nant Brook | At Acrefair          | A          | d          | -3              | 100                 |
| N193      | Ceidiog           | AT Llandrillo        | A          | b          | -1              | 83                  |
| N187      | Ceirw             | U/S Nug              | A          | b          | -1              | 54                  |
| N159      | Dee               | At Llandderfel       | A          | b          | -1              | 75                  |
| N200      | Gelyn             | Ty Nant              | A          | b          | -1              | 94                  |
| N195      | Hirnant           | Garth Goch           | A          | b          | -1              | 80                  |
| N198      | Mynach (Dee)      | U/S Tryweryn         | A          | b          | -1              | 82                  |
| N262      | Tryweryn          | US Llyn Celyn        | A          | b          | -1              | 80                  |
| N203      | Twrch (Dee)       | U/S Dee              | A          | c          | -2              | 100                 |

NB: Significant % change in class highlighted in red

#### Dee Estuary

Only 2 sites in this area were downgraded. Both Sandycroft Drain at Hawarden Castle and Wepre Brook at the Civic Centre were non-significantly downgraded by one biological class. The downgrade at Werpe Brook may have been due to intermittent pollution from Castle Hill farm. These problems have now been resolved.

#### Lower Dee

14 sites on the Lower Dee were downgraded, 6 significantly.



The Alyn had six sites downgraded, 4 of which were significant. The Upper catchment was investigated in 1999 for signs of pollution (NEAT/99/TM28). This survey showed that no sites were categorised as 'polluted' but a few sites showed signs of mild, diffuse pollution, expected in an area so intensively farmed. At several of these sites a sewage smell was noted at the time of sampling. The quality of the fishery in the Alyn has remained poor (NEAT/99/TM04). There was no decrease in water quality or RQO that would explain further the reduction in biological quality.

Worthenbury Brook had two sites decreasing in biological class significantly. Both sites (N146 @ Worthenbury and N147 @ Sam Bridge) showed an RQO failure for BOD and the site at Sam Bridge (N147) also failed the RQO target for NH<sub>3</sub>. Changes in biological quality can reflect changes in water chemistry which is heavily influenced by agriculture. Diffuse agricultural pollution may be the cause of the water quality decline.

The Aldford at Lea Hall (N252) also showed a drop in biological class of one grade (not significantly). There is no obvious reason for this change in biological quality, especially as the site downstream (N129 Aldford @ Aldford) increased by one biological class. The biological, nutrient and sediment quality of Aldford Brook was investigated in 1999 (NEAT/99/TM08). In this survey the biological quality was better at the upstream site, in contrast to the 2000 GQA Survey results. The reasons for the moderate/low biology for the Aldford catchment was determined to be due to numerous factors, with low summer flows in the Brooks and falling groundwater levels contributing mainly. Neither of the sites on the Aldford were sampled in Autumn 2000.

#### Middle Dee

12 sites on the Middle Dee were downgraded, 7 significantly.

The Ceiriog U/S Teirw (N172) was degraded significantly by two biological classes. This site was not sampled in Autumn 2000. The Teirw U/S of the Ceiriog (N175) was also significantly downgraded by 2 biological classes from 1995.

Two sites on the Afon Clywedog were downgraded in biological class, one significantly (N162 @ Five Fords Bridge, significant downgrade of 3 biological classes & N164 U/S Gwenfro). The Clywedog water quality has also decreased with significant decreases in pH and fluctuating dissolved oxygen levels. It is thought that the significant decrease in biological quality on the Clywedog is due to Five Fords STW storm overflows. Since the 2000 GQA survey a fish kill occurred at this site causing damage to the biology of the watercourse which was attributed to the storm overflow (NEAT/02/18). Neither of these sites were sampled in Autumn 2000.

The Main River Dee at Bangor-on-Dee (N153) was downgraded significantly by one biological class. There is no obvious reason for this downgrade however high flows were experienced during Autumn sampling.

The Eitha at Ruabon (N176) was downgraded significantly by one biological class. There was no obvious reason for this downgrade although water chemistry quality declined also with reductions in both pH and dissolved oxygen.

Shell Brook U/S Kilhendre Brook (N260) was significantly downgraded by two biological classes from 1995. This stretch of the river also failed RQO targets for BOD and dissolved oxygen. Both spring and autumn samples were greatly reduced in quality compared with those in 1995, in the past agricultural pollution has been attributed to water quality issues at this site. Further investigation should be carried out to adequately determine the reason for this decline.

Tref-y-Nant Brook had two sites downgraded in biological class. The site at Acrefair (N178) was significantly downgraded by 3 biological classes, which could partly be attributed to a change in sample site. The site D/S Monsanto (N177) was non-significantly downgraded by 1 biological class. Neither of these sites were sampled in Autumn 2000 which may also account for the decrease in biological quality grades.

