RIVER QUALITY IN ENGLAND & WALES

A Report of the 1990 Survey

National Rivers Authority

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Summary

The 1990 River Quality Survey reports the water quality of rivers, canals and estuaries in England and Wales. The last survey was in 1985.

The survey was carried out by the National Rivers Authority (NRA). The NRA is a public body whose duty is to protect and improve the water environment in England and Wales. The NRA was set up under the 1989 Water Act.

The Survey found that 89% of rivers were of Good or Fair Quality and 2% were Bad. For canals, 90% were Good or Fair, while 1% were of Bad Quality. Ninety-two percent of estuaries were of Good or Fair Quality and 3% were of Bad Quality.

Since 1985, there has been a downgrading of 15% of the total river length, while 11% has improved. Comparable figures for canals are 16% and 8%, and for estuaries, 3% and 1%.

The net downgrading of rivers is 3.7% of length. The large number of changes to individual stretches of river is caused by an inherent imprecision in data. This introduces no significant error in the aggregated result of the net downgrading because 3.7% is an average from thousands of sites. The uncertainty lies in historic differences in assessing data around England and Wales, but there is strong confidence that the true downgrading lies in the range from 2 to 4.5%

For rivers and canals most of the decline was in the best quality waters. Rivers in the Thames basin and in Devon and Cornwall were responsible for most of the river length reported to have deteriorated.

The causes of the net downgrading include increased monitoring. This detected pollution not measured in 1985. Other factors include the weather, and discharges of wastewater from sewage works, industry and farms. In total, these three factors: monitoring, the weather and discharges, contributed equally to the net decline.

In many places, water quality improved either because of better treatment of wastewaters, or because industries closed down. Also, increased enforcement by the NRA has started to have an impact on the efforts of dischargers to make sure that discharges comply with the law.

The prospects for the future include improvements to those rivers which will benefit from investment by the Water Services Companies. The expenditure by the Water Services Companies on effluent treatment exceeds that of the former Water Authorities. Also, there will be more enforcement by the NRA, and there are new opportunities to control the pollution caused by agriculture.

The Survey has provided a more complete picture of water quality. This will assist in the planning of improvements especially through the introduction of Statutory Water Quality Objectives under the Water Act.

1 Introduction

The 1990 River Quality Survey is the latest in a series carried out since 1958 to show the state of rivers, canals and estuaries in England and Wales. The last survey was in 1985[1].

The survey was conducted by the National Rivers Authority (NRA). The NRA is a public body whose task is to protect and improve the water environment in England and Wales. The NRA was set up under the Water Act of 1989 with duties which include:

> Maintain and improve water quality in rivers, streams, canals, lakes, groundwaters, estuaries and coastal waters.

The NRA has been in operation since September, 1989. The NRA is a national organisation but its operating divisions, or Regions, cover the areas of the former Water Authorities.

This report gives the results of the 1990 Survey. It compares these with the results of 1985 and explains the general causes of the reported changes. The report also gives details of the results for different parts of England and Wales. The tables of results are at the end of the report and the full results are shown in the maps. Details of the classification schemes are in Appendix 1. Appendix 2 covers the statistical background. At the back of the report is a Glossary of Terms.

The quality of individual lengths of rivers, canals and estuaries is reported according to the classification schemes developed for the former National Water Council (NWC)[2]. Stretches of river and canal are ranked in four categories from Good Quality (Classes 1a and 1b), to Bad Quality (Class 4). The Classes are described in Table A1 in Appendix 1. Classes are related to the potential use of the waters especially in the support of fisheries.

The Class for a particular stretch of freshwater is determined mainly by the concentrations of Dissolved Oxygen, Biochemical Oxygen Demand (BOD) and Ammonia found from the routine monitoring conducted by the NRA. The limits of quality which define the Classes are 95-percentiles - the limits must be met for at least 95 percent of the time in order for the stretch to be placed in that Class. Additionally, some Regions applied criteria derived from the European Inland Fisheries Advisory Commission (EIFAC). These use data for Suspended Solids, Non-ionised Ammonia, Temperature, pH, Cadmium, Copper, Chromium and Zinc. Table A2 in Appendix 1 gives details.

For estuaries, the classification ranks water from Good Quality (Class A) to Bad Quality (Class D). The system combines an assessment of the biological and aesthetic state of the water with the measurements of the minimum levels of Dissolved Oxygen. Table A3 in Appendix 1 defines the Classes.

The report of the 1985 Survey[1] recognised that the classification systems had been applied differently in different parts of England and Wales and that this made it difficult to compare Regions. Nonetheless the NRA has attempted to repeat the procedures and practices of 1985 so that the results of 1990 could be compared with 1985 and indicate trend. This means that the regional differences noted for 1985 are also found in this Report.

The Survey for 1990 will be the last to use the NWC Classifications. A new system is required to:

- provide a scheme which is suitable for the Statutory Water Quality Objectives to be introduced under the 1989 Water Act;
- secure consistency throughout England and Wales; and,
- eliminate subjectivity.

The need for continuity will be addressed by applying both the old and new systems to the data collected in 1990. Thus this report has compared 1985 with 1990 using the NWC Classifications. The NRA has published its proposals for a new classification. The results produced by the new system will then be published and future changes in water quality will be assessed against this baseline.

2 Results

For England and Wales in 1990, 89% of the total river length was of Good or Fair Quality, 9% was Poor and 2% was Bad. For canals, 90% was of Good or Fair Quality, while 1% was Bad. Tables 1 and 2 show how these results vary for each Region. Table 3 shows the proportions of estuaries in each Class. 92% was of Good or Fair Quality and 3% was of Bad.

The results of surveys from 1958 to 1990 are summarised in Table 4.

In comparison with the report of 1985, this report suggests that there has been a downgrading of 15% of the total river length in England and Wales. Eleven percent has improved. The precise net downgrading is 3.7%. Comparable figures for canals are a 16% downgrading and an upgrading of 8%.

The changes for rivers and canals have resulted generally in the net loss of waters of the best quality, Class 1a. Eighty-five percent of the net downgrading was recorded in Thames Region, which covers the Thames basin and in South West Region, which covers Devon and Cornwall.

As discussed below, the main source of uncertainty lies in historic differences in procedure around England and Wales, but there is strong confidence that the true downgrading lies in the range from 2 to 4.5%

The report for 1985[1] stated that 12% of river was of higher quality in 1985 than it was in 1980 and 14% was of lower quality. This suggested a net decline of 2% from 1980 to 1985. This was considered too small to be certain that it represented a real change in quality from 1980 to 1985. The results for 1990 suggest a decline of nearly 4% since 1985. The size of this decline, coming on top of the 2% decline from 1980 to 1985, suggests that a real change in river quality has been recorded.

The classification of estuaries has changed little since 1985. There was a downgrading of 3% of the total estuary length, while 1% was upgraded. Generally, the changes have resulted in some loss of Class A. The changes from 1985 to 1990 are shown in Tables 5 and 6.

More details on the types of changes reported for each Region are given in Table 7. A small net change is reported for Anglian, Northumbria, North West, Severn Trent, Welsh and Wessex. The biggest net deteriorations are reported for South West and Thames Regions. Rivers in Southern and Welsh Regions are reported with the greatest net improvement.

As discussed below, the over half the changes in Class reported for Thames Region are brought about by increased monitoring. This means that many of the reported deteriorations could have occurred before 1985. Also, the results for Southern Region are affected by the fact that a number of stretches should not have been reported at all in the Survey for 1985. Without this factor the results for Southern Region would not have shown such a big improvement and would have been similar to those in other Regions.

As discussed below, most of the changes in the class of individual stretches can be ascribed to statistical aspects of the classification system. The causes of the residual net downgrading include increased monitoring. This detected pollution not measured in 1985. Other factors include the weather, and discharges of wastewater from sewage works, industry and farms. In total, these three factors: monitoring, the weather and discharges, contributed in roughly equal proportions to the net decline.

3 Reasons for the Reported Change

3.1 Regional Differences in the Application of the Classification Systems

As noted above, the classification systems have been applied differently in different parts of England and Wales. The NRA has tried to repeat all the procedures of 1985 so that the results for 1990 could be compared with 1985 and indicate trend. The scale of the Regional differences is indicated by the following summary of the changes in river quality reported from 1980 to 1990.

Percentage of River Length Changing Class

Region	1980 to 1985			1985 to 1990		
	Up	Down	Net	Up	Down	Net
Anglian	21	13	+ 8	9	11	- 2
Northumbria	0	3	- 3	2	5	- 3
North West	4	12	- 8	8	11	- 3
Severn Trent	10	7	+ 3	10	8	+ 2
Southern	19	20	- 1	23	16	+ 7
South West	4	45	-41	16	39	-23
Thames	15	18	- 3	20	33	-13
Welsh	22	21	- 1	19	16	+ 3
Wessex	27	10	+17	4	2	+ 2
Yorkshire	8	26	-18	3	8	- 5
England & Wales	12	14	- 2	11	15	- 4

This gives a picture in which water quality appears stable in some parts of the country and volatile in others. This cannot always have been caused by real changes in river quality. The cause of the Regional differences is discussed below (in Paragraph 3.2) and in Appendix 3.

