European Topic Centre on Inland Waters

REQUIREMENTS FOR WATER MONITORING

by

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EXECUTIVE SUMMARY

The European Topic Centre on Inland Waters was formed in December 1994 to undertake an identified programme of work for the European Environment Agency (EEA). This report is on one of the projects (MW1: Water Resources - quality and quantity, general approach to assessment) undertaken during 1995, and has the overall objective of suggesting possible approaches to co-ordinate and improve monitoring in the EEA area. This entailed the establishment of the detailed monitoring requirements of existing and proposed European Union (EU) legislation, policy and international agreements. At the time of finalising this report, information on monitoring requirements had not been validated by the Walloon and Brussels regions of Belgium.

Within the EEA area, many requirements for monitoring arise from the European Commission. However, there are also many other international commitments which make monitoring requirements and which are also detailed in this report.

EU legislation

Four types of directive have been employed by the EU to control the pollution of water: use-related directives; industry sector directives; substance directives; and, product directives. With the exception of the products directives, most of these directives require the implementation of monitoring, either routine programmes or preliminary investigations. The extent to which the monitoring requirements associated with directives overlap depends on commonalities between the national implementation of directive requirements, and the monitoring undertaken for this purpose will therefore vary from country to country.

The requirements made in the directives have been designed largely independently from each other. The Commission has, however, taken some initiatives to harmonise monitoring and reporting requirements in the Exchange of Information Decision (77/795/EEC as amended by Decision 86/574/EEC) and to harmonise reporting on the implementation of certain directives via questionnaires as specified in Council Decision (92/446/EEC) and laid down in the Reporting Directive (91/692/EEC).

In total four directives and one proposed directive make requirements for groundwater monitoring (the requirements made in the Dangerous Substances Directive (76/464/EEC) have been superseded by the Groundwater Directive (80/68/EEC)) and there is no overlap in the current monitoring requirements. With regard to surface waters, all monitoring requirements made in EU legislation which apply to rivers, also apply to lakes and reservoirs. Most directives which apply to freshwaters also apply to salt waters. The Shellfish Directive (79/923/EEC) is the only directive which applies to estuaries and coastal waters but not freshwaters.

Of the 15 directives that require monitoring of fresh surface waters, all include water column monitoring. The Dangerous Substances Directives and the Titanium Dioxide

Directive (82/883/EEC) also require monitoring of sediment and biota. The Exchange of Information Decisions make the only requirements for flow measurements. There are eight international agreements which also require monitoring of water quantity - flows and levels.

Barriers to the harmonisation of monitoring can be introduced at the sampling, analysis, and reporting stages, and can arise either because requirements differ (i.e. conflict) or because requirements are not clearly specified (i.e. weakness).

Sampling location

The most specific requirements in terms of named water bodies and measuring stations are in the Exchange of Information Decisions. These rivers are nationally significant rivers and lakes and as such are quite likely to be sampled for other national and international obligations (e.g. Rhine and Elbe Conventions). Generally, directives require monitoring in waters designated for specified uses or effected by specified discharges. Thus the scope for overlap in terms of sampling locations is dependant on the degree to which areas where designated use and the presence of specified discharges overlap, which is probably a limited circumstance in many states. Many of the directives allow the competent authority of each Member State to make decisions on such aspects as the exact sampling point, the distance from this point to the nearest point where pollutants are discharged and the depth at which the samples are to be taken but the same sites and depths should be used in all surveys, in relation to physical and temporal conditions.

As the choice of sampling location is, for some directives, related to areas designated by the Member States rather than by the European Commission, it is unlikely that, for some directives, a comparison of quality across Europe of these designated waters will give a complete picture of quality because the degree of comparability will depend on the interpretation of the designation rules and national differences of how these are implemented. Therefore, the degree of coverage that water quality data encompasses within each country will be determined by national designations and the prevalence of the industries that are required to be regulated.

For international agreements sample location is generally be related to the purpose of the agreement often being at designated or fixed sites. Other agreements are less specific, with the sampling location being determined by the needs of the signatories or monitoring programme.

Sampling frequency and period

The sampling frequency specified in directives and in international agreements is very variable. For some directives, once the fate and behaviour of an effluent is known and the effects have been established, and as long as there is no deterioration, then there is scope for the Member States to use a lower sampling frequency than specified in the directive. The sampling period is not usually specified or, if it is, the interpretation of its definition can give rise to differences

between countries (for example the definition of the bathing season). These imprecise requirements can give rise to different interpretations of results.

It is not apparent from most of the published directives whether there have been any, or if so, what, statistical considerations when defining the required sampling frequencies or numbers. These aspects have a significant effect on the statistical precision and confidence of the monitoring data produced. The required frequency should be derived with reference to the quantified risks that some waters will be misclassified (against compliance criteria).

Analysis

Sources of error in the overall assessment of a determinand in a water body would include sampling and analytical errors. The analytical requirements made in directives and in international agreements are generally very basic. Most directives stipulate analytical requirements in terms of performance criteria (i.e. limits of detection, precision and accuracy) and/or by method. The degree of definition, however, varies greatly from directive to directive. Many directives make very broad requirements to use '*appropriate methods*' for pre-treatment and analysis. The performance criteria are the key requirements with regard to analysis. Despite this several directives, for example the Titanium Dioxide Directive and all the use-related directives (except the Surface Water through the Sampling Analysis Directive), fail to establish performance requirements for analysis. In addition the laboratories concerned with applying the directives should be free to use '*appropriate methods*' providing they satisfy performance criteria. By comparison, analytical requirements in international agreements are rarely defined in terms of performance criteria, specific methods may be laid down, but often no requirements are made.

Probably the most significant omission in the requirements for analytical techniques is a requirement for analytical quality control (AQC). Increasingly AQC is being recognised as essential for data from monitoring programmes to be reliable and comparable. Microbiological methods should be standardised for efficiency of recovery and performance (accuracy, specificity, precision) and, for securing harmonisation of results between Member States, single reference procedures must be agreed for each determinand.

Compliance Assessment

Another important aspect of directives, particularly when a comparison of quality across Member States is expressed as a comparison of compliance against limits and standard values (e.g. as in the Bathing Waters Directive), is how the compliance requirements in the directives are expressed, calculated and interpreted. Differences in interpretation of these requirements is another significant barrier to harmonisation of monitoring and implementation of directives across Europe.

Interpretations

As well as the aspects described above, a further significant barrier to obtaining valid and quantitative temporal and spatial comparisons of water quality across Europe is the differences in how Member States implement and interpret directives. This issue has not been addressed in this project, but it is recommended that such an assessment is undertaken.

The Future

There are European policy initiatives and proposed new directives that will potentially change and/or increase the need for national and Europe-wide monitoring. In particular the groundwater action and water management programme (GAP) will focus on the monitoring of groundwater resources, and the proposed Ecological Directive will place more emphasis on biological monitoring in all surface waters.

The outputs from Project MW1 and MW2 (inventories of current monitoring networks) have been used in the next phase of the Topic Centre's work programme - the design of an inland water monitoring network to meet the needs of the European Environment Agency.

1. INTRODUCTION

The European Environment Agency (EEA) was established under Council Regulation No. EEC/1210/90 and was given a task:

> '*to provide the Community and the Member States with objective, reliable and comparable information at European level enabling them to take the measures to protect the environment, to assess the results of measures and to ensure that the public is properly informed about the state of the environment.*'

To assist in this task, the EEA established five European Topic Centres (ETC) in December 1994 addressing media-orientated monitoring projects on air quality, air emissions, inland waters, marine waters and coastal zone management (scoping study only) and nature conservation.

Three projects were originally identified by the European Environment Agency (EEA) to be undertaken by the European Topic Centre on Inland Waters (ETC/IW) during 1995.

These are coded and entitled as follows:

- MW1: Water resources - quality and quantity. General approach to assessment.
- MW2: Inventory of water resources monitoring networks.
- MW3: Design of freshwater monitoring network for the EEA area.

Additional Tasks within projects MW4 and MW5 were subsequently identified by the EEA for the 1994 subvention. The titles of MW4 and MW5 are as follows:

- MW4: Development and establishment of the European water quality monitoring network and data bases.
- MW5: Water resources evaluation.

The additional specific Tasks relate to the key issues and problems associated with the quality, use and resource of lakes and reservoirs in the EEA area, particularly in semi-arid and water scarcity regions.

The Tasks required to achieve the objectives of the Projects are described in detail in the technical work programme produced (Task 1) at the end of January 1995 by the Water Research Centre as the Lead Organisation of the ETC/IW. In brief, Task 2 is to review current and proposed European Union (EU) legislation, policies (such as the Dobríš assessment, including the identified Prominent Environmental Problems related to freshwater resources) and international agreements. Monitoring requirements made under these obligations are numerous, and, because they are generally designed to meet specific needs, the programmes have been designed largely independently from each other. Thus, monitoring requirements for inland waters in the EEA area have not been drafted in any co-ordinated way.

Task 3 is to use the information collated in Task 2 to suggest an approach to co-ordinate and improve monitoring across the EEA area. This report is on the findings of project MW1 (Tasks 2 and 3).

2. AIMS AND APPROACH

The overall objective of Project MW1 is to suggest possible approaches to co-ordinate and improve monitoring in the EEA area. This objective has a number of specific aims, namely to:

- establish the detailed monitoring requirements of existing and proposed European Union legislation, policy and international agreements;
- analyse the information gathered to highlight possible commonalities between the requirements made;
- identify key definitions which may be subject to interpretation and hence possible barriers to harmonisation; and,
- propose ways of harmonising monitoring requirements to avoid duplication, and improve cost-effectiveness.

This Task was achieved by a thorough review of current EU directives, regulations and decisions, policy statements and international agreements. This information was validated and supplemented by each Member State. This was achieved by a short questionnaire which listed relevant legislation, policies and agreements believed to be applicable to each country. The questionnaire was distributed to the Agency's National Focal Points (NFPs) for completion either by themselves or by other appropriate official bodies, such as the National Reference Centres (NRCs), nominated by them. Members of the ETC had the responsibility of making initial contacts with the NFPs for specific countries, to answer any questions arising and to chase and receive the completed questionnaires. In addition, ETC Members also had a responsibility to seek more detailed information on international agreements applicable to their own country and their other specified countries when necessary. As an example, the questionnaire for the United Kingdom is reproduced in Appendix A. Copies of the full list of commitments circulated and the list of the national representatives responsible for validating the list are given in Appendices A and B respectively.

The timetable, target dates and those actually achieved, for the circulation and receipt of the completed questionnaire is given in Appendix C. To date replies have been received from all EEA Members except the Belgium regions of Brussels and Walloon.

The information received from, or validated by, the returned questionnaires was entered into a database which was used to examine the information for commonalties and differences in monitoring requirements. The structure of the information and meta-data in the database is described in Section 3. Section 4 summarises the EU legislation and other international agreements which require monitoring. Sections 5 and 6 detail the basic and design requirements of monitoring and Section 7 discusses ways in which monitoring efficiency could be improved. The use of tables in the main text is kept to a minimum, with the more detailed summary tables being incorporated into Appendices D and E.

3. THE DATABASE

3.1 Database structure

The database was constructed using Microsoft Access software which offers a number of advantages. It is an extremely powerful relational database tool with excellent application development. In addition, it is both widely used by other organisations, such as EUROSTAT, and is able to support a large number of other database formats. Access, therefore, offers the potential for a great degree of compatibility with other databases that are already established.

The database is designed to minimise duplication of data and retain flexibility to allow interrogation for a wide range of queries. Figure 3.1 outlines the major component data tables held within the database. Four tables hold the information relating to monitoring required for each directive, these are labelled sampling, core, frequency and analysis. The information contained in these is as follows:

- **Sampling**: This table contains general information such as directive name, reporting frequency and other general comments;
- **Core**: This contains a list of determinands measured for each directive and indicates the type of water sampled along with which specific matrix is involved. This table is the key table in the database structure and provides all of the linking fields for relating different aspects of data;
- **Frequency**: Holds data related to frequency and sampling strategy for a determinand on a determinand basis;
- **Analysis**: Holds data related to methods of analysis associated with each determinand and covers all aspects of analytical method and allows comparison of methods of pre-treatment, limits of detection and AQC procedures.

In the four main tables described above data have been entered as faithfully as possible to that given in the directives (English versions). This reproduction of directive requirements has associated problems, small differences in the words used between one directive and another will mean that the database is incapable of accurately resolving commonalties. To solve these problems the database holds several look-up tables which attempt to standardise aspects of the data contained. A clear illustration of this comes from the determinand look-up table.

Determinand described by directive	Standardised term for determinand
Phenol	Phenol
Phenols	Phenol
Phenolic compounds	Phenol

In the above example phenol has been described by different directives in slightly different ways, the introduction of a standardised term allows the database to readily assess commonality. By careful consideration look-up tables can be constructed to assess commonality at any level. For example, the determinand look-up table has been further extended by grouping determinands into broad categories.

Determinand described by directive	Standardised term for determinand	Broad determinand type
Total ammonium	Ammonia	Nutrient
Non-ionised ammonia	Ammonia	Nutrient
Ammonia	Ammonia	Nutrient
Nitrites	Nitrite	Nutrient
Nitrite	Nitrite	Nutrient

This allows comparison between directives in terms of the types of determinand that are required for monitoring.