#### Lower Dee

8 sites on the Lower Dee were downgraded from 1995, one significantly.

The Twrch U/S Dee (N203) was significantly downgraded by 2 biological classes. There is a history of sheep-dip pollution causing problems in this area (EAN/98/TM03, EAN/97/TM13, NEAT/98/TM34, NEAT/99/TM27). The latest of these reports showed that although the Upper Twrch was recovering biological quality, the Lower Twrch still showed signs of impact from pesticides. Further investigation into this continued problem should be carried out.

### 3.3 CONTINUED LOWER THAN EXPECTED BIOLOGICAL QUALITY IN 1995 & 2000

Some biological quality however has remained as fairly good to poor (Table 5).

**Table 5: Summary of Continued Poor/fairly good Biological Quality between 1995 & 2000**

| SITE REF. | RIVER NAME        | SITE NAME            | Class 1995 | Class 2000 | Change in Class |
|-----------|-------------------|----------------------|------------|------------|-----------------|
| N248      | Finchetts Gutter  | D/S A540             | e          | e          | n/a             |
| N246      | Sandycroft Drain  | At B5129             | d          | d          | n/a             |
| N128      | Caldy Brook       | At Huntingdon Road   | e          | e          | n/a             |
| N123      | Dee               | Chester              | e          | e          | n/a             |
| N124      | Dee               | At Heronbridge       | c          | c          | n/a             |
| N253      | Golborne Brook    | At Milton Green      | c          | c          | n/a             |
| N254      | Golborne Brook    | At Tatternhall       | c          | c          | n/a             |
| N251      | Henlake Brook     | At B5130 Road Bridge | c          | c          | n/a             |
| N131      | Pulford Brook     | At Pulford           | c          | c          | n/a             |
| N149      | Worthenbury Brook | Higher Wych          | c          | c          | n/a             |
| N161      | Clywedog (Dee)    | At Pickhill Bridge   | c          | c          | n/a             |
| N165      | Clywedog (Dee)    | At Erddig Park       | c          | c          | n/a             |
| N166      | Gwenfro           | At King Mills        | d          | d          | n/a             |
| N184      | Alwen             | Pont Yr Alwen        | d          | d          | n/a             |

NB: Significant % change in class highlighted in red

Fourteen sites in the Dee LEAP area showed continued poor / fairly good quality.

#### Dee Estuary

Both Finchetts Gutter and Sandycroft Drain run through industrial areas and may be affected surface water drainage. They are both slow moving watercourses with poor habitat limiting the diversity found.

#### Lower Dee

Caldy Brook runs through farmland before entering the Dee in Chester. The combination of agricultural diffuse pollution and urban pollution / runoff serve to keep the biological quality of the watercourse low.

The Dee at Chester runs through the centre of the city and is therefore subject to diffuse urban pollution and runoff. The sample site is also relatively slow moving, deep and silted therefore the diversity is not expected to be high.

**Middle Dee**

The Gwenfro at Kings Mill is subjected to both urban drainage and impacted from nearby CSO's and so maintains a low biological Quality.

**Upper Dee**

The Alwen arises from Alwen Reservoir which is surrounded by forest. The biological quality of the watercourse maintains a low quality due to the acidic nature of the area and the deposition of peat from the reservoir.