For Regions reporting a decline in quality from 1985 to 1990, South West and Thames stand out. If the results are omitted from either of these two Regions the net downgrading of rivers in England and Wales from 1985 to 1990 is reduced from from 3.7% to about 2%. On the other hand without the two Regions with the biggest improvements in water quality the net decline for England and Wales rises to 4.5%. This range in the net decline, 2 to 4.5%, can be viewed as a rough indication of the confidence in the result of the 1990 Survey.

The above table also suggests that the NRA has not succeeded completely in repeating exactly the procedures used in all its Regions in 1985. This is to be expected because the procedures require interpretation (see Table A2, for example) and the reorganisation of the Water Industry in 1989 led to widespread changes in staff.

As discussed above, in order to achieve harmony in future, the NRA proposes a new classification and a uniform protocol for its application. Such a system is also required for the implementation of Statutory Water Quality Objectives. The Department of the Environment has issued a consultation document with a view to deciding the form of classification required for Statutory Objectives. The need for continuity will be addressed by applying both the old and new systems to the data collected in 1990.

3.2 Random Changes in Class

Compared with 1985, 26% of river length is reported to have a changed Class (15% down and 11% up). Most of this can be explained by the operation of random chance through sampling. Appendix 2 explains that the classification procedure, if applied punctiliously, produces a probability of 20 to 30% that a site may be declared wrongly to have changed Class when the true quality of the site has not changed at all.

Part of the inconsistency around England and Wales is caused by attempts to control this error. The degree to which this was done explains why some Regions report big swings in river quality whilst others report a more stable position.

Some of the former Water Authorities used to seek confirmation that small apparent changes were real by looking at extra data. Typical checks included:

- sites which 'failed' a chemical standard because of a single bad analytical result at a place where river quality was good according to all the other indicators, e.g. biological data;
- cases where a site 'complied' with all the standards but had no fishery or poor biology; in this case the site might be downgraded;
- sites which failed (or passed) marginally after several years of compliance (or failure) and where there was no obvious cause for the change.

By using this extra information, these Authorities damped out the effects of low precision in the estimates of percentiles.

Other Authorities preferred to adhere strictly to the classification scheme but took account of poor precision and other factors as part of the process of deciding whether there was a real need for action to restore water quality. Either way, the former Authorities tried to avoid the expenditure of effort and money on downgradings caused by chance.

Although the potential error in reporting for a particular individual site may be up to 20 to 30%, this introduces no significant error in the aggregated result of a net downgrading of 3.7% of river length throughout England and Wales. This is because the aggregate is the average of 6000 sites and 800,000 results of analysis. At this scale the effects of random chance on the average of all these results becomes vanishingly small. As discussed above the main source of uncertainty in the aggregated result lies in the differences between Regions.

3.3 Monitoring

In 1990, the NRA revised the monitoring programmes in several Regions as part of its drive to apply resources more evenly across the country. With the benefit of more monitoring a more confident estimate of Class has been possible for 1990. This has resulted in some reported changes of Class which may have been caused before 1985.

3.4 Changes in Reported Lengths

In 1985, 38,896 km of freshwater rivers were surveyed. This report covers 39,905 km. Of the net increase, 200 km were for new lengths of river, mostly in Southern, which were included in the Survey for the first time. The balance is due to the better measurement of river lengths mainly in Severn-Trent, Wessex and South West Regions. An update of the lengths reported in 1985 is given in Table 8.

Since 1985, the overall decline of river quality in England and Wales is a net figure of 3.7% of river length. Of the extra 250 km of new river length, 100 km is excluded from the calculation of figure because there are no data which can be used to assign Class for 1985. The remaining 150 km has not affected the estimate of the net decline.

Without the extra 750 km of re-assessed river length net downgrading would have been 4.1%.

The total length of canals classified was 24 km less than in 1985 and this had no significant effect on the comparison of 1985 and 1990. There were hardly any changes to the total length of estuaries reported.

3.5 The Weather

Certain characteristics of water quality are affected by the weather. Many rivers had dense algal growths in the hot, dry summers of 1989 and 1990 and water quality subsequently deteriorated because of the increased oxygen demand from the plant material. On the other hand, the natural processes by which rivers cope with pollution take place more quickly when the weather is warm.

The dry weather caused a reduction in river flows and this provided less clean water to dilute discharges and so produced higher concentrations of pollutants in rivers. Conversely, sewage treatment works perform better in warm, dry weather and the lower rainfall meant that there was less contaminated run-off from farms and urban areas. There were also fewer discharges of storm sewage. So, in some places, rivers received less pollution than in an average year.

The effect of the weather on water quality varied from place to place according to the local balance of all these effects. Overall, the effect was detrimental and, with more typical weather, the net downgrading of 3.5% might have been closer to 2.5%.

3.6 Investment in Effluent Treatment

The report on the 1985 Survey forecast a modest improvement in water quality England and Wales during the period up to 1990. One reason that this did not occur was because of reduced expenditure on sewage treatment. In some Regions the impact of this was compounded by the effects of growth in population and an increase in the use of water. This produced pressure on water resources, bigger discharges and more urban areas.

The Survey has occurred too soon to reflect the impact of the investment programmes of the new Water Services Companies.

3.7 Enforcement

One reason for some of the improvements reported in 1990 was tighter pollution control exercised by the NRA . It will require future Surveys to show the full impact of this.

4 Prospects beyond 1990

The rainfall during the autumn and winter of 1989/90 was insufficient to prevent another summer of low river flows. Information obtained during the drought will be taken into account in considering the need for further controls on discharges.

In the run-up to the Privatisation of the Water Industry in 1989, the former Water Authorities were granted temporary relaxed Consents for discharges from their sewage treatment works. The new private Water Services Companies were obliged to invest in these works so as to secure the improvements to discharge quality required to meet the previous standards. These plans will continue to result in a reduction in polluting loads.

The introduction of the Farm Waste Regulations, which seek to minimise the risk of pollution from farms, is seen as a very real benefit to the efforts of the NRA to improve water quality. The NRA can now act to prevent pollution by farm waste before a discharge occurs.

Recent increases in NRA staff will result in additional efforts to control pollution.

It is also expected that more control will be imposed on effluents with the implementation of the first report in the NRA's Water Quality Series, *Discharge Consent and Compliance Policy: a Blueprint for the Future*.

In future, water quality objectives will have a statutory basis. Statutory Water Quality Objectives will be set by the Secretary of State and the NRA will have a duty to see that they are achieved within a set period of time. The Department of the Environment has issued a Consultation Document on this.

The NRA has used its resources to ensure that the Survey has provided a picture of the state of rivers and estuaries which is as accurate and as complete as possible. This will assist in the planning the action needed, where necessary, to achieve improvements. The NRA has already started to identify this action. It includes further reductions in the polluting loads from discharges of wastewater.

The NRA is also developing **Catchment Management Plans**. These will provide the strategy by which the catchments will be managed. They will also provide a vehicle by which the NRA can consult and obtain agreed sets of long term objectives, and resolve potential conflicts between those who use waters.

4 Comments on Regions

The above text gives a general discussion of the results of the Survey. The following discusses the results for individual Regions and comments on how the Region's results differ from the overall picture for England and Wales. It highlights river lengths where an important change has occurred and, where possible, gives the reasons for the change. Where no reason is given, the cause of the change is either unknown or may be ascribed to the effect of chance on sampling (Paragraph 3.2).

4.1 ANGLIAN

Changes since 1985

Some of the improvements which were forecast to take place between 1985 and 1990 have been achieved. However, these are limited mainly to small stretches of rivers.

Freshwaters

Since 1985, 11% of classified river length has deteriorated, while 9% has improved. The net length of river downgraded is therefore 2% (81 km). There have been no changes in the classes of Canals.

The causes of downgradings are various. Reduced levels of expenditure on sewage treatment meant that increased effluent loads affected water quality. This was noted especially in concentrations of ammonia. Sporadic discharges from storm overflows contributed to the downgrading of several stretches. A few downgradings were caused by particular incidents of pollution from industry or agriculture. The majority of deteriorations were changes from Classes 1a and 1b to 2. About one third of the significant downgradings were related to the drought. Without the drought this Region might well have reported a small net improvement in river water quality.

The effects of tighter pollution control and increased surveillance are exemplified by the improvement of over 50 km of the River Waveney in 1988, following a campaign to reduce pollution from agriculture.

During 1989 and especially in 1990, improved effluent quality, from sewage treatment works operated by Anglian Water, resulted in over 120 km of river being upgraded. Some of the other reported improvements were due to the availability of better data.

The majority of improvements were changes from Classes 3 to 2 and from 2 to 1b. Examples include 15 km of the River Cam which moved from 2 to 1b as a results of improvements in the quality of the discharge from the sewage works at Saffron Walden. Improvements to the sewage works serving Buckingham led to better water quality in 10 km of river and better facilities at Mablethorpe Sewage Treatment Works resulted in a changed Class for the Wold Grift Drain in Lincolnshire.