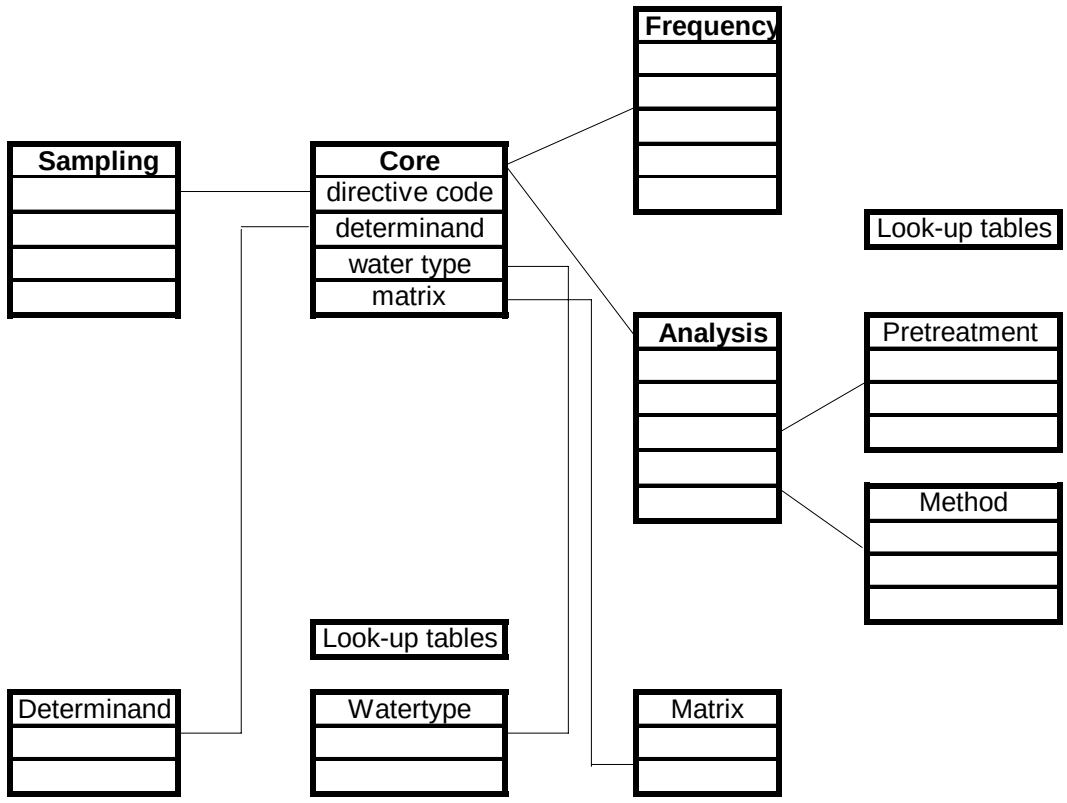


Figure 3.1 Schematic representation of the major elements of the database structure

Information from the directives was categorised in the database in terms of:

1. **Water type** (using the seven categories stated in the directives):
    - surface water (i.e. all types of surface water, namely fresh surface water, coastal and estuarine waters);
    - fresh surface water (i.e. only fresh water, namely rivers, lakes and reservoirs);
    - coastal waters;
    - estuaries;
    - groundwater;
    - freshwater (i.e. fresh surface water and groundwater); or,
    - salt water (i.e. coastal and estuarine waters).

2. **Matrix:**
    - water;
    - sediment; or,
    - biota.

3. **Determinand category** (quantity and quality):
    - physical (river flow, groundwater level, abstraction rate);
    - physicochemical (pH, salinity, alkalinity, temperature, turbidity, suspended solids);
    - organic pollution indicators (dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), organic carbon, redox potential);
    - metals;
    - synthetic organic compounds (e.g. organochlorines, organophosphorus, PAHs);
    - nutrients (nitrogen, phosphorus);
    - microbiological (total coliforms, faecal coliforms, faecal streptococci, viruses);
    - biological (invertebrates, fish tissue, shellfish, algae);
    - radioactivity (gross alpha and beta radioactivity, specific radionuclides);
    - chemical (other than physicochemical, organic, nutrients or metals); or,
    - aesthetic (foam, mineral oils, surfactants).

4. **Sampling**
    - methodology (e.g. on-line, discrete, composite);
    - frequency; or,
    - location and density.

5. **Analysis**
    - storage and pre-treatment;
    - methods;
    - performance; or,
    - specified quality control procedures.

6. **Reporting**
    - data treatment;
    - data storage;
    - compliance assessment of data against, for example, relevant standards and other requirements; or,
    - data availability, exchange and reporting.

An identical database was constructed for the international agreements. This allowed comparison of directives and international agreements at any level of detail either, within the databases, or through other packages such as Microsoft Excel.

3.2 Data analysis

Much of the analysis of the database has been undertaken using graphical-descriptions of the relationships between the monitoring requirements in the various directives. This has the aim of reducing the complexity of the multivariate information to a low-dimensional picture of how the directives may interrelate. The two techniques exploited here are hierarchical clustering and non-parametric multi-dimensional scaling (MDS). Each of these methods start explicitly from a triangular matrix of similarity coefficients computed between every pair of directives. This coefficient is a simple algebraic measure of how close the directives are, for example if two directives required monitoring of exactly the same determinands they would be 100% similar at this level.

Following the calculation of the similarity matrix, the results can be represented by a dendogram, linking the samples in hierarchical groups on the basis of the similarity between each cluster, or using MDS which attempts to place directives on a map. Both of these methods give a visual representation of "closeness" of the monitoring requirements of any combination of directives, Figure 3.2 outlines the stages involved the multivariate analysis.

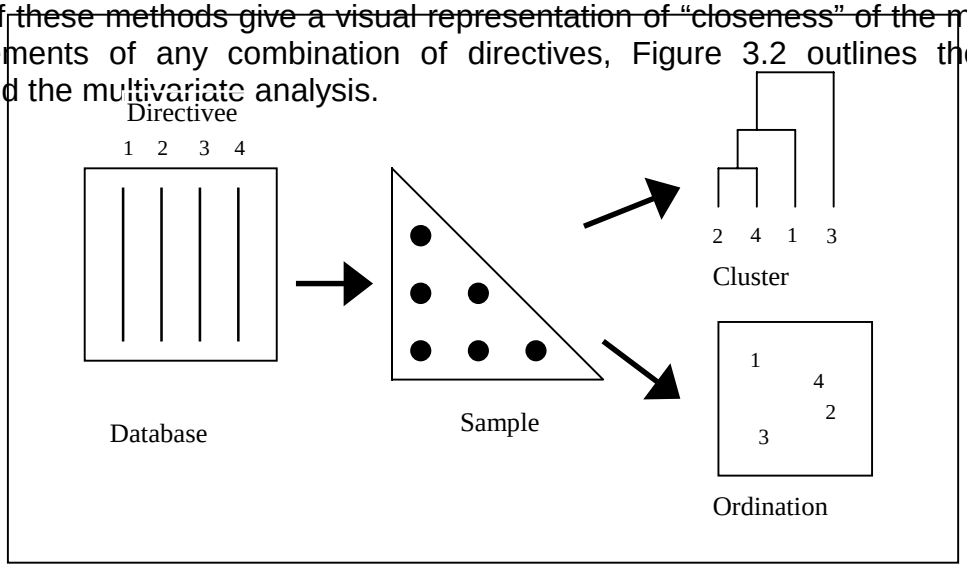


Figure 3.2 Stages in multivariate analysis (adapted from Clarke and Warwick 1994)

4. INTERNATIONAL COMMITMENTS

This Section briefly summarises international commitments which require monitoring of inland waters and the scope of their application in terms of the countries committed to meeting their requirements.

Within the EEA area, many requirements for monitoring arise from the European Commission. However, there are also many other international commitments which make monitoring requirements. Both categories are addressed in this report.

4.1 EU legislation and policies

4.1.1 Directives

Since the foundation of the European Community, several directives have been introduced to protect the quality of water resources, many of which contain monitoring requirements for inland waters. With a few exceptions (see Table 4.1), all Member States are required to implement the requirements made in these directives. The new Member States, i.e. Austria, Finland and Sweden, and the new Länder in Germany have, in some cases, been granted extended periods for implementation. Norway and Iceland are not members of the EU and are therefore not bound to meet the requirements of the directives, however, they have signed the EEA agreement obliging them to respect environmental standards.

As previously mentioned, the requirements made in the directives have been designed largely independently from each other. The Commission has, however, taken some initiatives to harmonise monitoring and reporting requirements in the Exchange of Information Decision (77/795/EEC as amended by Decision 86/574/EEC), and in the Reporting Directive (91/692/EEC) as detailed in Council Decision (92/446/EEC).

In the Exchange of Information Decision, Member States are asked to use a common procedure to exchange the results on the quality of fresh surface waters. It specifies measuring stations (covering the main rivers in each Member State), a list of determinands to be monitored, as well as, briefly, methods of analysis. It also recommends intercalibration exercises and gives a simple format for the data to be reported (unit and significant figures).

The Reporting Directive requires the use of standard questionnaires (as provided in Council Decision (92/446/EEC)) as a framework within which reports are to be submitted to the Commission, mainly on the implementation of certain EU directives. The objective is to achieve harmonised information on the monitoring undertaken in respect of EU directives rather than to harmonise monitoring requirements.

Table 4.1 European legislation requiring monitoring of inland waters

Legislation	Dates of formal compliance	Exceptions
Surface Water[a] Directive (75/440/EEC)	18/06/77	• Austria until 01/10/95 • New Länder until 31/12/95
Sampling and Analysis of Surface Water[a] Directive (79/869/EEC)	11/10/81	• Austria until 01/10/95 • New Länder until 31/12/95
Bathing Water[b] Directive (76/160/EEC)	10/12/77	• Austria until 31/12/96, first report for 1997 • New Länder until 31/12/03
Dangerous Substances Directive (76/464/EEC)	n\s	• New Länder until 31/12/95 • Luxembourg
Mercury from Chlor-alkali Directive (82/176/EEC)	01/07/83	• New Länder until 31/12/95 • Ireland and NI - no industry present
Mercury from other Sectors Directive (84/156/EEC)	12/03/86	• New Länder until 31/12/95
Cadmium Directive (83/513/EEC)	28/09/85	• New Länder until 31/12/95
Hexachlorocyclohexane Directive (84/491/EEC)	01/04/86	• New Länder until 31/12/95
Carbon tetrachloride Directive (86/280/EEC)	01/01/88	• New Länder until 31/12/95
Aldrin, etc. Directive (88/347/EEC)	01/01/89	• New Länder until 31/12/95
Dichloroethane, etc. Directive (90/415/EEC)	01/01/92	• New Länder until 31/12/95
Titanium Dioxide Directive (82/883/EEC)	03/12/84	• Greece-no Titanium problem • Austria, Ireland, Scotland, NI - no industry present
Freshwater Fish[b] Directive (78/659/EEC)	20/07/80	• New Länder until 31/12/92 • Finland - still to implement
Shellfish[b] Directive (79/923/EEC)	05/11/81	• Austria, Walloon, Luxembourg • Finland -still to implement
Groundwater[c] Directive (80/58/EEC)	19/12/81	• New Länder until 31/12/95
Drinking Water[d] Directive (80/778/EEC)	17/07/82	• Flanders-only water supply monitored
Urban Waste Water Treatment Directive (91/271/EEC)	30/06/93	• Denmark-awaiting information • Greece-an initial implementing programme exists • Italy
Nitrates Directive (91/676/EEC)	19/12/93	• Finland-still to designate NVZs • Greece-basic monitoring in whole country
Exchange of Information Decisions (77/95/EEC) (86/574/EEC)	12/06/78	• Italy-implementation being investigated
Report Format Decision[e] (92/446/EEC)		• Flanders-implementation being investigated • Portugal-applies only for Bathing Waters

Notes:
a Monitoring only at list of sampling stations
b Monitoring only in designated areas
c No specific monitoring requirements as such although some site specific investigation sampling may be required for purposes of identifying the appropriate control measures and auditing their effectiveness
d Initial analysis of source waters to be carried out before exploitation and to investigate problems and resolve pollution during exploitation
e No monitoring requirement but harmonised format for reporting results of monitoring of several directives
NI Northern Ireland
n\s Not specified
NVZs Nitrate vulnerable zones

At the time of submitting this report it should be noted that the information on monitoring requirements had not been validated by the Walloon and Brussels regions of Belgium.

A brief summary of the objectives for each directive is given in Table 4.2 below.

Table 4.2 Summary of objectives and purposes of European legislation

Legislation	Summary/Objective/Purpose
Surface Water Directive (75/440/EEC)	Classifies sources of surface water for abstraction of drinking water by their existing quality into 3 categories corresponding to 3 standard methods of treatment. Two purposes: to ensure that surface water used as drinking water reaches certain standards and is given adequate treatment and thereby to improve rivers or other surface waters used as sources for drinking water.
Sampling of Surface Water Directive (79/869/EEC)	Recommends methods of measuring determinands for surface waters used as sources for drinking water (not mandatory) in terms of precision and accuracy. The frequency of such measurements is set by Member States based on minimum frequencies specified in the Directive. These frequencies increase as the quality (category) of surface water decreases and as the population served increases.
Bathing Water Directive (76/160/EEC)	Sets standards for bathing water (fresh or sea water) quality during the bathing season in terms of physical, chemical and microbiological determinands. Monitoring requirements are defined in terms of minimum frequency, location and reference methods for analysis.
Dangerous Substances Directive (76/464/EEC)	Requires the elimination or reduction of pollution of inland, coastal and territorial waters by particularly dangerous substances (List I and List II). Subsequent daughter directives set standards (limit values and quality objectives) for particular substances. Discharges of both List I and List II substances are to be subject to prior authorisation. For List II, pollution reduction programmes must be implemented and results of implementation must be communicated to the Commission. For List I, inventories of all discharges must be reported.
Daughter Directives: • Mercury from Chlor-alkali (82/176/EEC) • Mercury from other Sectors (84/156/EEC) • Cadmium (83/513/EEC) • Carbon tetrachloride (86/280/EEC) • Hexachlorocyclohexane (84/491/EEC) • Aldrin, etc. (88/347/EEC) • Dichloroethane, etc. (90/415/EEC)	Specifies limit values for different types of processes or industrial sectors which must be met in 2 stages and quality objectives for various types of waters (inland surface water, estuaries, coastal and territorial and water abstracted for drinking water) and sometimes biota. Areas affected by discharges must be identified by Member States and monitored to ensure that quality objectives are met. A standstill provision applies for concentration in sediment, fish and shellfish.
Titanium Dioxide Directive (82/883/EEC)	Establishes procedures for surveillance and monitoring required under Directive 78/176/EEC to prevent and reduce pollution caused by waste from the titanium dioxide industry. It covers monitoring of air, salt water, freshwater, storage and dumping on land and injection into soil.
Freshwater Fish Directive (78/659/EEC)	Sets quality objectives for designated fresh waters in order to support fish life. Two types of waters are to be designated those suitable for: salmonids; and cyprinids. Objectives are based on physical and chemical determinands. Minimum monitoring frequencies and some reference methods for analysis are given.