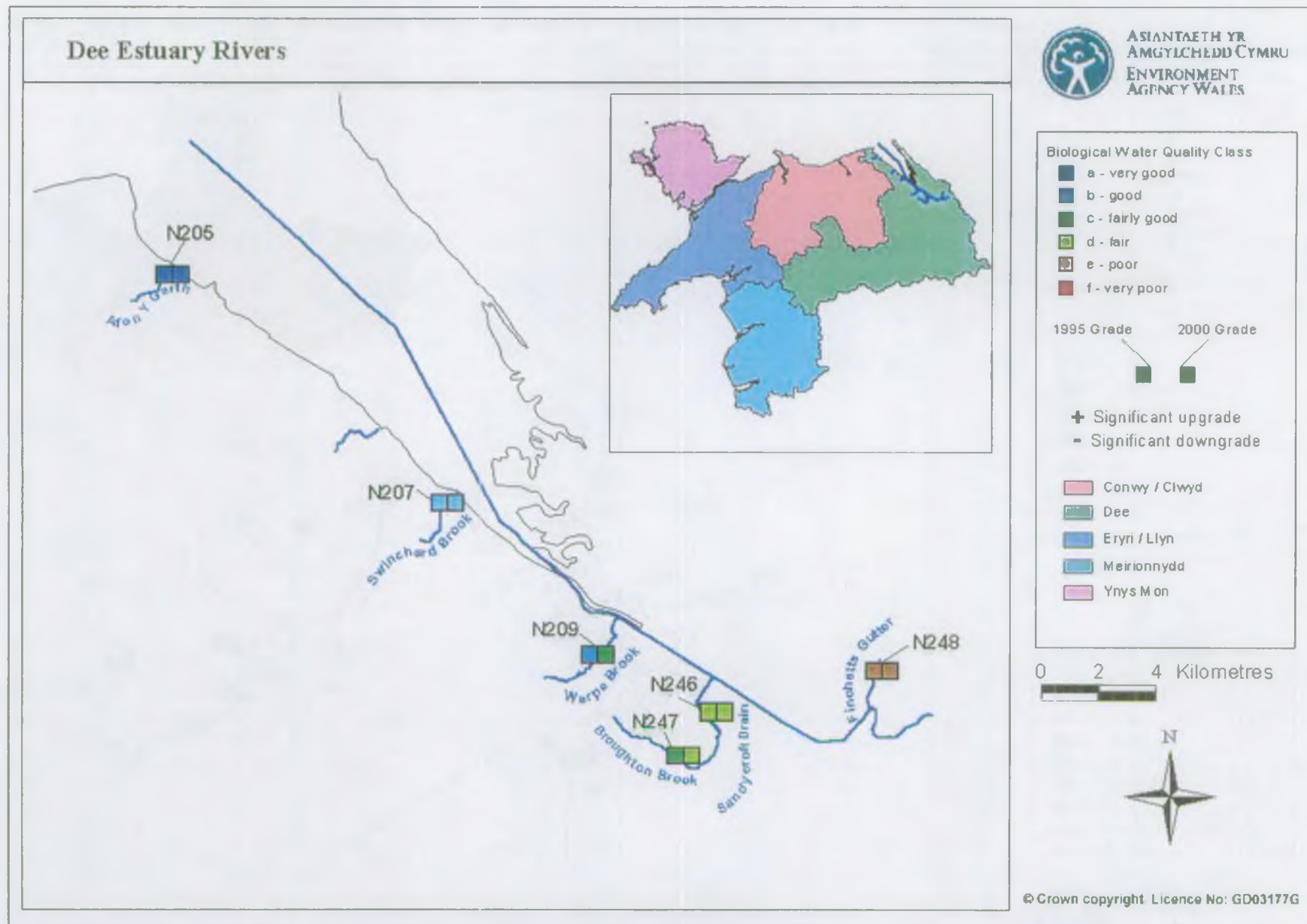


Figure 1a Dee Estuary Area surveyed and comparison between 1995 and 2000 scores.