Estuaries

The main change since 1985 has been the downgrading of the Nene from Class A in 1985, to Class B in 1986, and to Class C in 1987. Low levels of dissolved oxygen and limited biological life are found over a substantial length of the estuary during summer. This is related to increased discharges of effluent, whose effects were picked up by closer monitoring.

Part of the Stour estuary was regraded from Class A to Class B because of lowered oxygen concentrations due to effluent discharges in and around Harwich Harbour. Part of the Orwell remains in Class D.

Prospects

In 1985, a modest improvement was expected up to 1990. This has not occurred because of reduced levels of investment in sewage treatment, rapid growth and, more recently, low river flows.

By the end of 1992, the investment at over 200 sewage treatment works will be completed by Anglian Water. This is expected to improve the quality of rivers.

The recent introduction of the Farm Waste Regulations will be very important to Anglian Region.

4.2 NORTHUMBRIA

Changes since 1985

Most of the improvements which were forecast to take place between 1985 and 1990, have been observed, but these were offset by downgradings elsewhere.

Freshwaters

Since 1985, 5% of the classified river length has deteriorated, while 2% has improved. The net downgraded river length is therefore about 3% (79 km). Most of the change was in losses of Class 1a to Class 1b and from Class 1b to Class 2.

The River Leven has been downgraded from Class 1a to Class 1b over 18km in its lower reaches, probably as a result of the influence of farming on water quality. About 12 km of the Baydale Beck, a small tributary of the River Tees, has been downgraded from Class 1a to Class 2. The stream flows though an area which is intensively farmed and has been subject to the effects of run-off and intermittent discharges of farm effluents. Eight kilometres of the Ouse Burn, which is affected by urban run-off, has been downgraded from Class 2 to Class 3. An 8 km stretch of the River Wear in the area of Bishop Auckland has been downgraded from Class 1a to 1b. The classifications assigned in 1985 to these stretches were based on limited data and are now considered to have been optimistic.

Five stretches below sewage treatment works (totalling 4 km), have deteriorated from Class 3 to Class 4.

Several improvements occurred because industries have closed. Others have been caused by the abandonment of sewage treatment works following the provision of pumping stations to transfer the flows to alternative facilities.

The closure of Lambton Coke Works resulted in 3 km of the Lumley Park Burn, a tributary of the River Wear, improving from Class 4 to Class 3.

Since the closure of Fishburn Coke Works, the quality of 16 km of the River Skerne in its upper and middle reaches has improved from Class 4, partly to Class 3 and partly to Class 2. This has resulted in an improvement from Class 2 to Class 1b, of 9 km of the River Tees below the confluence with the River Skerne.

The effluent from Cramlington Sewage Treatment Works used to discharge into the non-tidal River Blyth but has now been diverted into the estuary. This has resulted in the improvement of 3 km of the inland river from Class 3 to Class 1b.

Estuaries

A net improvement in the classification of estuaries had been expected between 1985 and 1990. Despite considerable reductions in polluting loads, the improvement has not materialised.

The River Derwent estuary has improved from Class D to Class B following the closure of Derwenthaugh Coke Works (2km). A 3 km length of the River Team estuary has improved from Class D to Class C as a result of the

closure of Norwood Coke Works and the commissioning of a section of the South Bank Interceptor Sewer (part of the Tyneside Interceptor Scheme) which eliminated discharges of untreated sewage to the river.

Prospects

Improvements to most remaining Class 3 and 4 stretches will be achieved by the abandonment of certain sewage treatment works or the provision of better sewage treatment.

Those stretches which are affected by intermittent or diffuse discharges will be improved by better measures to prevent pollution. Schemes of land reclamation should improve a few stretches affected by contaminated run-off or leachate.

Significant improvements are expected in the estuaries of the Tyne and Tees following the completion of sewerage schemes. On Tyneside, the North Bank Interceptor Sewer is due to be completed by the end of 1991. The remaining significant discharges of untreated sewage from the north bank to the upper estuary will then be connected into the Interceptor System. Extensions to the South Bank Interceptor Sewer, from Blaydon to Clara Vale, are due for completion in 1992/3. The only remaining discharges of untreated sewage into the estuary will then be from the low-lying riverside strip areas. These will be dealt with progressively as redevelopment proceeds.

Reductions of the polluting discharges from industry into the Tees estuary will result from the commissioning of treatment plants and other measures to control pollution. Secondary treatment will be provided at Portrack Sewage Treatment Works by the end of 1992. At Cargo Fleet, a sewage works providing preliminary treatment will be commissioned in 1991, resulting in the termination of several major discharges to the estuary from the Middlesbrough area. Biological treatment will be provided by the end of 1993.

It is expected that the runs of small numbers of migratory fish, which have returned to the Tees in recent years, will increase substantially as pollution levels fall.

4.3 NORTH-WEST

Changes since 1985

Improvements to agricultural drainage, which were expected to take place between 1985 and 1990, have been recorded. They resulted in no net improvement in classification because they were outweighed by downgradings.

Freshwaters

Since 1985, 11% of classified river length has deteriorated, and 7% has improved. The net length of downgraded river is therefore about 4% (96 km). About 35% (201 km) of canals has been downgraded.

The reduction in Class 1a is due largely to the impact of acid deposition on the Lake District and Pennines.

Most of deterioration of the 74 km of river which has moved into Class 4 is due to discharges of storm sewage and effluents from sewage treatment works. This emphasises the need for continuing capital investment.

The downgrading of canals towards Class 2 reflects a more realistic assessment of the data rather than any recent change in quality. The exception to this is the improvement from Class 3 to Class 2 in one section of canal. This is due to the diversion of industrial effluent.

The overall improvement of 87 km from Classes 3 and 4 to Class 2 or better was the result of investment in the sewage disposal infrastructure and the reversal of recent trends in agricultural pollution due to the education and enforcement campaigns undertaken by the the Authority's staff.

Estuaries

There are no reported changes to the classification of estuaries.

Prospects

An accelerating level of investment in the sewage disposal infrastructure and the application of tighter standards to industry will result in a steady improvement in the quality of watercourses.

Work is continuing on the Mersey estuary to eliminate discharges of crude sewage.

Recent increases in staff will result in additional pollution control especially in the impact from agriculture. The continued use of the grant system for farm improvements and the new Regulations on agricultural practice are opportunities for further resolution of these problems.

4.4 SEVERN-TRENT

Changes since 1985

Improvements to sewage treatment, which were expected to take place between 1985 and 1990, have been recorded. They contributed to an net improvement in classification.

Some of the reported deteriorations are attributable to better sampling at sites on smaller streams that were previously judged to be of good quality on the basis of limited evidence. Others are due to recent weather conditions.

Since 1985, over 9% of classified river length has deteriorated, while more than 10% has improved. The net upgraded river length is therefore about 1% (70 km). There has been a net downgrading of 2% (19 km) in the length of canals.

The lengths of all rivers classified in 1985 were remeasured more accurately in 1988. As a result the total length of reported river increased by 570 km. Those stretches whose lengths were altered were assumed to have had the same quality in 1985 as that reported for the original length.

In effect, these changes in river length are a retrospective correction of the 1985 Survey. The change has affected the results because in 1985 the length of Class 3 river was underestimated. For 1990, about 170 km of the new extra length improved in quality from Class 3. If the old, incorrect, lengths had been retained in the 1985 and the 1990 Surveys, the above mentioned 1% net improvement in river quality would be transformed into a 2% net deterioration.

Within the basins of both the Severn and the Trent there has been a net loss of 1a to 1b. The Severn had a greater length improving from Class 2 to 1b than the reverse. For the Trent catchment, movement between 1b and 2 showed little net change.

In the Severn catchment, less river length changed from Class 2 to Class 3 than improved from 3 to 2. For the Trent catchment, three times the length moved from 3 to 2 than the reverse.

There has been an increase in Class 4 river in the Trent catchment. This was mostly in the Tame where inadequate sewers still pose a problem. In the Severn, a short stretch of Class 4 has been improved by improvements to industrial and sewage discharges.

Particular features in results for the Severn basin included a deterioration of the River Avon downstream of Coventry. This should now recover following the completion of the improvements at Coventry Sewage Treatment Works. Poor trade effluent quality in Ledbury led to a deterioration in the quality of the sewage effluent and the downgrading of the River Leadon.

Good quality has returned to the River Perry following its recovery from agricultural pollution.

In the Trent, a downgrading from Class 2 to Class 3 downstream of the Nottingham sewage discharge, was caused by high concentrations of Unionised Ammonia. Improvements to river quality will require improvements at Nottingham Sewage Treatment Works. High levels of Unionised Ammonia are also seen in the River Soar downstream of the Leicester Sewage Treatment Works.

A number of long-standing problems such as the River Churnet downstream of Leek, and the River Anker downstream of Nuneaton, have got worse and led to a downgrading of Class. Poor sewage effluent quality was aggravated by trade effluent problems. These are being tackled and satisfactory conditions should soon be seen again.

Estuaries

The classification includes about 14 km of that part of the Severn estuary which is shared with Wessex Region. Overall, there has been a deterioration of 39% (29 km), mostly in the Severn Estuary downstream of Gloucester. This is caused by an increase in the organic load from Gloucester Sewage Treatment Works.