Table 4.2 continued

Legislation	Summary/Objective/Purpose
Shellfish Waters Directive (79/923/EEC)	Sets quality objectives for designated coastal and brackish waters in order to support shellfish. These are based on physical, chemical and microbiological determinands. Minimum monitoring frequencies are given. A separate directive (91/492/EEC) is concerned with protecting consumers of shellfish.
Groundwater Directive (80/68/EEC)	Aims to protect exploitable groundwater sources of drinking water from direct and indirect discharge of dangerous substances (Lists I and II). Prior investigations must be carried out prior to authorisation of a discharge and the effect of discharges on groundwater must be monitored.
Drinking Water Directive (80/778/EEC)	Sets standards for the quality of water intended for human consumption. Regular quality monitoring is to be carried by Member States to check compliance with the standards at the point where the water is made available to the consumer. Frequency increases with the size of the population supplied. Reference methods of analysis are given. Only some determinands have to be checked as an initial analysis before a source is exploited.
Urban Waste Water Treatment (UWWT) Directive (91/271/EEC)	Aims to reduce pollution of freshwater, estuarine and coastal waters by urban waste water, some industrial waste water and run-off waters. It sets minimum standards for collection and treatment of urban waste water and a timetable for implementation. Bans sewage sludge disposal at sea. It requires Member States to designate areas sensitive to waste water pollution where a higher level of treatment must be applied and to identify less sensitive areas where standards can be lower while monitoring that no adverse effect is taking place. Any receiving water must be monitored where negative effects might be expected.
Nitrates Directive (91/676/EEC)	Aims to reduce or prevent water pollution due to the application and storage of fertiliser and manure on farmland so as to protect drinking water supplies and to prevent eutrophication of fresh and marine waters. Member States must designate waters actually or potentially affected by pollution from nitrates as vulnerable zones (VZ). For the purpose of designating and reviewing VZ, a one-year monitoring programme is to be undertaken and repeated every 4-8 years. Every 4 years, the eutrophic state of freshwaters, estuaries and coastal waters is also to be reviewed. Reference methods of measurement are given. Every 4 years (beginning June 1996), a report is to be forwarded to the Commission.
Exchange of Information Decisions (77/795/EEC) (86/574/EEC)	Establishes a common procedure for the exchange of information on the quality of surface freshwater. Requires monitoring for specified water quality determinands at specific measuring stations (covering the main rivers in each Member State). Results of monitoring must be submitted to the Commission. Reference methods of analysis are given.

4.1.2 Other policies

There are other policies instigated within the EU that have or will have a potential effect on the monitoring requirements of water resources in the EEA area. These are briefly outlined below.

Groundwater action and water management programme

A Ministerial seminar held at the Hague in 1991, on the long term deterioration of the quality and quantity of water resources, emphasised the special significance of groundwater in the water cycle and in ecosystems, and as a source for drinking water. As a result the European Council called for Community Action and required that a detailed action programme be drawn up for comprehensive protection and management of groundwater as part of an overall policy on water protection. This led to a draft proposal for a groundwater action and water management programme (GAP) which requires a programme of actions to be implemented by the year 2000 at both national and EU levels, aiming at sustainable management and protection of freshwater resources. The draft proposal develops the basic quality standards for groundwater adding at the same time a quantitative dimension to water management. National action programmes should aim for full implementation by 2000 and should address elements such as mapping and monitoring of quality and quantity of freshwater resources, identification and designation of protection zones for areas of particular ecological interest and sensitivity, including present and future resources for drinking water and other resources. Water quality and quantity should be appropriately monitored in order to provide Member States with sufficient information to allow them to follow developments in the quality and quantity of aquifers and in particular to detect early signs of deterioration from leaching of dangerous substances towards groundwater reservoirs

Fifth environmental action programme

The United Nation's Conference on Environment and Development (UNCED) held in 1992 in Rio de Janeiro focused the world's attention on the need to promote environmentally sustainable development. Agenda 21 was one of the agreements arising from the Rio Conference and sets out a comprehensive programme of actions for achieving sustainable development, sector by sector for the next century. National strategies and action plans are the key to the implementation of Agenda 21. The fifth environmental action programme, published in March 1992, represents an important starting point for the implementation of Agenda 21 in the EU.

The fifth environmental action programme stated that community policies must aim at:

- preventing pollution of fresh and marine surface waters and groundwater with particular emphasis on prevention at source;
- restoring natural ground and surface waters to an ecologically sound condition, thus ensuring a suitable source for extraction of drinking water; and,
- ensuring that water demand and water supply are brought into equilibrium on the basis of more rational use and management of water resources.

Long term targets to be achieved by the year 2000 are also given. These are in line with the programme of action outlined in the Hague Declaration and the subsequent GAP. The objectives of these targets include for groundwater: the maintenance of

uncontaminated aquifers; the prevention of further contamination of contaminated aquifers; and, the restoration of contaminated aquifers for drinking water. For surface freshwaters the objective is to maintain a high ecological quality with a biodiversity corresponding as much as possible to the unperturbed state of a given water and for marine waters, a reduction of discharges of all environmentally hazardous substances to levels consistent with high standards of ecological quality. For marine waters there is also an action for surveillance of geographic zones with appropriate monitoring techniques. It is also likely that specific monitoring would be required in order to achieve the other objectives, particularly for groundwater where relatively little monitoring is apparently undertaken at present.

The Dobríš report

The Pan European Conference of Environment Ministers held at Dobríš Castle in 1991 called for the preparation of a State of the Environment report for Europe and invited the European Commission to take responsibility for the work. This request recognised the need for the compilation of reliable and comparable data in order develop effective policies for Europe's environment.

The report identified a number of important and significant information gaps. In particular, the report noted:

- the absence of regional water resource statistics so that the present rates and trends of water abstraction by source and economic sectors are poorly known;

- an almost complete lack of comparable and reliable data on groundwater quantity and quality;

- a lack of comparable and reliable data on surface water quality across Europe making a comparison very difficult, in particular data were lacking on small rivers and lakes, whilst data on organic micropollutants, metals and radioactivity were patchy and incomplete. Biological assessments of river quality are carried out using a variety of methods and hence were not comparable;

- there is no pan-European water quality database either for freshwater or for marine water and reporting schemes differ markedly between countries;

- with regard to marine waters and seas there is very little comparable data on water quality and biology available for the White sea and Barents sea, and estimates of pollutants loads from different human activities and natural sources in general are not available; and,

- there is also a need for a unified procedure for estimating land-based emissions to seas so that comparison of contaminant load estimates between different seas can be made.

The Dobríš report noted problems associated with the aquatic environment in Europe (not only the EEA area but also eastern Europe). These included water

scarcity problems in southern European countries, over-exploitation of groundwater (65% of Europe's population is supplied from groundwater), nitrate problems in north-western Europe, pesticides in soil water, river and lake eutrophication and acidification of rivers and lakes. It also defined European prominent environmental problems which have potential implications on the monitoring required (or at least the data and information required) to define and assess temporal and spatial differences. Those that effect water resources include: climate change (effects on hydrological cycle, sea level rise, salination of freshwaters, effects on aquatic ecosystems); acidification (effects on lakes, rivers and streams); and, the management of freshwater (water availability, water quality, groundwater pollution, eutrophication, organic pollution (including pathogens), acidification, physical changes).

4.2 Other international agreements

There are a large number of international agreements concerning surface waters, however, not all of these make monitoring requirements (see Appendix A.2). Many agreements aim to protect a specific water body and are made between countries within the catchment of that water body. For large rivers and seas this can involve many countries, for example, the agreements made at the North Sea Conferences are made between all countries bordering the North Sea, i.e., Norway, Sweden, Denmark, the Netherlands, Germany, France and the UK. By contrast, there are many agreements which exist between just two countries**.** Thus the scope of application for international commitments varies greatly. For the purposes of this report, they have been divided into three categories:

- multi-national commitments, i.e. between three or more EEA countries;
- international commitments where more than one party has signed the EEA agreement; and,
- international commitments where only one party has signed the EEA agreement.

Harmonisation with the latter type of agreement may be difficult because of the differing priorities of parties outside of the EEA area. This review therefore concentrates on the first two categories.

A brief summary of the objectives for those agreements which require monitoring and which fall into category A, i.e. involving three or more EEA countries, is given in Table 4.3. A list of all international agreements which require monitoring is given in Table 4.4 which also indicates the countries obliged to meet the requirements laid down.

There are also other international organisations that some, if not all, EEA Member States are members of, or co-operate with, that either instigate monitoring programmes, or collect, collate, report and disseminate national monitoring data and information. These are discussed briefly below and the objectives of those which make monitoring requirements are summarised in Table 4.3.

The Organisation for Economic Co-operation and Development (OECD) has developed a questionnaire on the State of the Environment which since 1988 has been jointly presented with that from EUROSTAT. Before 1992 the OECD concentrated on water abstraction and water consumption (with little breakdown by

activities), pollution connected to sewage treatment plants, total polluted water discharged (without reference to its origin), and data on surface water quality for sample stations at the borders of Member States. In addition, EUROSTAT collects data on water quality indicators for selected rivers and lakes. In the last revision of the now joint EUROSTAT/OECD questionnaire on inland waters (during 1990-1991) more detailed questions on water resources and waste water treatment were added. In the questions concerning water abstraction, consumption and discharge, a limited breakdown into activities has been added and determinands have been redefined.

The United Nations established an Environment Programme (UNEP) to act as 'a focal point for environmental action and co-ordination within the United Nation's system' within which a Regional Seas Programme (now the Oceans and Coastal Areas Programme) was adopted in 1978.

An international group of experts, GESAMP, sponsored by the United Nations, collects monitoring data and information from different states so that it can to report on, and assess, current marine environmental quality issues and provide scientific advice on marine pollution problems to the sponsoring agencies and to the Intergovernmental Oceanographic Commission (IOC).

The United Nations Economic Commission for Europe (UNECE) has promoted international co-operation on water issues for over four decades. To meet the dual challenges of sustainable use of water and maintenance of acceptable environmental quality, the UNECE has adopted a number of declarations and decisions resulting from the work of its committee on water problems. These declarations and decisions are intended to provide guidance to UNECE member governments in formulating and implementing water management policies and should assist in fostering co-operation among UNECE Member States. The UNECE has recently developed (1992) the Convention on the Protection and Use of Transboundary Watercourses and International Lakes. The Convention has been signed by 25 European countries as well as by the EU, and will come into force 90 days after it has been ratified by 16 of these countries. The European Commission has made a proposal for a Council Decision (COM(93)271 final), which, if adopted would ratify the Union's signature of the Convention. The Convention will require establishment of programmes for monitoring the conditions of transboundary waters, surface and groundwaters.

The Convention on Long Range Transboundary Air Pollution also has monitoring activities for water in two subgroups, namely:

- surface water: international co-operative programme on acidification of lakes and rivers (ICP-Waters);

- surface and groundwater: international co-operative programme on integrated monitoring of ecosystem effects (ICP Integrated monitoring).

Table 4.3 Summary of objectives and purposes on international agreements between three or more EEA countries

Agreement[1]	Summary/Objective/Purpose
Moselle 1961	Established an international commission for the protection of the Moselle against pollution through collaboration between the competent authorities of the three signatory governments (D,F,Lu). The Commission should: prepare and carry out necessary research to determine the nature, importance and origin of pollution and put the results of such research to use; and, propose to signatory governments measures capable of protecting the Moselle against pollution.
North East Atlantic (Oslo Convention) 1972 [a]	Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft. One of the Tasks of the Commission that administers the Convention is to review generally the condition of the sea within the Convention area. The contracting parties must also harmonise their policies and introduce, individually and together, measures to prevent pollution of the sea by dumping by or from ships and aircraft.
North East Atlantic (Paris Convention) 1974 [a]	Represents the second step taken by the maritime states bordering the North East Atlantic in combating pollution of the marine environment of that region. It followed on from the Oslo Convention which deals with the control of pollution of the seas by the dumping of harmful substances. It introduced two lists of substances for control, the Black and Grey Lists. Contracting countries are obliged to eliminate pollution by substances on the Black List and limit pollution by substances on the Grey List. This approach was later adopted in EU legislation. The Convention is administered by a Commission (PARCOM) which requires, amongst other things, marine environmental monitoring to be undertaken. A Joint Monitoring Programme (JMP) was established with the Oslo Commission in 1987.
Baltic Sea (Helsinki Convention) 1974/1992	The original Convention was signed in 1974 by 7 states and covered pollution of the Baltic Sea from land, air and water. Recent political changes have enabled the Convention to be re-drafted (in 1992) to reflect advances in pollution control as well as the expansion in the number of countries (13 and the EU) that now have an impact on the Baltic. The new Convention requires the use of best available technology to control point sources and the use of best environmental practice to control diffuse inputs. It also places greater emphasis on controlling riverine inputs of pollutants. A Baltic Monitoring Programme has been established to follow the long term changes and trends of selected determinands in the Baltic ecosystem.
Mediterranean (Barcelona Convention) 1976	Mediterranean Action Plan (MAP) (Phase I 1975 - 1980) leading to the long term Mediterranean Pollution and Monitoring and Research Programme (MEDPOL). Phase II (1981-), included monitoring at four levels: sources of pollution; near shore areas; offshore areas; and, atmospheric transport of pollutants. MEDPOL monitoring started in 1983 through the implementation of National Monitoring Programmes and at present 16 countries have on-going programmes and are submitting data.