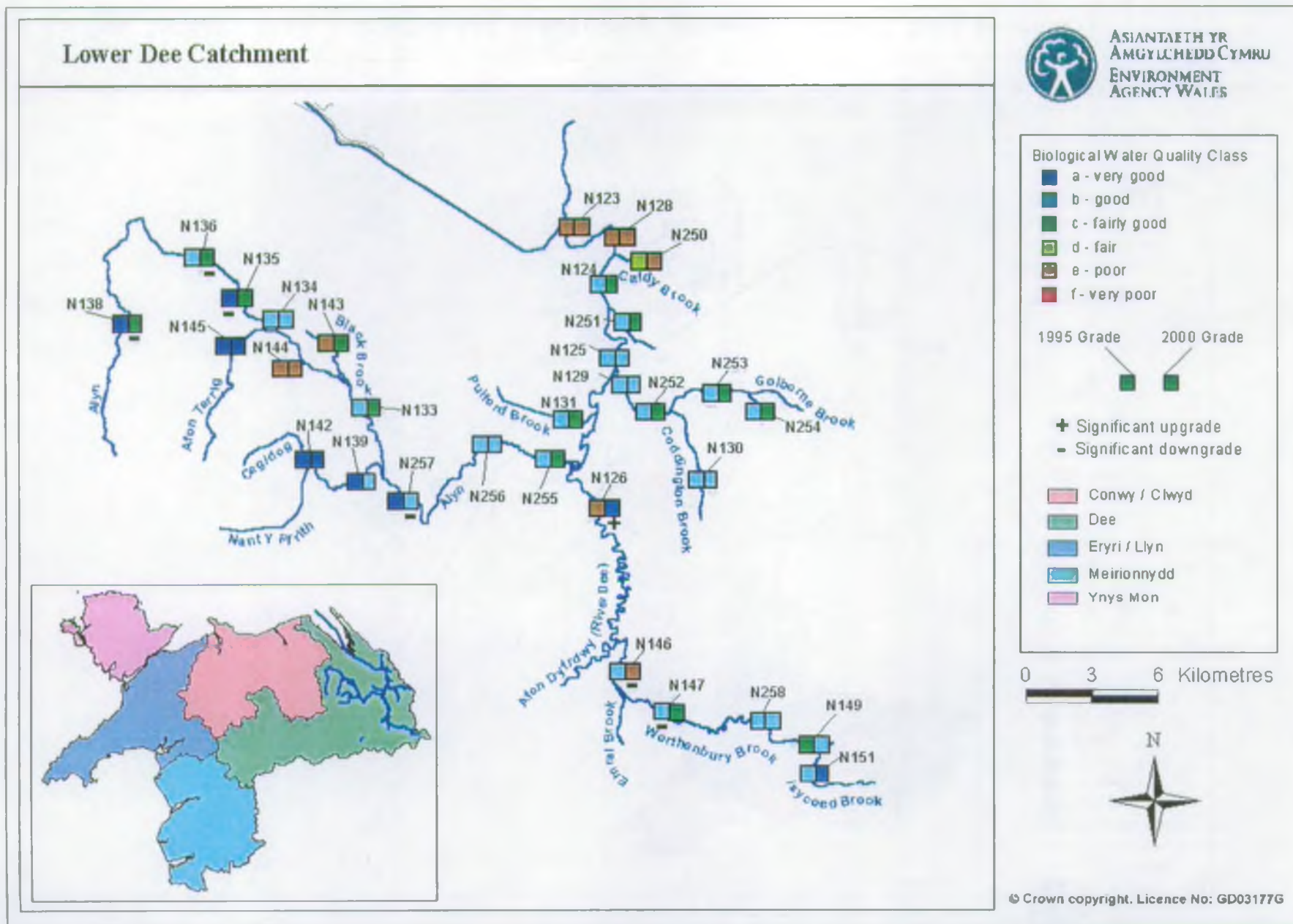


Figure 1b Lower Dee Area surveyed and comparison between 1995 and 2000 scores.







## 4.0 CONCLUSIONS

In summary the rivers in the Dee LEAP area have deteriorated slightly in biological quality since 1995. Quality within the catchment is fair with 84% of sites classified as 'fairly good' or above. Many of the significant detrimental changes in biological quality within the Dee catchment can largely be explained.

## 5.0 RECOMMENDATIONS

- Further biological investigation into the continued low biological quality of the Afon Twrch (Dee).
- Investigation to determine the reason for the low biological and water quality of Shell Brook.
- Investigation into the low biological quality of Tref-y-Nant Brook.
- Further investigation into the low biological quality of the Alyn (Dee).
- Further investigation into the low biological quality of the Afon Clywedog (Dee) in relation to Five Fords STW storm overflow.

## 6.0 REFERENCES

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## **Appendix D Example of Welsh 2000 GQA survey catchment report: The Afan and Kenfig Catchments**

South West Area  
2000 General Quality Assessment

Tech memo:TMW02\_18  
Author: Graham Rutt  
Date: 20<sup>th</sup> June 2002

### **Biological quality of the Afan and Kenfig Catchments (1995 & 2000)**

#### **1.0 INTRODUCTION**

The Environment Agency is responsible for water quality monitoring in England and Wales and has a specific duty to do so under the Water Resources Act 1991. The water quality of rivers and canals is classified by the General Quality Assessment (GQA) which provides an assessment of current water quality status and any changes that may have occurred over time. The scheme consists of four separate reporting windows: chemistry, biology, nutrients and aesthetics. The biological monitoring component of the GQA is carried out once every five years.

The results for 2000 have been reported nationally (see 'Rivers and Estuaries - a decade of improvement, Environment Agency Wales, 2002) but there is a need to examine the Welsh data more closely as changes since 1995 have been detrimental. There has been an overall 22% decline in quality since 1995 in Wales contrasting with a 4% improvement for England and Wales combined, and an improvement of 28% in Anglian region. The decline in biological quality in Wales is matched by a 5% decline in GQA chemical quality compared with improvements of at least 10% in every other Agency Region since 1995. These changes reverse improvements in quality seen between 1990 and 1995.

Figures for Southwest area show that out of 290 sites sampled for biological quality 39 (13%) were upgraded by one or more grades whilst 86 (30%) sites were downgraded. Of these changes 4 of the upgrades and 19 of the downgrades were statistically significant. The most marked declines in quality are in the Ogmore, Afan, Kenfig, Neath, Rheidol and Ystwyth. The reasons for the changes have been discussed with the relevant Environment Protection Officers. The downgrades appear to arise from a number of causes with sewage and industry related problems dominating in the Eastern catchments. In the more rural areas, acidification, diffuse agricultural pollution including sheep dip impacts and sampling problems related to high flows are likely factors.