Prospects

The Authority is particularly concerned about water quality in lengths of the Tame, Stour (in Worcestershire), Erewash and Chelt. Capital expenditure, beyond that planned up to 1992, will be needed to improve these rivers.

In the Upper Tame system, inadequate sewers have caused an increase in the length of river assigned to Class 4. Further downstream, the Tame Purification Lakes, which were constructed in the early 1980's, have led to further improvements in the lower Tame. This stretch is now colonised by fish and there is the prospect of an improvement to Class 2.

The major water supply rivers, the Dove and Derwent, continue to have good quality and longer-term improvements in the Trent make it a source of public water supply with some potential. It is now used to support water supplies drawn from the Rivers Witham and Ancholme in Anglian Region.

4.5 SOUTHERN

Changes since 1985

Improvements to sewage and agricultural effluents, which were expected to take place between 1985 and 1990, have been recorded. They contributed to an net improvement in classification.

Freshwaters

At face value, a comparison of this report with the report for 1985 shows that 9% of river length has deteriorated mainly through the loss of river length in Class 1a. However, a re-appraisal of 1985 showed that 195 km of minor streams should not have been included because there were no data to assign Class. Up to 164 km of this length was placed in Class 1a on the basis of subjective judgement and, from evidence gathered since 1985, the classification was probably optimistic in many cases.

Following a review in 1989, an additional 398 km of minor streams and 41 km of canals were added to the Survey. There was sufficient information for canals to assign a Class for 1985, but not for the rivers.

This means that the comparison between 1990 and 1985 is best provided by using only those lengths for which data are available for both years. This shows that 16% of classified river length classified in 1990 has deteriorated, while 23% has improved. The net length of river upgraded is therefore 7% (168 km). Comparable figures for canals are 19% deterioration, 34% improvement and a net upgrading of 15% (6 km).

The single most widespread cause of decline was a lack of dilution for sewage effluents. This resulted in the deterioration of 88 km of watercourse. Low flows and warm water encouraged the growth of algae and eutrophication. This resulted in deteriorations in 66 km. In all, about 326 km was affected by low flows. Drought Orders were in force in Kent and Sussex as a result.

The headwaters of rivers and their tributaries suffered across the Region but the impact of low flow was most noticeable in Kent, with The Royal Military Canal and its feeder streams being particularly affected. On the other hand, the lack of rainfall resulted in a reduction of contaminated run-off into these catchments with the result that whilst watercourses with very low gradients or very low flows deteriorated, those with higher flows improved.

Agricultural pollution affected more than 13 km and resulted in the Authority taking prosecutions.

Deteriorations in the River Hamble and 9 km of the River Meon reported in 1985 have now been rectified. Previous agricultural pollution of the Eden Brook was notable but this has now been remedied.

Identified improvements include those resulting from capital expenditure on sewage treatment works or improved operation (123 km), diversion of sewage flows to other works (9 km) and improvements to sewerage systems (5 km). The provision of settlement ponds at fish farms improved 8 km, and the control of agricultural practice improved 58 km, whilst industrial improvements accounted for 48 km.

Estuaries

The reported quality of estuaries remained unchanged.

Prospects

The rainfall during the autumn and winter of 1989/90 has been too low to prevent another summer of low river flows although the unexpectedly cool and wet weather in early summer has improved conditions in some of the worst affected areas. Drought orders may be in force by the Autumn unless above-average rainfall occurs.

4.6 SOUTH WEST

Changes since 1985

Despite improvements to sewage and agricultural effluents, river quality declined from 1985 to 1990. However, this masks a small improvement from 1989 to 1990; this is a welcome sign of the end of a consistent decline since 1980.

In this Region, pollution from agriculture is a problem which is particularly severe and widespread. The programme of visits by staff to farms has been extended. Catchments are dealt with systematically, according to priority, and action taken to reduce the risk of pollution. Emphasis is given to the prevention of pollution by ensuring an effective response in consultations while developments are still at the planning stage.

Although the reported number of incidents of pollution has increased significantly since 1985, the use of positive measures such as the pumping to land of polluted water and the aeration of watercourses has reduced the impact of many serious incidents.

There have been improvements in the quality of some discharges and the Region has adopted a rigorous approach to the setting of future standards for discharges. There has been a substantial and sustained increase in population. A number of embargoes on development have been registered at places where discharges fail to meet their present legal standards and where river quality is unsatisfactory.

Because of its geography and geology, the effect of dry weather on river flows is particularly marked in this Region. Measures to maintain river flows have been put in place. New agreements on the operation of reservoirs have boosted the flows of some rivers during periods when flows would otherwise have been low.

Freshwaters

An additional 96 km of rivers have been added to the survey since 1985. This was due to the redefinition of the sources of rivers. The extra length had no effect on the Region's results.

Since 1985, 39% of river length has been downgraded and 18% upgraded. This gives a net deterioration of 21%. Nineteen kilometres of canals were also downgraded. The results suggest net losses from Classes 1a and 1b, and increases for Classes 2 and 3.

In past Surveys, the procedure used to classify rivers in this Region has tended to produce volatile results and to place rivers in a worse class than might have been the case elsewhere. In addition, it has proved difficult to reproduce exactly all the subjective factors used in the classification for 1985. These two circumstances account for part of the decline recorded from 1985 to 1990.

Data used for the 1990 classification included those collected during two droughts, whereas only one drought occurred in the data used for classification for 1985. This probably contributed to the differences in water quality between the two classifications.

The principal reasons for inadequate water quality were high Biochemical Oxygen Demand and Ammonia, and low Dissolved Oxygen. Inadequate water quality was caused also by high Suspended Solids, Copper or Zinc, or low pH and high Temperatures. The main causes remain as they were in 1985 - land use and agricultural practices, and historic mining and the associated contaminated land.

The most notable improvements include the River Torridge where most of the main river is now within its objective of Class 1b. The Red River improved from Class 4 to 3, generally as a result of a reduction in pollution from mines.

Estuaries

Estuarial quality shows no change from 1985.

Prospects

A series of Catchment Action Plans is being drawn up as a simple and practical way of directing resources. The public is being consulted on the Plans. Special Task Forces will continue to be deployed in those catchments where water quality falls short of standards, so that pollution law can be enforced with rigour.

A considerable programme of investment in waste treatment and pollution control is being undertaken by industry. This includes 150 schemes by South West Water to improve discharges to freshwaters. These will lead to improvements in water quality.

Future reviews of the quality of estuaries will benefit from a programme of monitoring which has been expanded to cover 114 new sites on 22 estuaries. The quality of estuaries looks set to improve as a result of

the Marine Improvement Programme being carried out by South West Water. The Authority is now issuing the Consent conditions associated with the Programme.

The Farm Waste Regulations will be very important to South West Region.

4.7 THAMES

Changes since 1985

There has been an apparent net decline in river quality since 1985. The quality of canals has improved. There has been no significant change in the quality of estuaries.

Over half the changes in class can be attributed to the greatly increased monitoring programme in 1990 compared with 1985. The Region now routinely monitors 575 sites compared with 213 in 1985. In 1985, the stretches not monitored were either assumed to be within their target class, or they were assumed to retain the class assigned in 1980. This means that some of the changes reported now could have occurred prior to 1985. The increased monitoring gives a better picture of the true water quality.

Freshwaters

Since 1985, 33% of classified river length is reported to have deteriorated, while 20% has improved. The net length of river downgraded is therefore 13% (485 km). There has been a net improvement to about 20% (42 km) of the length of canals.

In 1985, 65% of rivers were classed as Good Quality (Class 1a or 1b). This proportion has fallen to 61% of the total length in 1990. Consequently, 39% of rivers are now classed as Fair, Poor or Bad Quality (Class 2, 3 or 4), a corresponding increase of 4%. In 1985 44% of canal length was classed as Good Quality. This has increased to 61% in 1990. The majority of class changes have been from adjoining Classes.

A significant cause of the deteriorations, apart from the consequences of the increased monitoring programme and poor effluent quality, was the unusual weather during 1990. Stretches showing a deterioration in quality due to the various effects of low flows, include the lower 43 km of the Cherwell, 42 km of the Kennet, the whole (64 km) of the Evenlode, 24 km of the Oxfordshire Ray, and 19 km of the Thames from its source to the Key.

Specific deteriorations related to effluent quality were: 7 km of the lower Oxford Canal downstream of Kidlington Sewage Treatment Works; 28 km of the Wey (South) downstream of Bordon Sewage Treatment Works; 22 km of the Lee downstream of Luton Sewage Treatment Works and 14 km of the Thames from the Ray to the Coln downstream of Swindon Sewage Treatment

Works. Other, diffuse sources of pollution, such as those from agriculture and other trade effluents continued to be a problem for a few rivers.

There was an improvement of the whole length of the Cut (24 km) from Class 3 to Class 2 as a direct result of improved effluent quality from sewage treatment works serving Ascot, Bracknell and Maidenhead. Over 32 km of the lower River Loddon has improved from Class 2 to Class 1b due to improved effluent quality from Basingstoke and Wargrave Sewage Treatment Works. The 7 km of the Cherwell below Banbury have improved from Class 3 to Class 1b following much improved effluent quality from Banbury Sewage Treatment Works. Other improvements directly attributable to improved effluent quality were 5 km of the Wye and more than 10 km of the Roding. The majority of other improvements were attributed to the better spread of sampling in 1990.