Table 4.3 continued

Agreement[1]	Summary/Objective/Purpose
Rhine 1976	In 1950, the International Commission for the Protection of the Rhine against Pollution (ICPR) was founded in Basle. In 1963, the International Convention (Bern Convention) detailed the tasks of the ICPR which include monitoring the state of the Rhine and preparing international conventions on chemical pollution (Rhine Convention 1976), chlorides (Bonn Convention 1976 and 1991) and thermal pollution (ICPR's work in this field is now ended). In 1987, the Rhine countries as well as the ICPR elaborated a comprehensive action programme, the Rhine Action Programme (RAP) which defined targets to be achieved by the year 2000. The ICPR has a monitoring programme which is revised regularly, the latest was published in July 1994 for 1995.
Rhine (hydrology) 1989	This Commission was founded in 1970 by regional co-operation of the national International Hydrological Decade (IHD) committees within the framework of the United Nations Educational and Social Organisation (UNESCO) IHD programme. The Commission later (1975) also worked within the framework of the Operational Hydrological programme of the World Meteorological Organisation. It's tasks include supporting the co-operation of scientific hydrological institutes and hydrological services, promoting the exchange of data and information, and standardising data bases and the exchange of results on hydrological research in the Rhine basin.
North Sea (conference) 1990	Establishes a common list of 36 dangerous substances, referred to as the North Sea Conference Common, or Annex IA, List. Signatories agreed to achieve significant reductions of these 36 substances and nutrients from rivers and estuaries to the North Sea by around 50% between 1985 and 1995.
North Sea (NSTF) 1987	Established following a Ministerial Declaration made at the Second International Conference on the Protection of the North Sea held in London in November 1987. Its aim was to enhance scientific knowledge and understanding of the North Sea environment, to provide more consistent and dependable data and to permit links between contaminant inputs, concentrations and effects to be established with greater confidence. A North Sea Task Force Monitoring Master Plan (MMP) has been developed which builds on the monitoring carried out under the Joint Monitoring Programmes (JMP) of the Oslo and Paris Commissions.
Arctic Sea (AMAP) 1993	At a Ministerial conference in Rovaniemi, Finland 1991, the Ministers from eight Arctic countries agreed to develop an Arctic Monitoring and Assessment Programme. The primary objectives of the programme are the measurement of the levels of anthropogenic pollutants and assessment of their effects in relevant compartments of the Arctic environment. The assessment will include monitoring for fresh and marine waters and will be presented in status reports. As an initial priority, the AMAP will focus on persistent organic contaminants, selected heavy metals and elements and radionuclides. Ultimately, AMAP should include ecological indicators to provide a basis for the assessment of the status of the Arctic ecosystems.
North East Atlantic (OSPAR) 1992 [a]	This is a wide ranging agreement covering the North East Atlantic and many aspects of the marine environment including the dumping of waste, incineration, assessment of loads to the environment, and the impact of oil installations. The convention has replaced the agreements made in the Oslo and Paris Conventions. A monitoring and assessment programme (JAMP) is currently under preparation to replace the JMP.
Transboundary Waters 1992	This was developed under the auspices of the United Nations Economic Commission for Europe to provide a mechanism for prevention of transboundary water pollution and rational use of water resources in Europe. The EU has signed the Convention although it has not yet been ratified by the Council. Once adopted the Convention requires monitoring of transboundary waters, surface and groundwaters, quality and quantity. Monitoring programmes have yet to be drafted.
Meuse 1994	The details of the associated monitoring programmes are being formulated.
Scheldt 1994	The details of the associated monitoring programmes are being formulated.

Notes: 1 A list of the full names for international agreements is given in Appendix A, Table A.2

a The requirements for monitoring marine water quality under the Oslo Convention were consolidated with those of the Paris Convention in 1978 in the joint monitoring programme (JMP). This is dealt with under North Sea (Paris) 1974. The JMP will be superseded by the Joint Assessment and Monitoring Programme (JAMP) in the future under OSPAR 1992.

Table 4.4 Summary of international agreements requiring monitoring of inland waters in the EEA area

	International Agreement [2]	A	B*	D	Dk	E	F	Fi	Gr	I	Ic	Irl	L	N	NL	Pt	S	UK	EC	Others
	Category A																			
A.1	Moselle 1961	-	-	X	-	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-
A.2	North East Atlantic (Oslo) 1972[b]	-	X	X	X	X	X	X	-	-	X	X	-	X	X	X	X	X	-	-
A.3	Baltic Sea (Helsinki) 1974/1992	-	-	X	X	-	-	X	-	-	-	-	-	-	-	-	X	-	X	PO,RU,ES,LILA,CZ,SL, UKR
A.4	North East Atlantic (Paris) 1974[b]	-	X	X	X	X	X	-	-	-	X	X	X	X	X	X	X	X	X	-
A.5	Mediterranean Sea (Barcelona) 1976	-	-	-	-	X	X	-	X	X	-	-	-	-	-	-	-	-	X	-
A.6	Rhine 1976 [a]	-	-	X	-	-	X	-	-	-	-	-	X	-	X	-	-	-	X	CH
A.7	Rhine (hydrology) 1989																			
A.8	North Sea (conference) 1990	-	X	X	X	X[1]	X	X[1]	-	X[1]	-	X[1]	-	X	X	X[1]	X	X	X	CZ
A.9	North Sea (NSTF) 1987	-	X	X	X	-	X	-	-	-	-	-	-	X	X	-	X	X	-	-
A.10	Arctic Sea (AMAP) 1991			X[1]	X			X				X		X	X[1]		X	X[1]		C, USA, RU
A.11	North-East Atlantic (OSPAR) 1992[b]	-	X	X	X	X	X	X	-	-	-	X	X	X	X	X	X	X	X	CH
A.12	Transboundary Waters 1992[c]	X	X	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	-
A.13	Meuse 1994	-	X	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-
A.14	Scheldt 1994	-	X	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-
	Category B																			
B.1	Foyle Fisheries 1952	-	-		-	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
B.2	Lake Inari 1959	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-	RU
B.3	Lake Constance 1960	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CH
B.4	Sarre 1961	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
B.5	Lake Constance (water withdrawal) 1966	X	-	X-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CH
B.6	Frontier Rivers (Fi/S) 1971	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-
B.7	Boundary Waters (Fi/N) 1980	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-	-
B.8	Danube (Bucharest) 1985	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	BU,CZ,SL, SV,HU,RO, UKR, Y
B.9	Moselle (industry) 1986	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-
B.10	Danube (Regensburg) 1987	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
B.11	Elbe (Magdeburg) 1990	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	CZ,SL
B.12	Danube (Sofia) 1994	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	BU, CR, HU, MO, ROM ,SL, UKR
	Category C																			
C.1	Drava 1954	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y
C.2	Mura 1954	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SV
C.3	Lake Lugano 1955	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	CH
C.4	Water Economy (Au/Hu) 1956	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	HU
C.5	Lake Geneva 1962	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	CH
C.6	Frontier Waters (Fi/Ru) 1964	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	RU
C.7	Frontier Waters (Au/Cz) 1967	X																		CZ
C.8	Frontier Waters (Au/Sl) 1970	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SL
C.9	Italo-Swiss Waters 1972/86	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	CH
C.10	Vuoska 1972/83	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	RU
C.11	Adriatic 1974	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	SV

Table 4.4 continued

	International Agreement [2]	A	B*	D	Dk	E	F	Fi	Gr	I	Ic	Irl	L	N	NL	Pt	S	UK	EC	Others
	Category C (cont.)																			
C.12	Lake Geneva (navigation) 1976	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	CH
C.13	Frontier Waters (I/Sv) 1978	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	SV
C.14	Lake Geneva (phosphorus) 1980	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	CH
C.15	Saimaa/ Vuoski 1989	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	USSR
C.16	Technical Co-operation (Bu/Gr) 1991	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
C.17	Black Sea 1992	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	BU, GE, RO, RU,TU,UKR

Notes:
- A Multi-international convention, applicable to three or more EEA Member States.
- B International convention applicable to two EEA Member States.
- C International convention applicable to only one EEA Member State.
- 1 Observer.
- 2 A list of the full names for international agreements is given in Appendix A, Table A.2
- a In 1950, the International Commission for the Protection of the Rhine against Pollution (ICPR) was founded in Basle. In 1963, the International Convention (Bern Convention) detailed the tasks of the ICPR including monitoring the state of the Rhine and preparing international conventions on chemical pollution (Rhine Convention 1976), chlorides (Bonn Convention 1976 and 1991) and thermal pollution (ICPR's work in this field is now ended). In 1987, the Rhine bordering countries as well as the ICPR elaborated a comprehensive action programme, the Rhine Action Programme (RAP) which defined targets to be achieved by the year 2000. The ICPR has established a monitoring programme which is revised regularly, the latest has been published in July 1994 for 1995-programme.
- b Monitoring under the Oslo and Paris Conventions was consolidated in 1987 in the JMP. The conventions will be replaced by OSPAR 1992 and a Joint Assessment and Monitoring Programme (JAMP) will be drafted to replace the JMP.
- c When ratified by the European Council.
- * Country which has not yet replied to MW1 questionnaire (Belgium, Brussels and Walloon regions).

Countries:

A-Austria	B-Belgium	BU-Bulgaria	C - Canada	CH-Switzerland
CR- Croatia	CZ-Czech Republic		D-Germany	DK-Denmark
E-Spain	EC/EU-European Community/Union			ES-Estonia
F-France	Fi-Finland	GE-Georgia	GR-Greece	HU-Hungary
I-Italy	Ic-Iceland	IRL-Ireland	L-Luxembourg	LA-Latvia
LI-Lithuania	MO-Moldavia	N-Norway	NL-Netherlands	Pt-Portugal
PO-Poland	RO-Romania	RU-Russia	S-Sweden	SL-Slovakia
SV-Slovenia	TU-Turkey	UK-United Kingdom		UKR-Ukraine
USA - United States of America		USSR- Union of Soviet Socialist Republics		
Y-Yugoslavia				

5. MONITORING - BASIC REQUIREMENTS

There are certain requirements for monitoring which can be classed as 'basic requirements' since they are, to a large extent, predetermined by the objectives of the directive/agreement. Such requirements are:

- water type (i.e. groundwater, rivers, lakes/reservoirs, estuaries and coastal waters);
- matrix (i.e. water column (including suspended sediments), settled sediment and biota); and,
- determinand type (both quantity and quality determinands).

Appendix D summarises the monitoring requirements made in EU legislation and other international agreements according to these criteria.

These monitoring requirements can be analysed using the multivariate statistical techniques described in Section 3.2, namely clustering and multidimensional scaling (MDS), to give a simple two dimensional picture of the similarities between the requirements. Figures 5.1 to 5.6 show the results of the analysis for EU legislation and international agreements.

For EU legislation, the key features to note are (Figures 5.1 and 5.2):

- the extreme similarity between many of the directives when considering them at this high level (i.e. not taking into account analysis methods, sampling frequency etc.) for example, between the Dangerous Substances Daughter Directives. In these cases the similarities can be attributed to same water types, matrices and similar determinands being measured;
- the distinct dissimilarity of the Proposed Landfill Directive from all other directives as it is the only proposed directive which applies exclusively to groundwater; and,
- the definition of two clusters at around the thirty percent similarity level. This clustering can be attributed to the type of water monitored, those directives in the top cluster are only associated with one water type, usually fresh water, and those in the lower cluster have monitoring associated with many water types.

Figure 5.2 is the result of an MDS analysis of the same data and broadly reveals the same groupings as those defined by the clustering technique. The key feature to note here is the distinct similarity of many of the directives at this high level of analysis so that they collapse to a single point on the map. The plot also provides information on dissimilarity of the other directives:

- the Shellfish Waters Directive forms a singleton group as this is the only directive for which marine monitoring only is required;
- the proposed Landfill Directive forms a singleton group as this is the only directive requiring groundwater monitoring exclusively;

- the Freshwater Fish Directive, Exchange of Information Decisions, the Surface Water and its Sampling Directive (Sampling and Analysis in the Figures) together with the Drinking Water Directive form a group which only require monitoring of freshwaters.

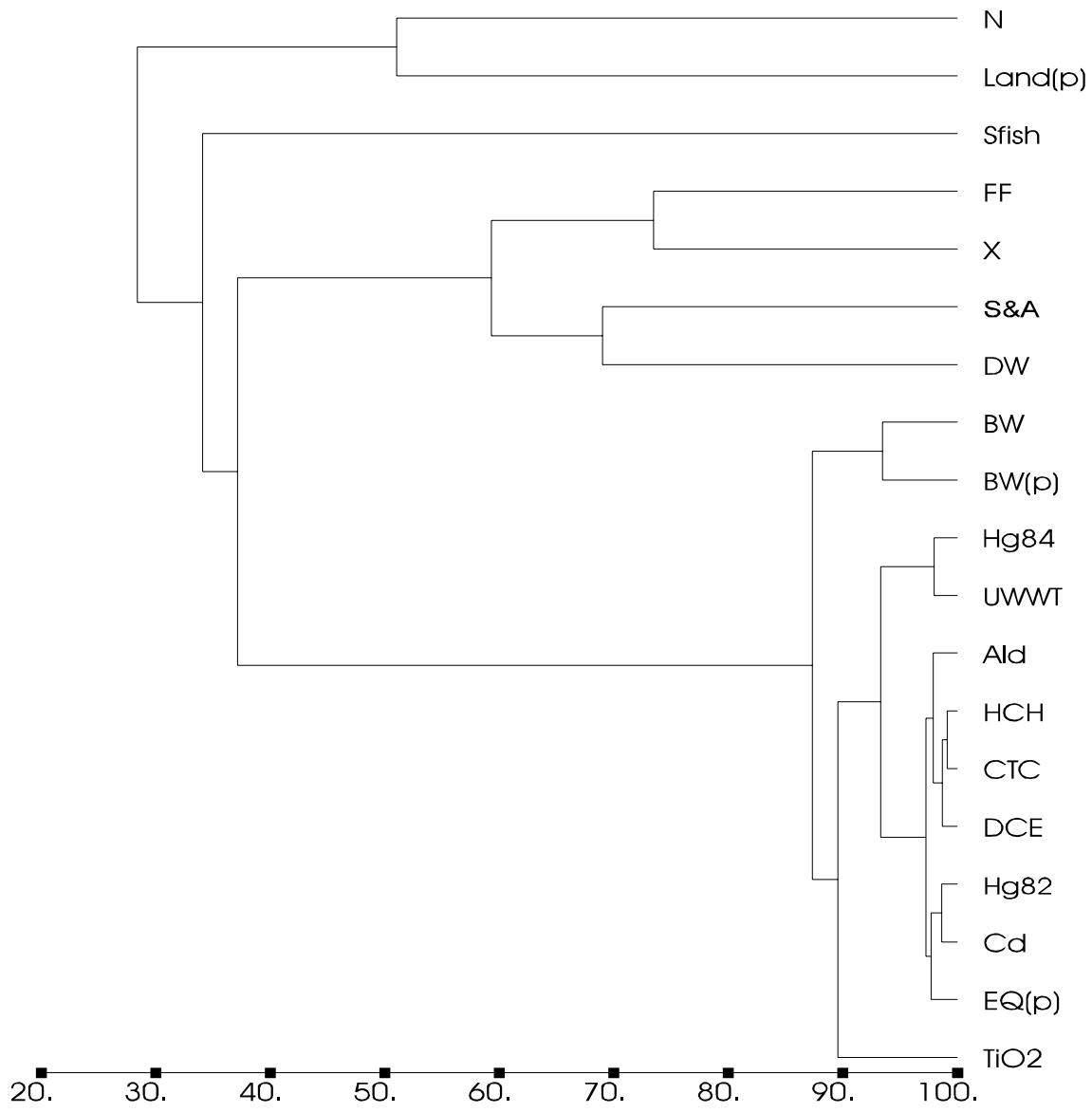
The relationships between directives can be further illustrated using Venn diagrams, Figures 5.3a and 5.3b outline both the commonalties and differences in terms of water body type and matrix sampled. The same general patterns described above can again be seen in these diagrams. For example, Figure 5.3a clearly shows that two directives, the Titanium Dioxide and Nitrates Directives, require monitoring of all types of water body. Figure 5.3b illustrates the same data with respect to the matrix required to be monitored. The most striking feature of this figure is that it shows that all directives require water sampling whilst one (the Shellfish Waters Directive) requires water and biota sampling and eight require sampling of all three matrices.