This report describes the biological quality of the Afan and Kenfig catchments. The upper part of the Afan catchment is mountainous and heavily forested and there are areas of base poor geology principally the Pennant measures. These factors make the upper catchment susceptible to acidification. There are further water quality problems associated with acid mine drainage and colliery spoil. Further down the catchment there are issues associated with urban waste water. The Kenfig has minewater discharges in the upper reaches and pollution issues associated with agriculture and urbanisation in the middle and lower reaches. Davies (1996) previously summarised quality in these catchments following the 1995 GQA survey.

Chemical data from the River Ecosystem (RE) classification scheme is included to aid in interpretation of the biological data

## 2.0 METHODS

Each stretch of river (in some cases multiple stretches) has a representative biological and chemical sampling site allocated to it. Although the biological and chemical sites are not necessarily at the exact same location they are subject to the same water quality, and are as far as possible, not separated by tributaries, discharges or other potential influences on water quality.

Biological samples were collected in both spring (March-May) and Autumn (September-November) using the standard Environment Agency Methodology as detailed in BT001. This consists of a three minute kick or sweep sample with a pond net followed by a one minute active search. Sampling effort is split between different habitat types (eg riffle, water-plants, tree root systems) in proportion to the prevalence of each habitat type at the site. The samples were then fixed in the field to achieve a final concentration of 4% formaldehyde. At a later date the samples were sorted in the laboratory and macroinvertebrates identified to family level and Biological Monitoring Working Party (BMWP) scores were calculated. The number of different scoring taxa present is recorded as is the average score per taxon (ASPT) which is calculated by dividing the BMWP score by the number of taxa. Data were stored on the national biological database, Biology for Windows

The River Invertebrate Prediction and Classification System (RIVPACS), a mathematical model, uses physical data measurements and alkalinity from each site to predict the invertebrate fauna expected to be present at each site under conditions of good environmental quality. Predictions are made for biotic indices derived by pooling the invertebrate taxa found in both spring and autumn samples. The biological quality of a river is expressed as a ratio of the actual value from the sampling compared with that predicted. This is known as the Environmental Quality Index (EQI) and is calculated for both the number of taxa and the ASPT. A sample with an EQI of 1 or more has a similar number of taxa or ASPT to that expected under conditions of natural water quality. Biological grades are based on the EQI values set out in Table 1 below. The lower of the grades is assigned to a site, if they differ for the two indices.

**Table 1. Biological Grading Scheme**

| Grade           | EQI for ASPT | EQI for Taxa | Outline description   |
|-----------------|--------------|--------------|---|
| A - Very good   | 1.00         | 0.85         | Biology similar/better than expected. High diversity of taxa, usually with several species in each.   |
| B - Good        | 0.90         | 0.70         | Biology falls slightly short of expected. Small reduction in the number of taxa that are sensitive to pollution and moderate increase in the number that are tolerant to pollution. |
| C - Fairly good | 0.77         | 0.55         | Biology worse than expected. Many sensitive taxa absent/reduced in number. Marked increase in tolerant taxa.  |
| D - Fair        | 0.65         | 0.45         | Sensitive taxa scarce and sparse numbers. A range of pollution tolerant taxa, some with high numbers of individuals.  |
| E - Poor        | 0.50         | 0.30         | Sensitive taxa rare/absent. Dominated by tolerant taxa.   |
| F - Bad         | <0.50        | <0.30        | Restricted to a small number of very tolerant taxa, present in very high numbers. In the worst case, there may be no life present.  |

The RE classes for 1995 and 2000 are based on sampling in the years 1993-1995 and 1998-2000 respectively. Grades are calculated using data from monthly samples analysed for Biochemical Oxygen Demand (BOD), total ammonia, unionised ammonia, dissolved oxygen (%saturation) dissolved copper and total zinc. Definitions of the RE grading scheme are summarised in Table 2 below.

TABLE 2: CHEMICAL RIVER ECOSYSTEM GRADING SCHEME

| RE Class | Description  |
|----------|--|
| RE1      | Water of very good quality suitable for all fish species               |
| RE2      | Water of good quality suitable for fish species                        |
| RE3      | Water of fair quality suitable for high class coarse fish populations  |
| RE4      | Water of fair quality suitable for coarse fish populations             |
| RE5      | Water of poor quality which is likely to limit coarse fish populations |

### 3.0 RESULTS AND DISCUSSION

A total of 14 sites were sampled in both the spring and autumn of 2000 in the Afan and Kenfig catchments.

The results of the 2000 survey compared to those obtained during 1995 are presented in Appendix 1, results of RE classifications for water quality have also been included in Appendix 1 for information. Figure 1 illustrates the sites surveyed and comparisons between biological quality in 1995 and 2000.

Reasons behind any changes have been based on comparison with chemical data, examination of taxon lists and local knowledge.