Estuaries

There has been no significant change in estuarial quality.

Prospects

Action is being planned to rectify the deteriorations mentioned above as caused by effluent quality.

By the end of 1992, the refurbishment programme at sewage works operated by the Water Service Companies should be completed. This should result in improved water quality. However, further urbanisation and pressures on water resources, may offset some of these benefits.

The Survey has provided a more complete picture of water quality. This will assist in the planning of improvements especially through the introduction of Statutory Water Quality Objectives.

4.8 WELSH

Changes since 1985

Most of the improvements which were expected to take place between 1985 and 1990, have been recorded, with the exception of parts of Sandycroft Drain, and the estuaries of the Ely and Tywi.

Freshwaters

A more accurate measurement of river length has led to an increase of 46 km in the length of river reported. The extra length had no effect on the Region's results.

Since 1985, 18% of classified river length has deteriorated, while 20% has improved. The net length of river upgraded is therefore 2% (100 km). There was a net upgrade of about 2% (3 km) to canals.

Individual stretches have changed class for a variety of reasons. These included differences in the weather which affected the measurements of Dissolved Oxygen, BOD and Temperature. Other factors were the general decline in heavy industry and coal mining, the impact of acidification, and an increase in monitoring.

More specifically, 9 km of Class 1a and 5 km of Class 2 river have been downgraded to Class 4 because of discharges from sewage treatment works. These problems are currently being resolved.

Net changes in the quality of rivers and canals resulted in about 3% of lengths being upgraded from Class 2 to Class 1b.

Estuaries

The classification includes 51 km of that part of the Severn which is shared with Wessex Region. There has been very little change.

Prospects

It is anticipated that there will be improvements in the quality of discharges from sewage treatment works and reduced pollution from storm sewage following consultation with Dwr Cymru (Welsh Water).

The quality of estuaries should improve as the new standards for discharges are achieved and as capital works are carried out to improve the quality of Bathing Waters.

The introduction of the Farm Waste Regulations will be especially beneficial to Welsh Region.

4.9 WESSEX

Changes since 1985

No major changes had been expected to take place between 1985 and 1990.

Freshwaters

The total length of rivers reported has risen from 2,467 km to 2,622 km. This is due to a more accurate measurement of river lengths.

Since 1985, 3% of the classified river length has deteriorated, while 4% has improved. The net length of upgraded river is therefore about 1% (18 km). Over 6% (5 km) of the total length of canals was downgraded.

Only 5% of the total length of rivers now lies within the categories of Poor or Bad Quality. The general picture has been of fairly consistent water quality with some improvement of rivers from Class 3 to 2 and some deterioration from 1b to 2.

The main causes of the reported deteriorations are inputs of waste from agriculture, discharges from sewage treatment works and failures of the sewerage systems.

Agricultural pollution, especially from dairy and beef farms, continues to affect water quality. Many of the more acute problems, caused by direct discharges of farm waste, have been remedied. In some cases Low Rate Irrigation systems may have caused local problems. In some catchments the volume of farm waste being spread exceeds the capacity of the land to take it. This has resulted in polluted run-off into rivers following rainfall.

The deterioration in the Siston Brook and the River Frome in Bristol, appears to have been caused by the development of industrial estates in these catchments. The change is not attributable to any specific input, but there seems to be a decline in water quality both during and after development.

There has been an apparent deterioration in some rivers from Class 1b to 2. Further investigations are being undertaken on these stretches.

The dry weather caused a reduction in summer river flows but also reduced both the volume of sewage discharges and the frequency of storm overflows. This, together with the improved efficiency of treatment, due to warmer temperatures, meant that there was a smaller pollution load was discharged to rivers. Overall this produced a higher river quality than likely in a wet year.

Some of the improvements to Class 3 rivers have been produced by mounting special campaigns in catchments with inputs of agricultural waste. Notable amongst these are those on the Caundle Brook in Dorset and the River Biss in Wiltshire. Both campaigns resulted in significant improvements to water quality.

Many of the upgradings recorded are due to improvements to both the sewerage system and to sewage treatment works. These have resulted from reductions both in trade effluent (the Glastonbury Mill Stream and the River Yeo, both in Somerset) and from investment in the upgrading or refurbishment of sewerage systems and treatment works (the River Marden at Calne and the Bydemill Brook below Thingley Sewage Treatment Works).

Estuaries

There have been no changes to the classification of estuaries.

Prospects

The recent introduction of the Farm Waste Regulations will be especially beneficial to Wessex Region.

Industrial and agricultural impacts producing Class 3 rivers will continue to be targeted and it is planned to cut the small amount of Class 4 stretches by half as a result of action plans currently being drawn up.

4.10 YORKSHIRE

Changes since 1985

Some of the improvements which were expected to take place between 1985 and 1990 have been recorded. These did not result in a net improvement in classification because they were outweighed by downgradings elsewhere. Most downgradings were due to deteriorations in the quality of effluents from sewage treatment works and to reduced river flows caused by the drought.

Freshwaters

Since 1985, 9% of classified river length has deteriorated, while 4% has improved. The net length of river downgraded length is therefore 5% (300 km). The quality of canals is unchanged.

The length of river of Bad Quality declined by 20 km to 166 km, but the length of river with Poor Quality increased by 140 km to 623 km. The net result has been a loss of Class 1a and 1b rivers, with corresponding increases in Classes 2 and 3.

The general shift in water quality towards Classes 2 and 3 has resulted mainly from changes in quality over short river lengths at a large number of locations. Lack of dilution is partly responsible. An increase in the number of sampling locations allowed a reappraisal of water quality at some sites. Nonetheless, most problems are caused by discharges of sewage and sewage effluent.

The downgradings of 4 km of watercourse from Class 1b to Class 4, 20 km from Class 2 to Class 4 and 26 km from Class 3 to Class 4, were all due to the effects of sewage effluents and storm sewage overflows.

The deterioration of 61 km of river from Class 1a and 1b to Class 3 also occurred primarily because of sewage or sewage-related causes. The most significant impact was on the River Hertford, a tributary of the River Derwent, where 12 km were downgraded. This caused a downgrading of 10 km of the River Derwent from Class 1a to Class 2 and a further 4 km from Class 1a to Class 1b.

Improvements to sewerage and sewage treatment have led to 8 km being upgraded from Class 4 to Class 2, 30 km from Class 4 to Class 3, 20 km from Class 3 to Class 2 and 4 km from Class 3 to Class 1. One of the most significant improvements has been to Bradford Sewage Treatment Works at Esholt. This has resulted so far in 8 km of the River Aire being upgraded to Class 3. Further improvements to the works are in hand.

Improved control of trade effluents was responsible for the upgrading of 2 km of Class 4 rivers to Class 2 while the transfer of trade effluents to sewer and the closure of some works led to the improvement of 21 km from Class 4 to Class 3 and 31 km from Class 3 to Class 2.

Estuaries

The classification includes about 63 km of the Humber, responsibility for which is shared with Anglian and Severn Trent Regions. Overall, tidal waters showed a slight deterioration in quality.

Prospects

Over the next 5 years, there should be a progressive reduction in rivers of Bad Quality (Class 4) and some redress of the slippage in recent years from Class 1b to 2. Investment by Yorkshire Water is targeted to eliminate the lengths of river in Class 4, and reduce the length of Class 3 rivers from 641 to 29 km, by the year 2000. The NRA believes that major improvements in the quality of the main industrial rivers are achievable by the mid 1990s. To effect this, a strategy has been developed which will form the basis of consultation with the Water Company.

The rivers in the north of the Region are generally of high quality. On-going work to reduce farm pollution and to improve some sewage treatment works should raise the quality of some "black-spots" on tributaries during the period 1990-95. The downgradings of the Rivers Nidd, Hertford and Derwent should be reversed by 1995.

Schemes are in progress at the sewage treatment works serving Leeds and Bradford, which discharge to the Aire. Further improvements may result in Leeds but there are also problems to with the overflows of storm sewage. On the Calder, the main improvements depend on work at Huddersfield Sewage Treatment Works.

Major reconstruction is in progress at the works serving Sheffield. This should eliminate some of the Class 4 length of the Don. Schemes for effluent treatment are now in progress which will upgrade 33 km of the Rother from Class 4. These improvements will then benefit the quality of the River Don through Rotherham and Doncaster.

The Tidal Ouse and the upper part of the Humber will benefit from the improvements to the Aire and Don, but possibly not to the extent that the stretch of Class C is eliminated during the next five years.

TABLES OF RESULTS

All the values given in the tables are rounded to the nearest integer except those which are less than 1 which are quoted to one decimal place. This means that some of the percentages do not total to 100.