An identical set of analyses has also been undertaken for the international agreements using the multivariate techniques and Venn diagrams. Figures 5.4 to 5.6 show the cluster analysis, MDS plots and Venn diagrams, respectively. The primary feature to note from the dendogram (Figure 5.4) is division into two distinct clusters.

- at the top are those agreements with few determinands specified or non specified at all. At the very top of the dendogram is the 1992 Transboundary Waters agreement, the only one with a groundwater monitoring requirement.
- the bottom grouping comprises those agreements with very detailed monitoring requirements in terms of matrix and determinands. A subgroup of this, at the bottom of the dendogram, contains the North Sea, Mediterranean Sea, Baltic Sea and Arctic Sea agreements, all of which have marine monitoring requirements.

The MDS plot in Figure 5.5 shows a good correlation with the dendogram and all of the clusters described above can easily be picked out in the plot. For example, A12, Transboundary Waters 1992 is on its own as it requires groundwater monitoring. Those agreements above the diagonal line have few detailed requirements specified whereas those below do. The marine monitoring agreements (A2, A5 etc.) also congregate in the middle right of the ordination. Those to the bottom right are for freshwaters with detailed monitoring requirements.

The Venn diagrams, Figure 5.6a and b, illustrate the dominance of freshwater as the waterbody type for monitoring. All the reviewed international agreements require monitoring of the water matrix with only one agreement, the Convention on Transboundary Watercourses and International Lakes, requiring monitoring for all three types of waterbody.



Key to Figures 5.1-5.3

Ald	Aldrin Directive (88/347/EEC)	Hg82	Mercury Directive (82/883/EEC)
BW	Bathing Waters Directive (76/160/EEC)	Hg84	Mercury Directive (84/156/EEC)
BW(p)	Proposed Bathing Waters Directive (COM(94)36)	Land (p)	Proposed Landfill Directive (COM (93)275
Cd	Cadmium Directive (83/513/EEC)	N	Nitrates Directive (91/676/EEC)
CTC	Carbon tetrachloride Directive (86/280/EEC)	Sfish	Shellfish Water Directive (79/923/EEC)
DCE	Dichloroethane Directive (90/415/EEC)	S&A	Sampling and Analysis Directive (79/869/EEC)
DW	Drinking Water Directive (80/778/EEC)	TiO2	Titanium Dioxide Directive (82/883/EEC)
EQ(p)	Proposed Ecological Directive (COM(93)680)	UWWT	Urban Waste Water Treatment Directive (91/271/EEC)
FF	Freshwater Fish Directive (78/659/EEC)	X	Exchange of Information Decision (77/795/EEC)
HCH	Hexachlorocyclohexane Directive (84/491/EEC)		

Figure 5.1 Cluster analysis dendogram of the similarity between the monitoring requirements made in EU legislation according to water type, matrix and determinand

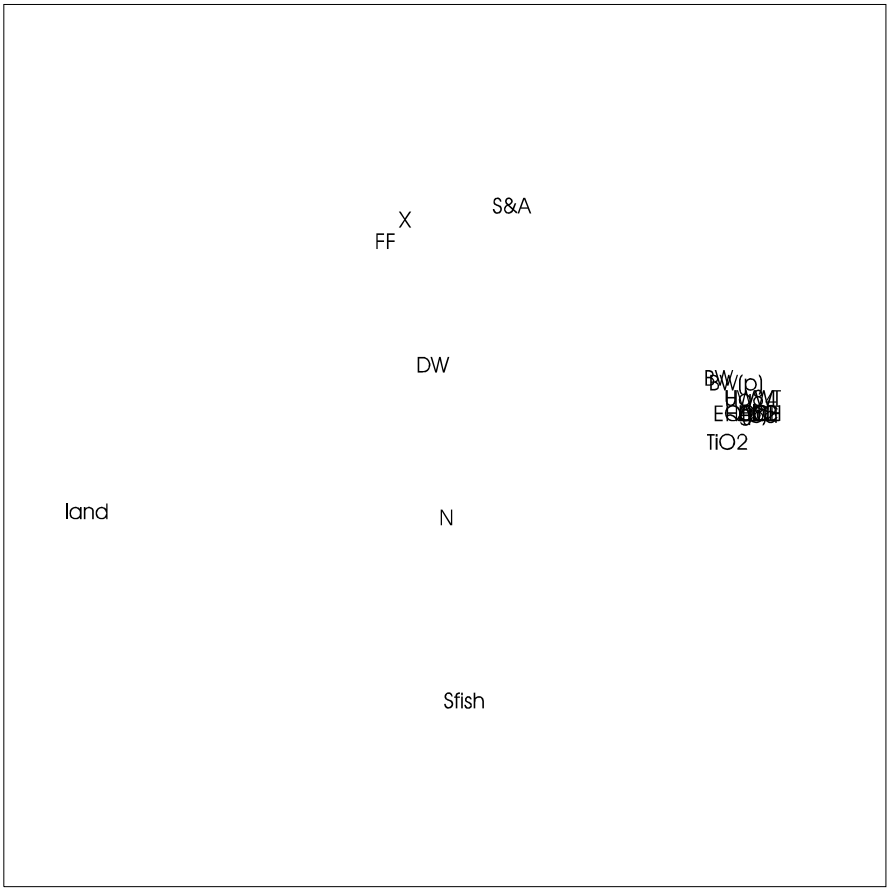
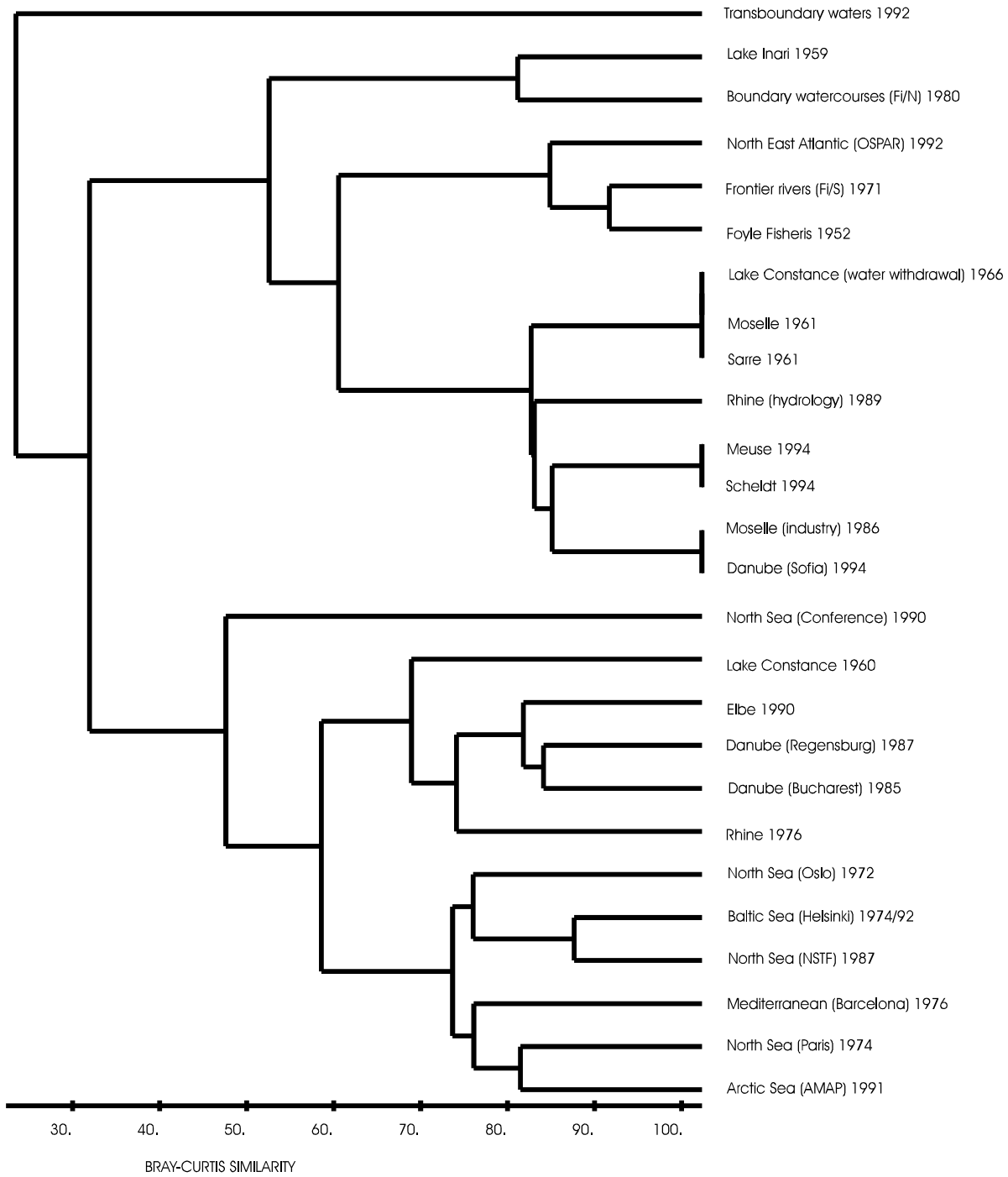


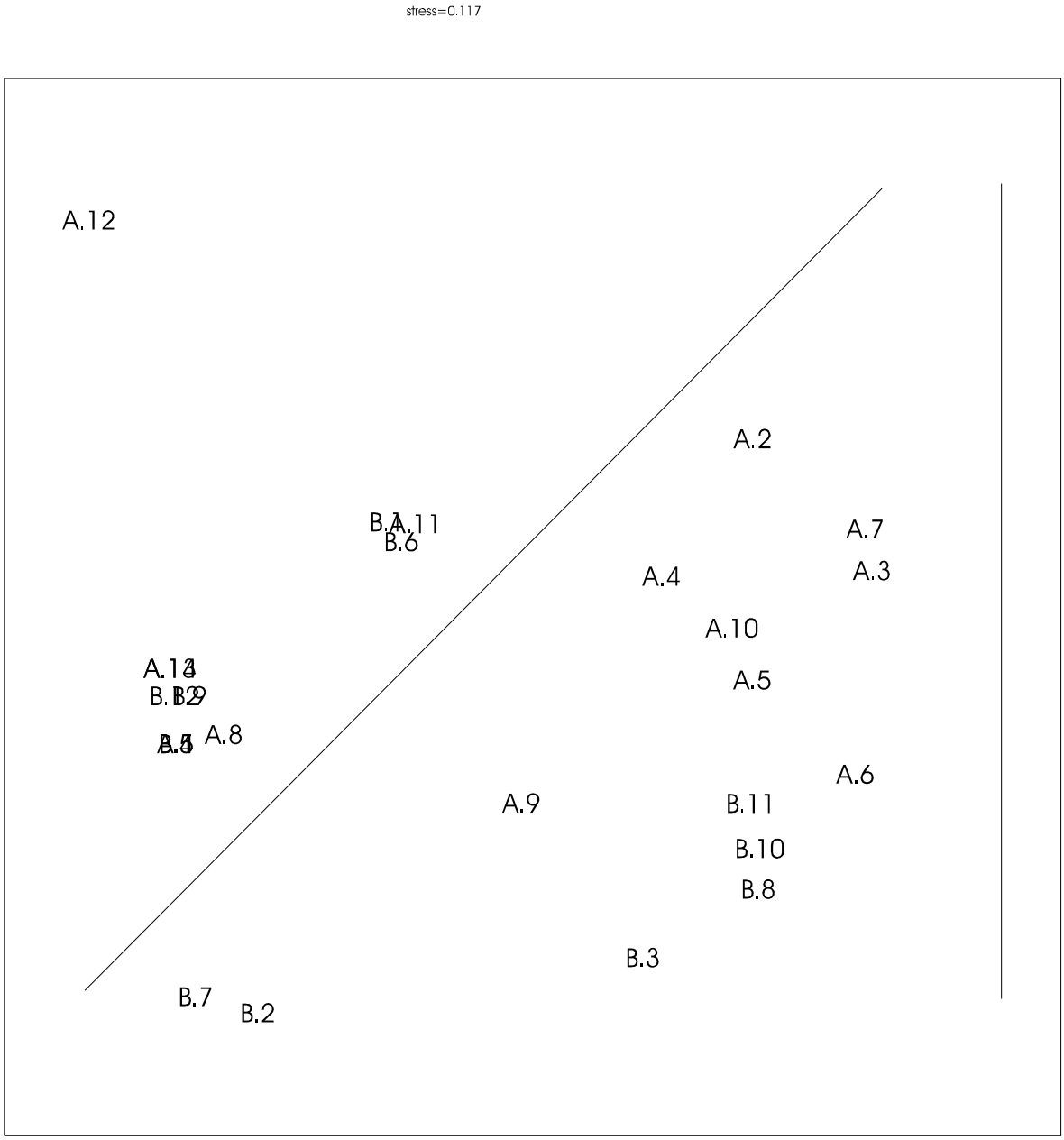
Figure 5.2 Multi-Dimensional scaling ordination of similarity between the monitoring requirements made in EU legislation according to water type, matrix and determinand

Figure 5.3 Venn diagram showing the similarities between the monitoring requirements made in EU legislation



Notes: A list of the full names for international agreements is given in Appendix A, Table A.2

Figure 5.4 Cluster analysis dendogram of the similarity between international agreements according to water type, matrix and determinand



Notes: A list of the full names for international agreements is given in Appendix A, Table A.2

Figure 5.5 Multi-Dimensional Scaling ordination of similarity between international agreements according to water type, matrix and determinand

Notes: A list of the full names for international agreements is given in Appendix A, Table A.2

Figure 5.6 Venn diagram showing the similarities in monitoring requirements made under international agreements

The figures above, together with Table D.1 in Appendix D which lists the EU legislation and international agreements according to water type and matrix, provide an indication of the similarities between and possible overlaps of existing monitoring requirements. This is discussed briefly below.