#### 3.1 SITES INDICATING BIOLOGICAL UPGRADES SINCE 1995

Upgrades occurred at one site in the Afan catchment and at one on the Kenfig (See Table 3 below).

Table 3: Summary of Upgrades Recorded for the Afan and Kenfig catchments

| SITE REF. | RIVER NAME         | SITE NAME                         | Class 1995 | Class 2000 | Change in Class | % Prob of change in class |
|-----------|--------------------|-----------------------------------|------------|------------|-----------------|---------------------------|
| W034      | NANT IORWETH GOCH  | CROWN ROAD                        | b          | a          | +1              | 63                        |
| W044      | PELENNNA GWENFFRWD | U/S CONFLUENCE WITH BLAENPELENNNA | e          | c          | +2              | 100                       |

NB: Significant % change in class highlighted in red

The Gwenffrwd upstream of the Blaenpeleenna (W044) improved from class 'e' to class 'c'. The upgrade is highly significant (100% probability of a real change) and has arisen due to the installation of minewater treatments systems to treat the 3 principal discharges of minewater which had previously been affecting the Gwenffrwd. The fauna has still not achieved 'Good' quality (ie class 'b' or above) due to intermittent poor operation of the treatment systems and background acidification although compliance with RE class 1 has now been achieved and a healthy trout population was present in 2000 and 2001. Latest sampling undertaken in spring 2002 indicates a marked decline in quality due to the latest problems with the treatment systems on the Gwenffrwd.

The improvement on the Iorweth Goch (Site W034) was only 63% certain but was matched by a clear decline in the amount of ochre at the site since 1995. However sampling in spring 2002 indicates that there are now considerable quantities of ochre at the site once again. Short-term changes in iron-rich discharges from Aberbaiden mine and the Parc Slip open-cast will account for this variability. The failure to achieve RE 1 class in 2000 due to high ammoniacal nitrogen and BOD may relate to a CSO upstream of the sampling site.



### 3.2 SITES INDICATING BIOLOGICAL DOWNGRADES SINCE 1995

Seven biological downgrades were recorded in the Afan and Kenfig catchments of which three were significant at the 95% level of confidence (see Table 4 below for details).

Table 4: Summary of Biological Downgrades Recorded for the Loughor & Llan catchments

| SITE REF | WATERCOURSE | SITE NAME           | Class 1995 | Class 2000 | Change in class | % Prob of change in class |
|----------|-------------|---------------------|------------|------------|-----------------|---------------------------|
| W030     | KENFIG      | BSC INTAKE          | b          | c          | -1              | 98                        |
| W032     | KENFIG      | PYLE BRIDGE         | a          | c          | -2              | 100                       |
| W035     | AFAN        | DOCK INTAKE         | a          | b          | -1              | 52                        |
| W038     | AFAN        | ARGOED COUNTRY PARK | a          | c          | -2              | 98                        |
| W039     | AFAN        | AT CYMMER AFAN      | b          | c          | -1              | 68                        |
| W040     | FFRWYDWYLLT | PORT TALBOT         | a          | b          | -1              | 40                        |
| W046     | CORRWG      | CYMMER AFAN         | b          | c          | -1              | 62                        |

NB: Significant % probability of change in class highlighted in red

There were two highly significant downgrades on the Kenfig. The downgrade at the BSC intake (W034) from 'b' to 'c' may relate to discharges from industrial estates upstream. The downgrade at Pyle Bridge (W032) from 'a' to 'c' matches a significant failure to achieve RE class 1 based upon BOD and ammonia.

Only one of the 4 downgrades in the Afan catchment was statistically significant - the decline for the site at Afan Argoed (W038) from 'a' to 'c' with 98% probability. The downgrades on the Afan at the Dock Intake (W035) and at Cymmer Afan (W039) had associated probabilities of 52% and 68% respectively. Similarly the probability for the downgrade on the Corrwg (W046) from 'b' to 'c' was only 62%. There is no clear explanation for any of these downgrades though the Afan and Corrwg are highly erosive and the high flows prior to sampling may have had a marked impact on the fauna. Surface water acidification certainly affects some of the tributaries in the catchment but is unlikely to have a major impact on the main river Afan.

There is no clear explanation for the downgrade on the Ffrwydwyllt (W040) from 'a' to 'b' but level of certainty here was only 40%.

### 3.3 CONTINUED POOR/MODERATE BIOLOGICAL QUALITY IN 1995 & 2000

Table 5: Summary of Continued Poor/Moderate Biological Quality between 1995 & 2000

| SITE REF | WATERCOURSE   | SITE NAME                     | Class 1995 | Class 2000 |
|----------|---------------|-------------------------------|------------|------------|
| W376     | BLAENPELENNNA | U/S CONFLUENCE WITH GWENFFRWD | c          | c          |

The Blaenpelenna above the Gwenffrwd confluence has maintained class 'c' between 1995 and 2000. Using the GQA methodology, there is thus no clear evidence of an improvement in quality arising from the Garth Tonmawr treatment system.. Intermittent problems with effluent quality and possibly background acidification continue to suppress the fauna, although more detailed examination of the data from 2001 indicates that certain taxa most notably the mayfly *Ephemerella*

*ignita* have recolonised the Blaenpelenna following the installation of the system and there is now a healthy population of trout (Von Reibnitz, 2002).