Table 1: River Quality in 1990 by Region

Region	Percentage of river length in each class							TOTAL (Km)
	Good		Fair	Good and Fair	Poor	Bad	Poor and Bad	
	1a	1b	2	1a,1b and 2	3	4	3 and 4	
Anglian	8	49	35	92	8	0.3	8	4328
Northumbria	60	26	11	97	3	0.2	3	2785
North West	45	14	20	79	16	5	21	5323
Severn-Trent	15	40	32	87	11	2	13	5681
Southern	23	47	22	92	7	0.8	8	2185
South West	17	35	30	82	17	1	18	3037
Thames	16	45	32	93	7	0.3	7	3530
Welsh	54	32	8	94	5	0.6	6	4646
Wessex	28	32	35	95	5	0.6	5	2622
Yorkshire	39	33	14	86	11	3	14	5765
England and Wales	31	35	23	89	10	2	11	39904

Table 1a: River Quality in 1990 by Region

Region	River length in each class (km)					TOTAL (Km)
	Good		Fair	Poor	Bad	
	1a	1b	2	3	4	
Anglian	358	2120	1502	335	13	4328
Northumbria	1669	727	307	76	6	2785
North West	2352	768	1056	853	264	5323
Severn-Trent	861	2271	1853	612	85	5681
Southern	500	1032	484	150	18	2185
South West	506	1065	909	524	33	3037
Thames	554	1586	1116	265	9	3530
Welsh	2488	1505	384	244	26	4646
Wessex	736	828	915	127	15	2622
Yorkshire	2251	1895	831	623	165	5765
England and Wales	12305	13799	9358	3809	634	39904

Table 2: Quality of Canals in 1990 by Region

Region	Percentage of canal length in each class							TOTAL (Km)
	Good		Fair	Good and Fair	Poor	Bad	Poor and Bad	
	1a	1b	2	1a, 1b and 2	3	4	3 and 4	
Anglian	0	40	60	100	0	0	0	125
Northumbria	no canals							
North West	5	12	79	94	6	0	6	577
Severn-Trent	2	32	59	94	6	0	6	990
Southern	0	26	74	100	0	0	0	41
South West	0	0	10	10	28	62	90	29
Thames	18	43	35	96	4	0	4	210
Welsh	0	37	45	82	17	0	17	152
Wessex	12	62	26	100	0	0	0	82
Yorkshire	2	31	32	65	32	4	36	122
England and Wales	4	30	57	90	9	1	10	2328

Table 3: Quality of Estuaries in 1990 by Region

Region	Percentage of estuary length in each class						TOTAL (Km)
	Good	Fair	Good and Fair	Poor	Bad	Poor and Bad	
	A	B	A and B	C	D	C and D	
Anglian	69	24	93	7	0.4	7	518
Northumbria	34	38	72	17	10	27	135
North West	49	23	72	13	15	28	452
Severn-Trent	35	46	81	19	0	19	74
Southern	76	21	97	4	0	4	388
South West	92	8	100	0	0	0	350
Thames	45	55	100	0	0	0	112
Welsh	74	24	98	2	0	2	469
Wessex	46	51	97	3	0	3	156
Yorkshire	48	35	83	17	0	17	103
Shared estuaries:							
Humber	43	57	100	0	0	0	63
Severn	56	44	100	0	0	0	64
England and Wales	65	26	91	6	3	9	2756

Table 4: Water Quality in England and Wales: 1958 - 1990

Former classifications* 1958-1980 surveys									New classifications 1980-1985 surveys							
NON-TIDAL RIVERS AND CANALS									FRESHWATER RIVERS AND CANALS							
Class	1958		1970		1975		1980		Class	1980		1985		1990		
	km	%	km	%	km	%	km	%		km	%	km	%	km	%	
Unpolluted	24950	72	28500	74	28810	75	28810	75	Good 1a	13830	34	13470	33	12492	29	
									Good 1b	14220	35	13990	34	14531	34	
Doubtful	5220	15	6270	17	6730	17	7110	18	Fair 2	8670	21	9730	24	10760	25	
Poor	2270	7	1940	5	1770	5	2000	5	Poor 3	3260	8	3560	9	4022	9	
Grossly polluted	2250	6	1700	4	1270	3	810	2	Bad 4	640	2	650	2	662	2	
Total	34690	100	38400	100	38590	100	38740	100	Total	40630	100	41390	100	42467	100	
TIDAL RIVERS									ESTUARIES							
Class	1958		1970		1975		1980		Class	1980		1985		1990		
	km	%	km	%	km	%	km	%		km	%	km	%	km	%	
Unpolluted	1160	41	1380	48	1360	48	1410	50	Good A	1870	68	1860	68	1785	65	
Doubtful	940	32	680	23	780	27	950	34	Fair B	620	23	650	24	709	26	
Poor	400	14	490	17	420	15	220	8	Poor C	140	5	130	5	178	6	
Grossly polluted	360	13	340	12	280	10	220	8	Bad D	110	4	90	3	85	3	
Total	2850	100	2880	100	2850	100	2800	100	Total	2730	100	2730	100	2756	100	

* See Table A4 (Appendix A) for details of the former classification scheme

Table 5: **Changes in Water Quality in England and Wales from 1985 to 1990: Rivers, Canals and Estuaries**

Length in km

Water quality classification in 1990		Water quality classification in 1985					
		Good 1a	Good 1b	Fair 2	Poor 3	Bad 4	1990 quality
RIVERS							
Good	1a	10704	1231	236	30	4	12205
Good	1b	2012	9834	1573	203	12	13634
Fair	2	399	1906	5984	920	50	9259
Poor	3	74	422	838	2250	183	3767
Bad	4	9	20	70	147	384	630
1985 quality		13198	13413	8701	3550	633	39495
CANALS							
Good	1a	83	13	3	0	0	99
Good	1b	77	522	110	11	12	732
Fair	2	37	195	1142	29	0	1403
Poor	3	0	8	43	160	2	213
Bad	4	0	0	11	0	17	28
1985 quality		197	738	1308	200	31	2330
ESTUARIES		Good A		Fair B	Poor C	Bad D	
Good	A	1772		13	0	0	1785
Fair	B	39		667	1	2	709
Poor	C	32		12	131	3	178
Bad	D	0		0	0	85	85
1985 quality		1843		692	132	90	2757

The table includes only those sites surveyed in 1985 and 1990.

Note on interpretation: For example, in 1980 there were 13198 km of river in Class 1a. By 1990, 2012 km had moved into 1b and 399 into Class 2. Conversely, by 1990, 1231 km of river had moved into Class 1a from Class 1b and 236 km had moved into Class 1a from Class 2.

Table 6: Lengths of Rivers, Canals and Estuaries Assigned a Different Quality in 1990

Length in km

Type of water	Length assigned a higher quality in 1990 from that in 1985	Length assigned a lower quality in 1990 from that in 1985
Rivers	4445	5869
Canals	177	371
Estuaries	18	83

Table 7: Summary of Changes in the Quality of Rivers and Canals

Length in Km

Region	Length of stretches classified for both 1985 and 1990	Net improvement (length improved minus length deteriorated)	Change in length of Bad Quality*	Change in length of Good Quality	Change in length of Good & Fair Quality
Anglian	4453	- 81	+ 5	- 59	+ 51
Northumbria	2785	- 79	- 19	- 41	+ 4
North West	5900	-297	- 3	-223	+ 51
Severn-Trent	6671	+ 51	+ 12	+102	+148
Southern	1828	+174	- 4	+118	+ 35
South West	3066	-655	+ 25	-462	-380
Thames	3740	-443	+ 7	-139	- 60
Welsh	4798	+103	- 12	+156	+ 10
Wessex	2695	+ 13	0	- 33	+ 44
Yorkshire	5887	-301	- 18	-264	-122
England & Wales	41823	- 1515	- 7	- 645	- 219

* Negative figures in this column denote an improvement in quality

Table 8: River Quality in 1985 by Region (an update of the 1985 report)

Region	River length in each class (km)						TOTAL (Km)
	Good		Fair	Poor	Bad		
	1a	1b	2	3	4	X	
Anglian	443	2094	1392	392	7	0	4328
Northumbria	1729	709	262	63	22	0	2785
North West	2582	654	922	899	268	0	5323
Severn-Trent	977	2045	1801	787	71	39	5721
Southern	307	847	483	133	18	0	1787
South West	766	1289	795	167	19	2	3037
Thames	878	1436	994	219	2	0	3530
Welsh	2477	1375	525	242	26	0	4646
Wessex	738	854	840	166	15	0	2613
Yorkshire	2300	2111	687	483	184	0	5765
England and Wales	13198	13414	8701	3551	632	41	39537

The above table excludes lengths reported as 'unclassified'

APPENDIX 1

Table A1 Classification Scheme for Water Quality in Rivers and Canals

Table A2 Part 1: River Quality Classification
Part 2: Notes on the River Water Classification

Table A3 Scheme for Classifying Estuaries

Table A4 Criteria for the Former River Classification Scheme

Table A1: Classification Scheme for Water Quality in Rivers and Canals

Description	Class	Current Potential Use
Good Quality	1a	Water of high quality suitable for potable supply abstractions; game or other high class fisheries; high amenity value.
	1b	Water of less high quality than Class 1a but usable for substantially the same purposes.
Fair Quality	2	Waters suitable for potable supply after advanced treatment; supporting reasonably good coarse fisheries; moderate amenity value.
Poor Quality	3	Waters which are polluted to an extent that fish are absent or only sporadically present; may be used as a low grade industrial abstraction; considerable potential for further use if cleaned up.
Bad Quality	4	Waters which are grossly polluted and are likely to cause nuisance.