5.1 Groundwater

A summary of the requirements for groundwater monitoring made in EU legislation and in international agreements is given in Appendix D, Table D.2. This summary indicates that international requirements for groundwater monitoring are limited and that there is no overlap in the current monitoring requirements for groundwater.

5.1.1 EU legislation

In total four directives and one proposed directive make requirements for groundwater monitoring (the requirements made in the Dangerous Substances Directive (76/464/EEC) have been superseded by the Groundwater Directive (80/86/EEC)). Those requiring routine monitoring are:

- the **Titanium Dioxide Directive** (82/883/EEC) which requires that where discharges of titanium waste are made to land, unfiltered groundwater around the site, including where necessary outflow points, must be monitored once a year for six determinands (plus seven optional determinands); and,
- the **proposed Landfill Directive** (COM(93)275) which requires analysis every six months for a range of determinands, including groundwater level, depending on the leachate composition.

The other three directives require only preliminary or sporadic monitoring:

- the **Groundwater Directive** (80/86/EEC) requires investigation only prior to authorising dangerous substances;
- the **Nitrates Directive** (91/676/EEC) requires monitoring to identify vulnerable zones (i.e. those where nitrate is or may be greater than 50 mg l^{-1}); and,
- the **Drinking Water Directive** (80/778/EEC) which requires investigation before exploitation of sources for drinking water supply (after this monitoring is only required at the point of use).

The European Commission is currently developing a groundwater management and action plan which may require a revision of the Groundwater Directive.

5.1.2 Other international agreements

The only international agreement requiring monitoring of groundwater is the 1992 Convention on Transboundary Water Courses. This requires the riparian states to '*agree upon pollution determinands and pollution whose discharges and concentrations shall be regularly monitored*'. There is also a requirement for the states to harmonise rules for the setting up and operation of monitoring programmes, measurement systems, devises, analytical techniques, data processing and evaluation procedures, and methods for the registration of pollutants discharged.

5.2 Fresh surface waters

In EU legislation, all monitoring requirements which apply to rivers, also apply to lakes and reservoirs, they can therefore be referred to jointly under the general term fresh surface waters. This is often the term used in directives although other terms such as inland surface waters are also used frequently. In addition, most directives which apply to freshwaters also apply to saltwaters, the exceptions to this are:

- the Drinking Water Directive (only preliminary investigations);
- the Surface Water Directive and its Sampling Directive;
- the Exchange of Information Decisions; and,
- the Freshwater Fish Directive.

This aggregation of requirements does not occur with other international agreements which often apply only to one specific water body.

The requirements made for monitoring surface waters are summarised in Appendix D, Table D.3.

5.2.1 EU legislation

There are 15 directives which require monitoring of fresh surface waters. Several of the requirements are not, however, for routine monitoring:

- the **Drinking Water Directive** (freshwater only) only requires monitoring of the source before exploitation;
- the **Nitrates Directive** requires monitoring initially and then every four years to identify areas requiring protection: and,
- the **Urban Waste Water Treatment** (UWWT) Directive (as for the Nitrates Directive).

Routine monitoring is required by:

- the **Bathing Water Directive**;
- the **Dangerous Substances Directives**;
- the **Titanium Dioxide Directive**;
- the **Freshwater Fish Directive**; and,
- the **Exchange of Information Decisions**.

Of the directives which require routine monitoring, the requirements are generally site specific, either sites designated for a specific use, sites affected by a specific discharge, or, for the Exchange of Information Decisions (freshwater only), agreed

sites in main rivers. The degree of overlap will therefore depend on the degree to which these categories overlap. Clearly the requirements for monitoring shellfish waters (estuaries and coastal waters only) do not overlap with the requirements for freshwater uses, namely Freshwater Fish, and surface water.

All of these directives require water column monitoring. The Dangerous Substances Directives and the Titanium Dioxide Directive also require monitoring of sediment and biota.

The determinands covered by the Surface Water Directive, the Exchange of Information Decisions and the Freshwater Fisheries Directive are similar. The Daughter Directives made under the Dangerous Substance Directive are mutually exclusive. The Exchange of Information Decisions make the only requirements for flow measurements in fresh surface waters. They state that flow has to be measured by flowmeter at the time of sampling for the other stipulated determinands, and results should be expressed in $m^3 s^{-1}$ to four significant figures before and two after the decimal point. This requirement applies to specified rivers in Europe and also Lake Ijssel in the Netherlands.

The proposed Ecological Directive is due to replace the Surface Water, Freshwater Fish and Shellfish Directives. It will require Member States to undertake monitoring for basic and biological determinands in all surface waters for classification purposes. The Bathing Water and Drinking Water Directives are also being reviewed.

5.2.2 Other international agreements

Specific agreements cover the:

- Lake Inari (1959 between Finland, Norway and Russia);
- Lake Constance (1960 and 1966 between Austria, Germany and Switzerland);
- Moselle (1961 between Germany, France, Luxembourg and 1986 between France and Luxembourg);
- Sarre (1961 between Germany, France);
- Lake Geneva (1962 between France and Switzerland);
- Rhine (1976 between Germany, France, Luxembourg, Netherlands and Switzerland and 1989 on hydrology between aforementioned countries with Austria);
- Danube (Bucharest Declaration 1985, between Austria, Germany, Italy, Czech Republic, Slovak Republic, Slovenia, Hungary; Regensburg Agreement 1987 between Austria and Germany and Sofia Agreement 1994 between Austria, Germany, Bulgaria, Croatia, Hungary, Moldova, Romania, Slovakia and the Ukraine);
- Elbe (1990 between Germany, Czech and Slovak Republic);

- Meuse (1994 between Belgium, France and Netherlands); and,
- Scheldt (1994 between Belgium, France and Netherlands).

More general agreements are made in:

- Convention on Transboundary Watercourses (1992 all EEA countries except Ireland and Greece);
- Agreement on Frontier Rivers (1971 all rivers between Finland and Sweden);
- Agreement on Boundary Water Courses (1980 all water courses between Finland and Norway); and,
- Paris Convention (1974 all rivers entering the North Sea between riparian states).

With the exception of the Rhine and Lake Geneva (and measurement of the saprobic index for the Danube) requirements for monitoring under these agreements is confined to the water column. The Rhine Action programme considers the ecosystem as a whole rather than just concentrating on water monitoring, and has a goal of making the Rhine a suitable habitat for higher species, such as the salmon by the year 2000. There is also the aim of reducing substantially the pollution of river sediment by toxic substances so that it can be again used as a filling material on the land and in the sea. Monitoring of biota and sediment are, therefore, also required. In Lake Geneva, monitoring is undertaken at 200 sediment sites.

5.3 Salt waters

Most directives which apply to freshwaters also apply to salt waters (see above). The Shellfish Waters Directive is the only directive which applies to estuaries and coastal waters but not freshwaters. This requires monitoring of the water column and metals in shellfish flesh (the requirement to monitor faecal coliforms in internal valvular liquid is superseded by the Shellfish Hygiene Directive (91/492/EEC)).

International agreements to protect salt waters, include those to protect the:

- Lough Foyle (1952 between UK and Ireland);
- Mediterranean Sea (Barcelona Convention 1976, Spain, France, Greece, Italy and the EC);
- Baltic Sea (Helsinki Convention 1974/1992 Germany, Denmark, Finland, Sweden, the EC, Poland, Russia, Estonia, Lithuania, Latvia, Czech Republic, Slovak Republic, Ukraine);
- North East Atlantic (Oslo Convention 1972, Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Netherlands, Norway, Portugal, Spain, Sweden and UK; Paris Convention 1974, as for Oslo except for Finland and including Luxembourg, and North-East Atlantic Convention 1992, as for Oslo including Luxembourg and the EC);

- Adriatic Sea (1974, between Greece and Slovenia);
- North Sea (North Sea Conferences, 1987, 1990 and 1994 between riparian states, and the North Sea Task Force 1987 between Belgium, Germany, Denmark, France, Norway, the Netherlands, Sweden and the UK); and,
- Arctic Sea (Arctic Monitoring and Assessment Programme agreed at a Ministerial meeting between Arctic States 1991).

All the above agreements require monitoring of the water column. For the Barcelona Convention this requirement is made only for coastal waters, whereas the Helsinki, Oslo and Paris Conventions also require monitoring of estuaries, and for the Paris Convention, also rivers. In addition, these latter three conventions require monitoring for sediment and biota, although monitoring of biota and sediment is undertaken in the Barcelona Convention area under the auspices of the Mediterranean Action Plan, co-ordinated by the United Nations Environment Programme (UNEP).

A summary of monitoring requirements for salt waters is given in Appendix D, Table D.3.

5.4 Quantity monitoring

There are relatively few directives and international agreements which require monitoring of water quantity (compared to quality). These are, therefore, described separately. Requirements for monitoring water quantity are summarised in Table D.4 of Appendix D and discussed briefly below.

There are only two directives that have requirements for the monitoring of quantity determinands in surface and groundwater:

- the **Exchange of Information Decisions** require flow to be measured by flowmeter at the time of sampling for the other stipulated determinands; and,
- the **proposed Landfill Directive** will require the level of groundwater to be monitored.

There are eight international agreements requiring the monitoring of quantity determinands (Table D.4), all of which require river flow measurements. Two also require measurement of river level and one of the level of lake water. Generally monitoring must be undertaken at fixed nominated sites over the whole year.

6. MONITORING - DESIGN REQUIREMENTS

Once the basic requirements in terms of water type, matrix and determinand have been established, then other aspects of monitoring programmes can be designed. These monitoring requirements can be split into three aspects:

- sampling;
- analysis; and,
- reporting.

Barriers to harmonisation can be introduced at any one of these stages and can arise either because requirements differ (i.e. conflict) or because requirements are not clearly specified (i.e. are weak).

This Section analyses monitoring requirements with the aim of identifying both types of barrier. The specific aims are to:

- provide an indication of the degree to which monitoring requirements are specified;
- determine to what extent requirements are repeated in different commitments (data overlaps) or conflict;
- assess whether the most common requirements (standard requirements) meet the objectives, if not why not (i.e. data deficiencies);
- assess whether those requirements which differ from the standard are necessary to meet the specific objectives of that commitment or whether the standard requirements would be satisfactory;
- recommend areas for possible harmonisation or clarify the reasons where harmonisation is not possible; and,
- assess the extent to which directives do not specify adequate requirements to ensure harmonised implementation.

As for Section 5, summary tables of specific requirements described in this Section are given in Appendix E.

6.1 Sampling

Sampling strategies may vary according to:

- sampling location;
- frequency; or,
- sample number, type and volume.

6.1.1 Sampling location

Sampling location will be considered when competent authorities design their own national monitoring networks. They will have to ensure that the networks not only meet their national and international obligations, statutory or otherwise, but also that they meet other needs and objectives. For example, general surveillance data from a larger proportion (compared to that required by international statutory requirements) of the total national water resource may be required. Operational data, often at a sub-catchment level, may also be needed, for example, to monitor the impact of specific discharges on water quality. There will be obvious benefit, where possible, in replicating the purpose of sampling points and also in usage of the information obtained. It is likely, therefore, that monitoring networks associated with directive and international obligations will not represent the total monitoring networks of individual nations. For surveillance purposes, sample sites may be located in relation to changes in water quality, perhaps associated with point discharges or tributaries. Where there are gradual rather than discrete changes of quality, for example along a river, the optimum number of sample locations needed to define overall quality would be quantified through an assessment of the spatial and temporal variability of the determinands of interest in that river.

EU legislation

The most specific requirements in terms of named water bodies and measuring stations are in the Exchange of Information Decisions. These rivers are nationally significant rivers and lakes and as such are quite likely to be sampled for other national and international obligations (e.g. Rhine and Elbe Conventions).

In other directives, sampling location is generic rather than specific and is directly related to the type of directive (purpose) (Table E.1). Use-related directives, and the monitoring requirements made in them, apply only to waters designated for the protected use. Therefore, the degree to which the requirements overlap in terms of sampling location depends on the extent to which the uses overlap. Since water uses are designated by Member States this varies from country to country. Similarly, industry sector and substance directives aim to control discharges, either those from a specific industry or containing certain dangerous substances, and sample locations relate to specific areas or zones impacted by discharges (e.g. the Titanium Dioxide Directive). The monitoring requirements made in these directives apply only to waters affected by discharges covered by the directives (the Titanium Dioxide Directive also refers to sampling in a neighbouring area unaffected by the discharge). The overlap in sample location requirements is, therefore, determined by the distribution of discharges and again varies from country to country.

Thus the scope for overlap of sampling locations between directives appears to be limited to areas where use and designation overlap, which is probably a limited circumstance, for example where drinking water is abstracted from a river which is also a designated freshwater fishery, which is also stipulated in the Exchange of Information Decisions and receives a discharge of a regulated dangerous substance. Locations are, however, cross referenced between directives. For

example, the Nitrates and the Sampling and Analysis Directives both refer to locations specified in the Surface Waters Directive.

Less specific is one of the requirements of the Nitrates Directive where the general eutrophic states of surface waters have to be periodically reviewed by the national competent authorities. The requirements for the proposed Ecological Quality Directive are also less specific since monitoring will be required in a representative number of all surface waters, this will again be defined by Member States rather than be specified by the Commission. For many countries this will require an increased sampling load in terms of numbers of locations (and also numbers and types of determinands).