#### 4.0 CONCLUSIONS

The Afan and Kenfig catchments as a whole show a decline in quality compared to 1995 with 7 out of 14 sites showing downgrades, there being only two upgrades.

There is no clear explanation for the downgrades on the Afan catchment or that on the Ffrwydwyllt.

3. The downgrade on the Kenfig at Pyle Bridge (W032) most likely relates to farm pollution.

Maintenance of the wetland treatment systems on the Gwenffrwd and Blaenpelenna needs to be improved if sustained improvements in biological quality are to be achieved.

#### 5.0 RECOMMENDATIONS

A programme of farm visits should be undertaken on tributaries of the Kenfig above Pyle bridge in order to trace the sources of organic pollution. Targeting of visits using rapid biological assessment would assist if resources allow.

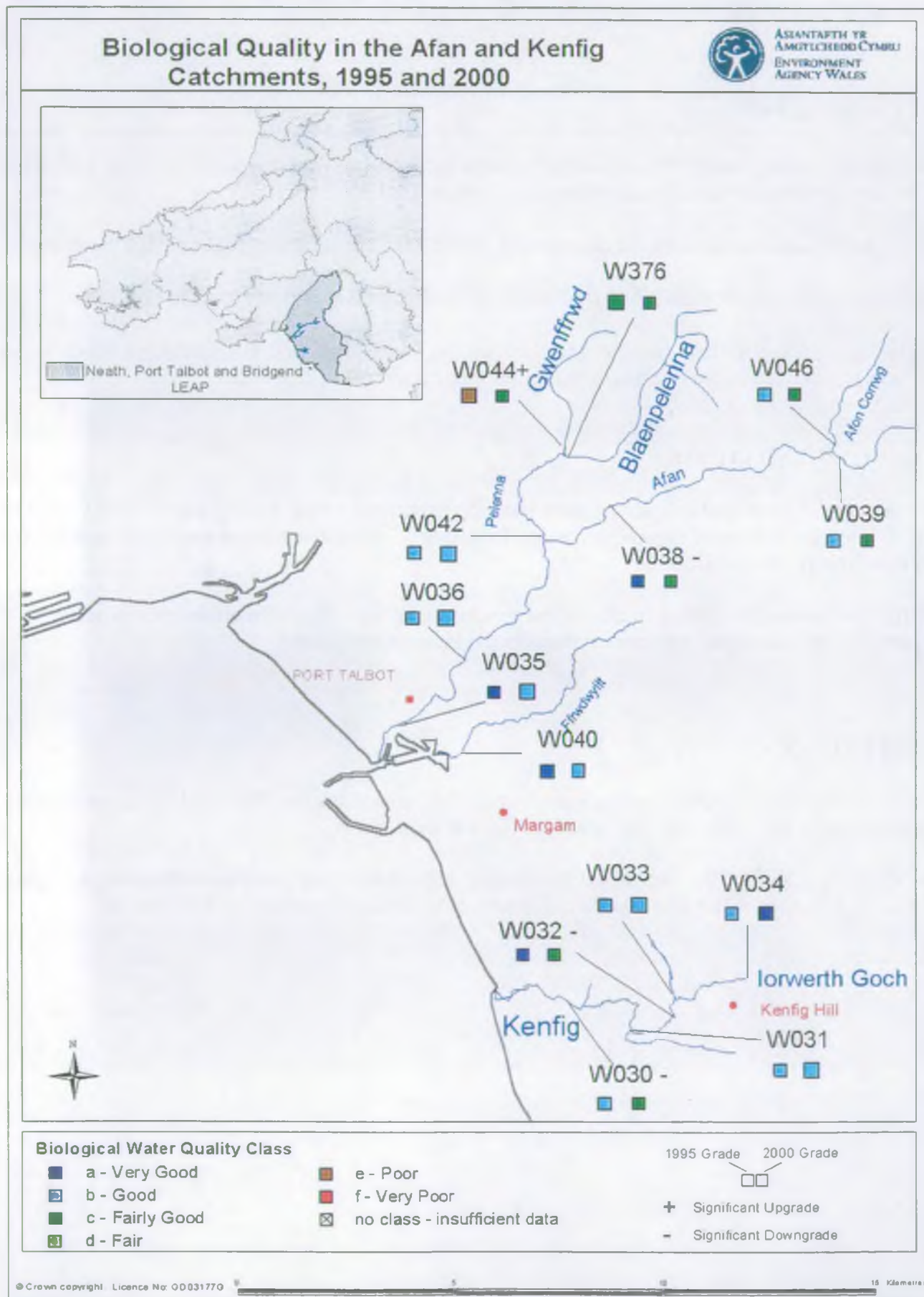
2. Urgent steps should be taken to ensure that an adequate programme of maintenance is put in place for the minewater treatment systems in the Pelenna catchment.