Table A2 (Part 1): River Quality Classification

River Class	Quality Criteria*	Remarks	Current potential uses
1a Good Quality	(1) 5-percentile Dissolved Oxygen Saturation greater than 80% (2) 95-percentile Biochemical Oxygen Demand not greater than 3 mg/l (3) 95-percentile Ammonia not greater than 0.4 mg/l (4) Where the water is abstracted for drinking water, it complies with requirements for A2* (5) Non-toxic to fish in EIFAC terms (or best estimates if EIFAC figures are unavailable)	(1) Mean Biochemical Oxygen Demand probably not greater than 1.5 mg/l (2) No visible evidence of pollution	(1) Water of high quality suitable for potable supply abstractions and for all other abstractions (2) Game or other high class fisheries (3) High amenity value
1b Good Quality	(1) 5-percentile Dissolved Oxygen Saturation greater than 60% (2) 95-percentile Biochemical Oxygen Demand not greater than 5 mg/l (3) 95-percentile Ammonia not greater than 0.9 mg/l (4) Where water is abstracted for drinking water it complies with the requirements for A3* (5) Non-toxic to fish in EIFAC terms (or best estimates if EIFAC figures are unavailable)	(1) Mean Biochemical Oxygen Demand probably not greater than 2 mg/l (2) Mean Ammonia probably not greater than 0.5 mg/l (3) No visible evidence of pollution (4) Water of high quality which cannot be placed in Class 1a because of the effect of physical factors such as canalisation low gradient or eutrophication	Water of less high quality than than Class 1a but usable for substantially the same purposes
2 Fair Quality	(1) 5-percentile Dissolved Oxygen Saturation greater than 60% (2) 95-percentile Biochemical Oxygen Demand not greater than 5 mg/l (3) Where water is abstracted for drinking water it complies with the requirements for A3* (4) Non-toxic to fish in EIFAC terms (or best estimates if EIFAC figures are unavailable)	(1) Mean Biochemical Oxygen Demand probably not greater than 5 mg/l (2) Water showing no physical signs of pollution other than humic coloration and a little foaming below weirs	(1) Waters suitable for potable supply after advanced treatment (2) Supporting reasonably good coarse fisheries (3) Moderate amenity value
3 Poor Quality	(1) 5-percentile Dissolved Oxygen Saturation greater than 60% (2) Not likely to be anaerobic (3) 95-percentile Biochemical Oxygen Demand not greater than 17 mg/l This may not apply if there is a high degree of re-aeration		Waters which are polluted to an extent that fish are absent or only sporadically present May be used for a low grade abstraction for industry Considerable potential for further use if cleaned up
4 Bad Quality	Waters which are inferior to Class 3 in terms of dissolved oxygen and likely to be anaerobic at times		Waters which are grossly polluted and are likely to cause nuisance
X	DO greater than 10% saturation		Insignificant watercourses and ditches which are not usable, where the objective is simply to prevent nuisance

* See notes overleaf

Table A2 (Part 2): Notes on the River Quality Classification

NOTES

(a) Under extreme weather conditions (eg flood, drought, freeze-up, or when rivers are dominated by plant growth, or by the the decay of aquatic plants, rivers usually in Class 1,2 and 3 may have levels of Biochemical Oxygen Demand and Dissolved Oxygen, or Ammonia outside the stated levels for those Classes. When this occurs the cause should be stated along with analytical results.

(b) The Biochemical Oxygen Demand refers to the 5-day carbonaceous determination performed in the presence of Allyl Thio Urea (ATU). Ammonia is expressed as as the Ammonium Ion, NH_4.

(c) In most instances the chemical classification given above will be suitable. However, the basis of the classification is restricted to a finite number of chemical determinands and there may be a few cases where the presence of a chemical substance other than those used in the classification markedly reduces the quality of the water. In such cases, the quality classification of the water should be down-graded on the basis of biota actually present, and the reasons stated.

(d) The standards set up to protect freshwater fisheries by the European Inland Fisheries Advisory Commission (EIFAC). The standards should be expressed as 95-percentile.

(e) The definition and the requirements of A2 and A3 are those specified in the Directive on the Quality of Water Intended for Abstraction for Drinking Water.

Table A3: Scheme for Classifying Estuaries

Description	Points Awarded if the estuary meets this description
Biological Quality (scores under a, b, c, & d to be summed)	
(a) Allows the passage to and from freshwater of all relevant species of migratory fish, when this is not prevented by physical barriers. Relevant species include salmonids, eels, flounders and cucumber smelts etc)	2
(b) Supports a residential fish population which is broadly consistent with the physical and hydrographical conditions	2
(c) Supports a benthic community which is broadly consistent with the physical and hydrographical conditions	2
(d) Absence of substantially elevated levels in the biota of persistent toxic or tainting substances from whatever source	4
Maximum number of points	10
Aesthetic Quality (Choose one description only)	
(a) Estuaries or zones of estuaries that either do not receive a significant polluting input input or which receive inputs that do not cause significant aesthetic pollution	10
(b) Estuaries or zones of estuaries which receive inputs which cause a certain amount of pollution but do not seriously interfere with estuary usage	6
(c) Estuaries or zones of estuaries which receive inputs which result in aesthetic pollution sufficiently serious to affect estuary usage	3
(d) Estuaries or zones of estuaries which receive inputs which cause widespread public nuisance	0
Water Quality (Score according to quality)	
Dissolved Oxygen exceeds the following saturation values:	
60%	10
40%	6
30%	5
20%	4
10%	3
below 10%	0
The points awarded under each of the headings of biological, aesthetic and water quality are summed. Waters are classified on the following scale:	
Class A (Good Quality): 24 to 30 points — Class B (Fair Quality): 16 to 23 points	
Class C (Poor Quality): 9 to 15 points — Class D (Bad Quality): 0 to 8 points	

Table A4: Criteria for the Former River Classification Scheme

Class 1: Unpolluted

(a) All lengths of rivers whatever their composition, which are known to have received no significant polluting discharges.

(b) All rivers which, though receiving some pollution, have an uninhibited BOD less than 3 mg/l, are well oxygenated and are known to have received no significant discharges of toxic materials or of suspended matter which affects the condition of the river bed.

(c) All rivers which are generally indistinguishable biologically from those in the area known to be quite unpolluted, even though the BOD may be somewhat greater than 3mg/l.

Class 2: Doubtful

(a) Rivers not in Class 1 on BOD grounds and which have a substantially reduced oxygen content at normal dry summer flows or at any other regular times.

(b) Rivers, irrespective of BOD, which are known to have received significant toxic discharges which cannot be proved either to affect fish or to have been removed by natural processes.

(c) Rivers which have received turbid discharges which have had an appreciable effect on the composition of the water or character of the bed but have had no great effect on the biology of the water.

(d) Rivers which have been the subject of complaints which are not regarded as frivolous but which have not been substantiated.

Class 3: Poor

(a) Rivers not in Class 4 on uninhibited BOD grounds but which have a dissolved oxygen saturation, for considerable periods, below 50%

(b) Rivers containing substances which are suspected of being actively toxic at times.

(c) Rivers which have been changed in character by discharge of solids in suspension but which do not justify being placed in Class 4.

(d) Rivers which have been the subject of serious complaint accepted as well-founded.

Class 4: Grossly polluted

(a) All rivers having an uninhibited BOD of 12 mg/l or more under average conditions.

(b) All rivers known to be incapable of supporting fish life.

(c) All rivers which are completely deoxygenated at any time, apart from times of exceptional drought.

(d) All rivers which are the source of offensive smells.

(e) All rivers which have an offensive appearance, neglecting for these purposes any rivers which would be included in this class solely because of the presence of detergent foam.

APPENDIX 2: Statistical Background

1. This Appendix explains the how the classification of water quality is affected by the Laws of Chance in Sampling.

Sampling Error

2. A river flows for 31 million seconds in a year and samples give a measurement of the quality of a small bit of it during those few seconds required to fill the sampling bottles. This means that the results from a set of samples are influenced by the Laws of Chance. There is a risk that the samples collected at a site may just happen to have been taken at those time when river quality was at its best or worst.

3. Given the number of sites in England and Wales it is inevitable that a proportion will show misleading results purely because of chance.

4. To illustrate, the following table shows the average uncertainty from the use of 36 samples to estimate percentiles:

Determinand	90% Confidence Interval
BOD	- 19% to + 34%
Ammonia	- 31% to + 68%
Dissolved Oxygen	- 6% to + 9%

5. This uncertainty produces a risk that rivers are placed in the wrong Class. For example a site with a true 95-percentile BOD of 4.2 mgl^{-1} is in Class 1b but has, with 36 samples, the following probabilities of being classified:

1a: 1%	1b: 82%	2: 17%

This suggests a chance of 18% of wrongly reporting the Class.