Many of the directives allow the competent authority of each Member State to make decisions on such details as '*the exact sampling point, the distance from this point to the nearest point where pollutants are discharged and the depth at which the samples are to be taken*'. It is indicated that these sampling points should be fixed on the basis of local environmental and hydrological conditions. This is so for the Titanium Dioxide Directive where the depth of sampling and distance from the discharge is also decided by Member States but the same sites and depths should be used in all surveys, including in relation to physical and temporal conditions such as relativity to high tide and tidal coefficient. Once the fate and behaviour of the effluent is known and the effects have been established, and as long as there is no deterioration, then there is scope for Member States to use a lower sampling frequency than specified in the directive. This proviso is absent from the Dangerous Substances Daughter Directives.

The proposed Landfill Directive has a requirement for the monitoring of leachate and run-off water based on a 10 litre global sample representative of the average composition of the waste deposited. In addition surface water run-off composition should be monitored monthly during the operating phase and every six months in the after-care phase. This should be undertaken at not less than two points, one upstream and one downstream of the landfill. At least one monitoring point should also be set up in the groundwater inflow region (0 level) and two in the outflow region.

Only two directives make specific requirements for sample depth: the Bathing Water Directive and Titanium Dioxide Directive. The former specifies 30 cm as the sample depth for all determinands other than for mineral oil for which surface sampling is required. The Titanium Dioxide Directive indicates that for discharges to fresh surface waters samples should be taken at a depth of 50 cm below the surface if possible. The requirements are not so definitive for discharges to salt water where samples should be taken at the same depth on each sampling occasion. For the Shellfish Waters Directive sample depth should be fixed by the Member States and similarly for the Freshwater Fish Directive sample depth should be defined by the competent authority. Sample volume is not specified in any directive. Thus sample number (e.g. replicates at a site), depth and volume are generally determined at Member State level and are, therefore, open to interpretation.

As has already been stated, the choice of sampling location is for some directives related to areas designated by the Member States rather than by the European Commission. It is unlikely, therefore that, for some directives, a comparison of quality across Europe of these designated waters will give a complete picture of quality because the degree of comparability will depend on the interpretation of the designation rules and national differences of how these are implemented. For example, it is likely that many more water bodies will be able to sustain fisheries than are covered by the directives. In terms of the Bathing Water Directive there is generally a wide spatial coverage across Europe of quality in designated salt water areas. If, however, the microbiological quality of inland waters was to be compared across Europe, there would be some major spatial gaps as some Member States do not designate inland waters as bathing waters. Therefore, the degree of coverage that water quality data encompasses within each country will be determined by national designations and the prevalence of the industries that are required to be regulated. The proposed Ecological Directive should, in the future, mean that a far greater proportion of a nation's water resources are monitored than is required at present. Better spatial comparison, at least for ecological quality, should therefore be possible in the future.

International agreements

For international agreements sample location is generally related to the purpose of the agreement (e.g. monitoring transboundary water transfer) often being at designated or fixed sites. For example, designated sites are specified for the sampling of water, biota and sediment under the Helsinki Convention, and at fixed stations under the Rhine Convention, the Protocol for Technical Co-operation between Greece and Bulgaria, and the Treaty between Austria and Hungary on Water Economy. Other agreements are less specific about sampling location, perhaps being determined by the research or information needs of the signatories or research programme (e.g. the North Sea Task Force). For many agreements signatory states also have to decide upon exact locations, perhaps within guidelines provided by the relevant Commission, for example, as in the quantification of riverine loads for the Paris Commission.

6.1.2 Sampling frequency and period

EU legislation

The requirements for sampling frequency vary considerably from directive to directive (Tables E.2 and E.3). Only 12 directives recommend minimum sampling frequency. Most directives allow the relevant authorities in each Member State to establish monitoring requirements or to provide recommendations to ensure that *'samples are representative of the quality of the water'* and '*sufficient to show any changes in the aquatic environment, taking into account in particular natural variations in the hydrological regime*'. For those where frequency is stipulated the requirement is quite specific to the objective of the directive, for example the monitoring of the quality of bathing water during the bathing season. Those which

do not specify any monitoring frequency include the Mercury Directive and other Dangerous Substances Daughter Directives.

Sampling period is not usually specified or, if it is, the interpretation of its definition can give rise to differences between countries (for example bathing season). These imprecise requirements can give rise to different interpretation.

Sampling frequency requirements also vary within directives reflecting:

- water type (for example, the Titanium Dioxide Directive requires three samples per year for surface waters but only 1 per year for groundwater);
- matrix type (for example, the Dangerous Substances Directives require monthly sampling of the water column but only annual sampling of sediment);
- determinand (for example, under the Freshwater Fish Directive it is required that temperature be measured weekly whilst other determinands such as dissolved oxygen and ammonia are measured monthly);
- extent of water use (for example, the population supplied under the Surface Water Directive); and,
- quality of the water (several directives allow for a reduced sampling frequency for some determinands if the quality of waters is higher than prescribed in the directive, and where there is no pollution and no risk of deterioration e.g. the Bathing Water Directive and the Titanium Dioxide Directive).

The Sampling and Analysis Directive has a very complex specification for sample frequency. It is dependent upon the population the water supply is to serve, the category of the determinand (I, II or III) and the level of treatment required (A1, A2 and A3). Stipulated sampling frequency varies from a minimum of once a year for category I determinands in A1 waters serving a population of 10,000 to less than 30,000, to 12 times a year for A3 waters serving a population of >100,000 for category I determinands. For some categories of determinand, population and water treatment classification, it is the role of the competent national authority to specify the sampling frequency.

The Mercury, Cadmium and Hexachlorocyclohexane Directives do not set a standard sampling frequency but specify that this must be sufficient to show any changes in impact. For the Freshwater Fish Directive, sampling frequency is specified for four of the eight determinands (petroleum, pH, total ammonia and total zinc).

The Bathing Water Directive also has a multifactorial approach in determining sampling frequency and depth of sampling. For many determinands the sampling frequency is fortnightly (faecal coliforms, mineral oils and surfactants) during the bathing season. Others should be sampled if, once checked, it is shown that the substance may be present or the quality deteriorated. These determinands include faecal streptococci, salmonella and enteroviruses. Sampling frequency may also be reduced by a factor of two if good results are obtained the year before and when no new factor has likely to have lowered the quality of water. Determinands in this

category include faecal coliforms and colour. Ammonia and Kjeldahl nitrogen are also included if there is a tendency towards eutrophication. Most of the specified determinands should be sampled 30 cm below the water surface, mineral oils are to be sampled at the surface.

If adopted the proposal for a revised Bathing Water Directive (COM(94)36) will make some important changes in the sampling frequency for some determinands. For example, faecal streptococci, dissolved oxygen and pH will have to be sampled fortnightly and enteroviruses monthly whereas in the present Directive all only have to be monitored *'when an inspection in the bathing areas shows that the substance may be present or that the quality of the water has deteriorated'*. In the case of enteroviruses there is a long descriptive qualifier in the proposal: *'This determinand must be measured once in the fortnight before the start of the bathing season. If during the two preceding bathing seasons the Bathing Water complied with the guideline value for Escherichia coli and the I value for Faecal streptococci, on the basis of Table 3 and 2 respectively, and the Bathing Water does not receive discharges of chemically treated sewage, then the determinand needs only to be measured once more. This measurement should be made in the middle of the bathing season'*. In the present directive, sampling is required to begin two weeks before the start of the bathing season. In the new proposal, the usual requirement will be for sampling to begin before the start of the bathing season.

The proposed Directive on the Ecological Quality of Surface Waters is again non-specific in defining sample frequency or period. Again this will be determined by the competent national authority and ideally would take account of the variability of the determinand being measured and the desired level of precision for the results. For many countries this potentially will require an increased sampling load in terms of numbers of locations (and also numbers and types of determinands).

It is not apparent from most of the published directives whether there have been any, or if so, what, statistical considerations when defining the required sampling frequencies or numbers. It is not clear, for example, whether the quoted different frequencies for some determinands are related to differences in the variability of those determinands in water.

Sources of error in the overall assessment of a determinand in a water body would include sampling error and analytical error. The former would include how representative the samples taken in time and space are of the underlying true quality/quantity. Clearly, except in a very stable body of water, it is likely that a single sample will give a very unrepresentative estimate of true quality/quantity. It is a common sense principal that the more samples taken the more precise (the smaller the margin of error) will the estimate be of the true underlying quality of a determinand in a water body. As a general rule, to secure double the precision requires four times the number of samples (Ellis 1989). As well as specifying the desired precision, the level of confidence associated with the precision must be stipulated. Again, the higher the desired confidence the greater the required number of samples. Sampling frequency and sample numbers, therefore, have a significant effect on the statistical precision and confidence of the monitoring data produced.

International agreements

The sampling frequency specified in other international agreements is also very variable within agreements and between agreements (Table E.4). For example, the Helsinki Convention requires a frequency of once per month (preferably in the morning) for microbiological determinands, seasonal for others (alkalinity, temperature, total nitrogen and oxygen), and up to once a year for specified synthetic organic compounds. Twelve samples a year is the most common sampling frequency required for three conventions (Danube (Bucharest Declaration), the Water Economy Agreement between Austria and Hungary 1956, and the Protocol for Technical Co-operation between Greece and Bulgaria 1991). The latter also requires continuous monitoring for some determinands (e.g. dissolved oxygen, temperature and turbidity) and very frequent for others (7 to 10 days e.g. for ammonia and some heavy metals).

6.1.3 Sampling number, type and volume

EU legislation and other international agreements rarely specify requirements for sampling number and volume (Table E.5). Most directives do not specify any requirements or provide recommendations to ensure that *'sufficient samples representative of the quality of the aquatic environment are taken'*.

6.2 Analytical methods

Analytical error is another component of the overall error in any estimate of quality or quantity. This Section summarises requirements for pre-treatment and analysis as defined by the methods (or media for microbiological analysis) and the performance (i.e. limits of detection, accuracy and precision). A separate comparison has been made for microbiological determinands (see section 6.2.3).

6.2.1 Pre-treatment

Although directives sometimes require pre-treatment for water column samples before analysis, methods are generally not specified. The exceptions to this are:

- extraction before analysis for mineral oils, arsenic, cadmium, chromium and mercury is specified in the Bathing Water Directive. Although several other directives also require analysis for these determinands in the water column, methods for pre-treatment are not specified;
- distillation, for nitrogen required in the Surface Waters Directive;
- filtration for salmonella and iron also under the Surface Waters Directive; and,
- organic cooling, an alternative method recommended for pre-treatment prior to analysis for dichloroethane under the Dichloroethane Directive.

These appears to be no uniformity in the requirements for pre-treatment of the water column.

For analysis of sediments and biota, the Daughter Directives to the Dangerous Substances Directive generally require analysis after '*appropriate preparation*' but do not define appropriate techniques. The exceptions to this are:

- the Hexachlorocyclohexane Directive recommends the use of extraction techniques; and
- the Mercury from the Chloro-alkali Sector Directive which requires pre-oxidation and successive reduction prior to analysis for mercury.

The Shellfish Waters Directive is also non-specific in its requirements for the pre-treatment of biota, recommending analysis '*after appropriate preparation*'. Only for organohalogenated substances does the Directive specifically recommend extraction. The Titanium Dioxide Directive is more specific. It recommends the use of wet/dry mineralisation and purification for ten metals, and extraction for hydrated oxides and oxides of iron.

6.2.2 Analysis

The analytical requirements made in directives are generally very basic and defined in terms of performance criteria (i.e. limits of detection (LoD), precision and accuracy) and/or by the method. The degree of definition, however, varies greatly from directive to directive (see Tables E.6 and E.7). As for pre-treatment, many directives make very broad requirements to use '*appropriate methods*'.

Several directives recommend one or more analytical methods appropriate for selected determinands. The methodologies provided are very brief and since many of the directives were published in the 1970's, the majority of these methods are now out-of-date. However, the methods of analysis recommended are only guidelines and alternative methods can be used providing that they can achieve the same performance criteria. This flexibility is essential given the wide range of methods now available and because simple and cheap methods can often achieve the same performance as more expensive methods. For example, for the analysis of iron as required by the Titanium Dioxide Directive, a simple, cheap but sensitive molecular absorption method can achieve the same analytical performance requirements as an expensive atomic absorption spectrophotometric method. Insisting on using the latter would incur a much greater financial burden without giving appreciative analytical benefit.

The performance criteria are, therefore, the key requirements with regard to analysis. Despite this several directives fail to establish performance requirements for analysis. These include:

- the Bathing Waters Directive;
- the Freshwater Fish Directive;
- the Shellfish Waters Directive; and,

- the Titanium Dioxide Directive;

Directives which establish analytical performance criteria for precision and accuracy usually express requirements as a percentage of the standard. They therefore vary depending on the substance and the media type. For example, in the Surface Water Directive there are different criteria depending on whether the standard is a guideline or a mandatory value. Of more concern is the lack of standardisation in approach to determining these requirements. Thus, for example, within the Surface Water Directive, the required level of precision varies from 5 to 50% of the standard value.

Probably the most significant omission in requirements for analytical technologies is a requirement for analytical quality control (AQC). Increasingly AQC is being recognised as essential for data from monitoring programmes to be reliable and comparable.

There are several national and international texts that provide detailed methods of analysis for numerous determinands, in a variety of matrices (e.g. SCA 'Blue Book' Methods, CEN, ISO, DIN, AFNOR). These, coupled with the propensity of analytical reference materials (e.g. BCR) and check samples (e.g. Aquacheck), that are now available on a pan-European basis, means that laboratories using any relevant analytical method should achieve the target LoD's, accuracy and precision stated in the directives. By participating in inter-laboratory assessments and analytical quality control schemes, any small bias that may occur between different methods (but smaller than the +/- 50% tolerance allowed in the directives for organics, for example) would soon be identified. If, and only if, a significant bias were to be measured, then careful consideration would have to be given to whether the method is suitable in the long term.

It is therefore recommended that directives should refer the reader to currently available texts describing recently developed methods that have been proven to be capable of performing satisfactorily. Consideration should also be given to including a statement that ensures that the laboratory undertaking the analysis uses appropriate internal quality control samples (e.g. as specified in Gardner 1989), participates in an accepted inter-laboratory AQC scheme and possibly has accreditation (e.g. NAMAS, ISO Guide 25, EN45001). In addition, the laboratories concerned with applying the directives should be free to use '*appropriate methods*' providing they satisfy performance criteria.