#### 6.0 REFERENCES

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Von Reibnitz (2002) The impact of minewater remediation on macroinvertebrate and fish communities: studies within the Pelenna catchment. MSc thesis, University of Manchester.

Figure 1 Biological Quality in the Afan and Kenfig catchments 1995 and 2000





Appendix 1 Summary of biological grades assigned to sites in the Afan and Kenfig catchments 1995 and 2000 with RE classifications for 1993-1995 and 1998-2000.

| SITE REF | RIVER NAME         | SITE NAME                         | NGR        | No. Stretches | Total Length defined (Km) | Class 1995 | Class 2000 | Change in Class | % Prob of change in class | RE 1995 | 1995 Compliance     | Marg/Sig            | RE 2000 | 2000 Compliance     | Marginal / Sig      |
|----------|--------------------|-----------------------------------|------------|---------------|---------------------------|------------|------------|-----------------|---------------------------|---------|---------------------|---------------------|---------|---------------------|---------------------|
| W030     | KENFIG             | BSC INTAKE                        | SS79848308 | 1             | 2                         | b          | c          | -1              | 98                        | R1      | Compliant           |                     | R1      | Compliant           |                     |
| W031     | KENFIG             | U/S MARLAS STW                    | SS81508232 | 1             | 1.7                       | b          | b          |                 |                           | R1      | Compliant           |                     | R2      | Significant Failure | Sig. BOD            |
| W032     | KENFIG             | PYLE BRIDGE                       | SS82558313 | 1             | 1.9                       | a          | c          | -2              | 100                       | R1      | Compliant           |                     | R2      | Significant Failure | Sig. BOD, Marg. NH3 |
| W033     | KENFIG             | CROWN ROAD                        | SS84138359 | 1             | 4.3                       | b          | b          |                 |                           | R2      | Significant Failure | Sig. NH3, Marg. BOD | R2      | Significant Failure | Sig. BOD            |
| W034     | NANT IORWETH GOCH  | CROWN ROAD                        | SS84158356 | 2             | 4.7                       | b          | a          | +1              | 63                        | R1      | Compliant           |                     | R2      | Significant Failure | Sig. NH3, Marg. BOD |
| W035     | AFAN               | DOCK INTAKE                       | SS76008972 | 1             | 0.7                       | a          | b          | -1              | 52                        | R1      | Compliant           |                     | R1      | Compliant           |                     |
| W036     | AFAN               | CORLANNAU                         | SS77709095 | 1             | 5.6                       | b          | b          |                 |                           | R1      | Compliant           |                     | R1      | Compliant           |                     |
| W038     | AFAN               | ARGOED COUNTRY PARK               | SS80989499 | 2             | 8.2                       | a          | c          | -2              | 98                        | R1      | Compliant           |                     | R1      | Compliant           |                     |
| W039     | AFAN               | AT CYMMER AFAN                    | SS86209626 | 3             | 5.8                       | b          | c          | -1              | 68                        | R1      | Compliant           |                     | R1      | Compliant           |                     |
| W040     | FFRWYDWYLLT        | PORT TALBOT                       | SS77328901 | 3             | 7                         | a          | b          | -1              | 40                        | R1      | Compliant           |                     | R1      | Compliant           |                     |
| W042     | PELENNNA           | U/S AFAN CONFLUENCE               | SS79299430 | 1             | 3                         | b          | b          |                 |                           | R1      | Compliant           |                     | R1      | Compliant           |                     |
| W376     | BLAENPELENNNA      | U/S CONFLUENCE WITH GWENFFRWD     | SS79809620 | 2             | 5.3                       | c          | c          |                 |                           | R5      | Significant Failure | Sig. pH6            | R1      | Compliant           |                     |
| W044     | PELENNNA GWENFFRWD | U/S CONFLUENCE WITH BLAENPELENNNA | SS79799640 | 2             | 3.4                       | e          | c          | +2              | 100                       | R5      | Significant Failure | Sig. pH6            | R1      | Compliant           |                     |
| W046     | CORRWG             | CYMMER AFAN                       | SS86169632 | 2             | 8                         | b          | c          | -1              | 62                        | R1      | Compliant           |                     | R1      | Compliant           |                     |