6. This error is bigger when using the data to detect a change of Class. In the first period, the percentile might be in Class 1b but the confidence limits show:

Confidence of 1b	83%
Confidence of 2	17%

which is taken as Class 1b. In the next period, the data could show:

Confidence of 1b	40%
Confidence of 2	60%

which suggests Class 2. Over the 2 periods this looks like a slip from 1b to 2, but the range of possibilities is:

From 1b to 2	50%
From 1b to 1b	33%
From 2 to 2	10%
From 2 to 1b	7%

6. So there is a strong possibility, 50%, that the reported deterioration from Class 1b to 2 did not really happen. There is a small chance, 7%, that quality actually improved (but was recorded as a downgrading).

7. The practical consequence of these effects is that the reported Class can change randomly back and forth, every year or so. The effect on a large number of sites is calculated by the CLass Allocation Model, CLAM[3]. The results indicate an average error of 20% in assigning Class and an average error of 29% in reporting a change in Class.

8. The need to control these errors is one of the main reasons for creating the new NRA Class. Standard statistical techniques will be used to assess the risk that an apparent change was caused by chance[4].

9. This report suggests an overall downgrading of 15% of river length, while 11% has been upgraded, a net downgrading 4%. Although the potential error in reporting for a particular individual site may be 20 to 30%, the aggregated result of a 4% downgrading is highly significant. This is because the aggregate is the average of 6000 sites and 100,000 results of analysis.

APPENDIX 3: Problems with the NWC Class

In its report for 1985[1], the DoE stated that the Survey revealed differences between the former Water Authorities in the monitoring and classification of rivers. The differences within England and Wales are illustrated in the following figures for areas now covered by the Regions of the NRA. The figures show the percentage of river length in each area which changed NWC Class between 1980 and 1990. The table shows a stable picture in some Regions and volatility in others. Such differences can only be explained by differences in procedure.

Percentage of River Length Changing Class

Region	1980 to 1985			1985 to 1990		
	Up	Down	Net	Up	Down	Net
Anglian	21	13	+ 8	9	11	- 2
Northumbria	0	3	- 3	2	5	- 3
North West	4	12	- 8	8	11	- 3
Severn Trent	10	7	+ 3	10	8	+ 2
Southern	19	20	- 1	23	16	+ 7
South West	4	45	-41	16	39	-23
Thames	15	18	- 3	20	33	-13
Welsh	22	21	- 1	19	16	+ 3
Wessex	27	10	+17	4	2	+ 2
Yorkshire	8	26	-18	3	8	- 5
England & Wales	12	14	- 2	11	15	- 4

The preparatory work done by the NRA for the 1990 Survey showed differences between the former Water Authorities in:

(a) the statistical methods used to obtain the summaries of water quality (mainly 95-percentiles);

(b) the inclusion or exclusion of any analytical results suspected as being in error because they differed markedly from others from the same site (or caused by extreme events like flood, drought and plant growth (Table A2));

(c) the sampling frequencies;

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

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

(f) the pooling of data for different sites;

(g) the procedure used to interpolate between sampling points;

(h) the use of judgements based on the effects of **algae**, biological data and visual pollution to qualify or overrule the classification suggested by other data;

(i) the weight given to the EIFAC standards, especially for Unionised Ammonia;

(j) the status given to non-compliance with standards in Directives (especially metals); and,

(k) the allowance made for Statistical Sampling Error when deciding whether a river had changed Class.

This last point may require explanation. It is a fact, often overlooked, that the summary statistics which are used in classification (such as percentiles) are estimated with low precision in relation to the ranges of concentration which define the better quality Classes.

If left unconstrained, this low precision leads to large numbers of spurious and random changes in Class. Faced with this, some of the Water Authorities sought confirmation that small apparent changes were real by looking at extra data. Typical cases included:

- sites which 'failed' a chemical standard because of a single bad analytical result at a place where river quality was good according to all the other indicators, e.g. biological data;
- cases where a site 'complied' with all the standards but had no fishery or poor biology; in this case the site might be downgraded;
- sites which failed (or passed) marginally after several years of compliance (or failure) and where there was no obvious cause for the change.

By using this extra information, these Authorities damped out the damaging effects of low precision in the estimates of percentiles. Had they not done this, 20-40% of sites would have been placed in the wrong Class.

Other Authorities preferred to adhere strictly to the classification scheme but take account of poor precision and other factors in the process of deciding whether they really needed to take action to restore water quality. Either way, the former Authorities tried to avoid the expenditure of effort and money on downgradings caused by chance.

Another problem with the NWC Class is that new water quality standards and new Directives are being introduced steadily over the years. If these were incorporated within the NWC Class, in the same way as the EIFAC Standards and the Surface Water Directive, the system will cease

to be usable as an absolute measure of water quality because not all the additions will apply to all rivers. Also, if the definition of Class changes over time in this way, the NWC Class cannot be used sensibly to indicate national trends in water quality. Instead, the system will produce apparent changes which are due to changes in the method of classification.

Recognising this, the former Water Authorities Association recommended a new Class specifically to show absolute quality[3]. Rivers would be checked separately for compliance with other standards and Directives. The new Class was similar to the NWC Class but based only on the Biochemical Oxygen Demand, the Dissolved Oxygen and Ammonia. These recommendations, together with proposals to use biological data, are the basis of the NRA's suggestions for a new classification. These suggestions will be issued for consultation as part of the Consultation Document on Statutory Water Quality Objectives.

GLOSSARY OF TERMS

Algae	*Simple microscopic plants that lack true stems but which are capable of photosynthesis. Algae occur in water and are often discussed in the context of Eutrophication (ibid).*
Ammonia	*A chemical found in water often as the result of pollution by sewage effluents. It is widely used to characterise water quality. High levels of Ammonia affect fisheries and abstractions for potable water supply.*
BOD and BOD(ATU) Biochemical Oxygen Demand	*A measure of the amount of oxygen consumed in water, usually by organic pollution.*
Uninhibited BOD	*Oxygen is vital for life so the measurement of the BOD tests whether pollution could affect aquatic animals. The value can be misleading because much more oxygen is taken up by ammonia in the test than in the natural water. This effect is suppressed by adding a chemical (Allyl Thio Urea) to the sample of water taken for testing. Hence BOD(ATU). Without ATU, the BOD is Uninhibited.*
Classification/Classes	*A way of placing waters in categories (Classes) according to assessments of water quality based, for example, on measurements of the amount of particular chemicals in the water (especially BOD, Dissolved Oxygen and Ammonia).*
Coarse Fish	*Cyprinid fish like roach, dace and bream.*
Consent	*A statutory document issued by the NRA to indicate any limits and conditions on the discharge of an effluent to a water.*
Controlled Waters	*All rivers, lakes, groundwaters, estuaries and coastal waters.*
Dangerous Substances	*Substances defined by the European Commission as in need of special control because of their toxicity, bioaccumulation and persistence. Subjects of the Dangerous Substances Directive. The substances are classified as List I or List II (ibid).*

Directive	*A type of legislation issued by the European Community which is binding on Member States in terms of the results to be achieved but which leaves to Member States the choice of form and methods.*
Dissolved Oxygen	*The amount of oxygen dissolved in water. Oxygen is vital for life so this measurement is a vital test of the health of a water. Used to classify waters.*
Determinand	*A general name for a characteristic or aspect of water quality. Usually a feature which can be described numerically as a result of scientific measurement.*
EIFAC	*An acronym for the European Inland Fisheries Advisory Commission.*
EIFAC Standards	*Water quality standards for freshwater fish. Recommended by EIFAC, the European Inland Fisheries Advisory Commission.*
Eutrophic	*A description of water which is rich in nutrients. At worst, such waters are sometimes beset with unsightly growths of algae (ibid).*
Eutrophication	*The process of nutrient enrichment of waters. At its worst this causes unsightly growths of microscopic plants (algae, ibid).*
Game Fish	*Salmonid fish, e.g. trout and salmon.*
95-percentile	*A level of water quality, usually a concentration, which is exceeded for 5-percent of the time.*
95-percentile Standard	*A level of water quality, usually a concentration, which must be achieved for at least 95-percent of the time.*
Percentile	*In this report, a level of water quality, usually a concentration, which is exceeded for a set percentage of the time. Hence: 95-percentile (ibid).*

Quality Objective	*The statement or category of water quality that a body of water should match, usually in order to be satisfactory for use as a fishery or water supply etc.*
Quality Standard	*A level of a substance or any calculated value of a measure of water quality which must be bettered. The pairing of a specific concentration or level of a substance with a summary statistic like a percentile (ibid) or a maximum.*
Salmonid Fish	*Game fish, e.g. trout and salmon.*
Standard	*See Quality Standard.*
Statistically significant	*A description of a conclusion which has been reached after making proper allowance for the effects of random chance.*
Statutory Water Quality Objective	*A Quality Objective (ibid) given a statutory basis by Regulations made under the Water Act.*
Target Class	*The class which a water should achieve in the future. Some rivers may already be within their Target Class, others will require improvement.*
Uninhibited BOD	*See BOD.*

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