The analytical requirements made in the international agreements are also generally very basic and are not defined in terms of performance criteria (i.e. limits of detection (LoD), precision and accuracy) (see Tables E.8 and E.9). The Baltic Sea monitoring programme generally gives alternative analytical methods for the required determinands but there is apparently no stipulation of performance criteria the methods should achieve, though for some determinands, such as salinity, dissolved oxygen and temperature, details are given for what type of quality control procedures should be adopted. For example, salinity measurements should be calibrated with standard salinity water. By comparison, many monitoring

programmes, such as for the North Sea Task Force, do not appear to specify either analytical methods or performance criteria.

6.2.3 Microbiological methods

In total, there are six directives which require microbiological analysis, the Bathing Water Directive and its proposed revision, the Surface Water Directive, the Drinking Water Directive, and, the Shellfish Waters Directive, for which the microbiological requirements have been superseded by the Shellfish Hygiene Directive. A summary of the analytical requirements made under these directives and international agreements is given in Table E.10.

The microbiological and virological determinands in EU directives for water quality all rely upon enumeration of viable (or culturable) units. The culturability is greatly influenced by exposure in the natural environment to stresses, such as starvation, salinity and long wavelength ultraviolet radiation in sunlight or to disinfecting agents such as chlorine, all of which reduce viability and culturability and ultimately bring about cell death. The culturability of bacteriological media is greatly influenced by their composition and by the temperature of incubation. In improving the specificity of culture media for the desired target organisms, specific microbial inhibitors may be incorporated to suppress unwanted species. These are not without effect on the target organisms. Similarly, control of incubation temperature can critically affect the specificity of the medium, and if too high, suppress stressed target organisms.

In the case of enteroviruses, numbers are usually so few that specific concentration and filtration procedures must be used. Inevitably, recovery is less than complete and is dependent upon conditions.

These factors indicate that microbiological methods must be standardised for efficiency of recovery and performance (accuracy, specificity, precision) and, for securing harmonisation of results between Member States, single reference procedures must be agreed for each determinand.

Some work has been undertaken in some Member States to develop the most specific methods given highest recoveries of stressed organisms, such as the guideline documents produced in the UK for bathing waters (National Rivers Authority 1992, and *The Microbiology of Water* 1994). The current work programmes of CEN/TC 230 (Water Analysis) and ISO/TC 147/SC4 (Water Quality/Microbiological Methods) are proceeding in parallel to produce standard reference procedures for microbiological examination of water, in particular, complete revisions of the current international standards for coliform organisms and *Escherichia coli* (ISO 9308-1, 2) and faecal streptococci (ISO 7899 - 1,2).

The microbiological determinands specified in international agreements for water quality are also given in Table E.10 together with a summary of the analytical requirements made under these agreements. Apart from the Helsinki and the Elbe Conventions, the analytical methods and performance criteria are in most cases not specified.

6.3 Reporting requirements

Summaries of reporting requirements for each directive in terms of reporting frequency and periods covered, and in terms of the contents of the reports are given in Tables E.11 and E.12 respectively. The reporting format has been standardised for most of the directives covering water in the Reporting Decision. Each Member State is required to periodically complete a questionnaire on aspects such as implementation, compliance details of any designation, emission standards, number of authorisations, quality objects, monitoring stations and action programmes. It does not influence the type of monitoring required under each directive.

Generally the requirement for reporting applies to each directive as a whole and covers the designated authority to whom the data are reported, the frequency of reporting and if there are any compliance rules specified.

The reporting frequency and the reporting period covered varies from directive to directive. In most cases, the information required covers monitoring results but also the number of monitoring stations and methods used. The reporting frequencies are:

- every five years for the Dangerous Substances and Daughter Directives;
- every four years for the Nitrates Directive;
- every three years for the Sampling and Analysis Directive and for the proposed Landfill and Ecological Quality Directives;
- every 12 months for the Surface Water Directive, Exchange of Information Decision and proposed Bathing Water Directive;
- at '*regular intervals*' in the present Bathing Water Directive, the Freshwater Fish and Shellfish Directives; and,
- '*on request*' (by the Commission) for the Groundwater and Urban Waste Water Treatment Directives.

There is no specification for the Drinking Water or Titanium Dioxide Directives.

The 13 directives (including 7 Dangerous Substances Daughter Directives) which require the reporting of the details and results of monitoring of surface waters are listed in Table E.12.

This report has not assessed how well Member States comply with the reporting requirements and hence how well the Commission can make temporal and spatial comparisons. Inadequate or infrequent reporting is another potential barrier to harmonisation of monitoring data and information across Europe.

Many international agreements also have reporting requirements, these are summarised in Table E.13. Annual reporting is usual.

6.4 Compliance assessment

Another important aspect of directives, particularly when a comparison of quality across Member States is expressed as a comparison of compliance against limits and standard values (e.g. as in the Bathing Waters Directive), is how the compliance requirements in the directives are expressed, calculated and interpreted. Differences in interpretation of these requirements is another significant barrier to harmonisation of monitoring and implementation of directives across Europe.

A compliance monitoring scheme can be defined as:

> '*Any procedure for making a pass/fail decision' about the quality of some defined population (e.g. effluent; river; potable water) on the evidence of the analysis of a number of randomly selected samples from that population'* (Ellis 1989).

Rules for establishing compliance would contain three key items:

- the number of samples;
- the statistic by which quality is characterised (e.g. in the case of Bathing Waters the number of samples exceeding the faecal coliform standard of 2000 per 100 ml); and,
- the pass/fail criterion to be applied to the statistic (e.g. 0 or 1 high samples = 'pass' 2 or more = 'fail').

These three items constitute the practical instructions that enable the scheme to be applied and a wide variety of compliance monitoring schemes can similarly be defined by these three basic components.

Any rule to test compliance - however non statistical in origin - can be characterised by two key quantities: a true underlying level of quality so good that the rule will almost always be passed, and a level so bad that the rule will always almost fail. The greater the number of samples the closer these two numbers will be and so the greater the discrimination provided by the scheme. The statistical capabilities of any percentile type scheme can be determined non parametrically by look up tables or charts. Whichever compliance assessment rule is adopted, attention needs to be given to frequencies of sampling. The required frequency should be derived with reference to the quantified risks that some waters will be misclassified (against compliance criteria). Furthermore for fairness of comparison the frequency of sampling should be uniform throughout Europe.

There are specific compliance assessment rules in four directives (the Bathing Water, Shellfish, Freshwater Fish and Surface Water Directives) and more general rules for the Dangerous Substances and it's Daughter Directives. There are no compliance criteria stipulated in the Nitrates, Groundwater, Drinking Water (initial

examination), and proposed Ecological Quality and Landfill Directives. However, for the latter, observations must be evaluated by means of control charts with established control rules and levels for each downgradient well. Compliance is generally required to be demonstrated in a percentage of the number of samples taken (95%, 90%, 80% and 75%). There are also examples of 100% sample compliance being required e.g. in the Shellfish Waters Directive.

The different percentages of sample compliance is generally related to the determinand being measured. For example, in the Shellfish Waters Directive three compliance rules are given for the three broad categories of determinands:

- 100% of samples for organohalogenated substances and metals (based on a minimum half yearly sampling frequency);
- 95% of samples for salinity and dissolved oxygen (based on a minimum monthly sampling frequency); and,
- 75% of samples for other determinands (based on a minimum quarterly sampling frequency).

Similarly it is also indicated in the Freshwater Fish Directive that 95% of samples for pH, BOD, ammonia, (total and non-ionised), nitrite, residual chlorine, total zinc and dissolved copper should comply with requirements. When the sampling frequency is lower than one sample per month all samples have to comply. For temperature and dissolved oxygen the percentages listed in Annex I of the directive should comply and average concentrations are set for suspended solids.

The requirements made in the Freshwater Fish Directive also demonstrate the use of secondary rules for when samples do not comply. This is also demonstrated in the Surface Water Directive where water is assumed to conform to the relevant determinands if '*it complies with the parametric values for the water quality in question, in the case of*':

- 95% of the samples for determinands conforming to those specified in the 'I' (mandatory) columns in Annex II;
- 90% of the samples in all other cases; and,
- if in the case of the 5 or 10% of the samples which do not comply:
  - the water does not deviate from the parametric values in question by more than 50% expect for temperature, pH, dissolved oxygen and microbiological determinands;
  - there can be no resultant danger to public health; and,
  - consecutive water samples taken at statistically suitable intervals do not deviate from the parametric values.

Similar secondary rules on how to treat non-complying samples are also used in the present Bathing Water Directive which stipulates that 95% of samples must comply for mandatory determinands, 90% of samples for the remaining determinands,

except for total coliforms and faecal coliforms where the percentage may be 80% (for the guideline value). Compliance will still be achieved if in the case of the 5%, 10% and 20% of the samples which do not comply; the water does not deviate from the parametric values in question by more than 50%; except for microbiological determinands, pH and dissolved oxygen; and consecutive water samples taken at statistically suitable intervals do not deviate from the relevant parametric value.

However the Bathing Water Directive only gives a brief explanation of the required method of compliance assessment. Even though it is relatively clear that compliance was to be judged by the percentage of samples that do not exceed the threshold values specified in the Annex, it is less clear how this rule should work if this specified percentage (e.g. 95%) did not correspond to a whole number of samples (Lacey *et al* 1995). It is also not explicit whether compliance was to be judged for each determinand in turn (determinand compliance) or across all determinands on the same sample (sample compliance).

The proposed Directive on Bathing Waters is clearer. First it is clear that determinand compliance is the meaning intended. Second the numbers of permitted exceedences is set out in look up tables of the Annex and completely specify the method of compliance assessment. In the 'look up' tables the number of samples which need not conform with the guideline and mandatory values are given. The test statistic is the number of exceedences of sample values above the specified percentile value, and that number is referred to the 'look-up table' to determine whether the frequency of exceedences is acceptable. The Directive, therefore, offers some clarification of the method of compliance assessment and also revises the quality requirements in particular by adding an I value for faecal streptococci. Another important feature is the footnote (1) to Table 1 in Annex 1 which allows re-sampling if an abnormal value for faecal streptococci is recorded. No definition of abnormal is given but since the footnote allows for the abnormal value to be replaced by the re-test value, this could have a very important effect on the operation of the compliance rule.

In the case where the compliance statistic is expressed as a maximum there are four principal statistical deficiencies: no unbiased method exists for estimating the population maximum (the sample maximum will always be an under-estimate of the true maximum - except where analytical error is appreciable in relation to the size of natural variability); the benefit-of-doubt approach to assessing compliance cannot be used (people will strive to take the very minimum number of samples so as to lessen their risk of an unlucky failure); the fail-safe approach cannot be used and so a face-value approach is in fact the only possible stance when monitoring against an absolute standard; and analytical error causes a special complication making in marginal cases making an important difference (Ellis 1989).

The Dangerous Substances Daughter Directives for Mercury, Cadmium, Hexachlorocyclohexane, and Carbon Tetrachloride indicate that all determinand concentrations relate to the arithmetic mean of the results obtained over 1 year. This requirement is not explicit in the other daughter directives. There are, however,

no specific compliance rules for the determinands but competent national authorities must check that there is no deterioration in the environment concerned.

No information is available on how compliance is addressed in other international agreements.

7. IMPROVING MONITORING EFFICIENCY

There are a number of ways to improve the efficiency, and hence cost effectiveness, of monitoring programmes required to meet statutory and international obligations. For example, this could be achieved by:

- increasing commonalities;
- removing duplicated or very similar determinands;
- reporting to one organisation;
- defining requirements more clearly;
- having common definitions; and,
- having the same analytical performance criteria (LoDs etc.).

These features (with others) may be termed '*best practice*'. For a monitoring programme as a whole, best practice would mean giving the maximum possible amount of information for a fixed cost. For an individual survey within a monitoring programme, it means giving sufficient information to address the monitoring objective at the minimum possible cost. The design of monitoring programmes should be based on a carefully considered, rational approach. For example, it is better to define sampling frequency by a statistical approach taking account of determinand variability than to sample 12 times per year just because this was done before.

The survey design should also be as efficient as possible so that it might be possible to obtain the same information for less monitoring effort, or more information for the same monitoring effort. Data analysis should also give the maximum information possible. Any assumptions made in the design should be able to be justified, for example, assumptions about natural variability of particular determinands.

Some of these points have been discussed in the preceding sections. For example, it is probable that Member States will duplicate the purpose of monitoring networks where possible, and, in terms of sample analysis and determinand measurement, there appears to be a good deal of scope for this as detailed methodologies are often not specified. However, where methods do not produce comparable results, and again performance criteria appear to be lacking, particularly in international agreements, the possibility of valid comparisons being made across Europe is limited. For microbiological determinands there does appear to be a strong case for having standardised methods as well as performance criteria to achieve comparable results.

Overlaps in monitoring requirements will depend on there being a common purpose for the monitoring and, in the case of directives, in there being common designations or uses of the water body. There are clear cases where there is a limited degree of overlap between directive and international agreement

requirements, especially for monitoring undertaken in Europe's seas e.g. Baltic, Mediterranean and North Seas.

Having common definitions is obviously important. Definitions can relate to the reporting of specific determinands such as nitrate which could, for example, be expressed as N l^{-1} or NO_3 l^{-1}, making an appreciable (4.4 fold) difference in the value reported. Similarly the inhibition (or not) of nitrification in BOD measurements will significantly affect the reported result. Definitions may also relate to aspects such the definition of 'bathing waters' or 'bathing season' which will again lead to national differences in implementation of the monitoring required under directives. Requirements could also be expressed statistically more precisely in terms of the confidence required in the results or in terms of the frequency of sampling.

Project MW2 will create inventories of the monitoring undertaken within each Member State. It may then be possible, depending on the transparency of Member State's responses, to determine the specific monitoring undertaken to meet each State's international obligations. It is likely for many sates that the extent of the monitoring network will be far greater than is actually required for these obligations. Other monitoring will be undertaken to meet national requirements and needs. The information from MW2 with that from MW1 will be used in the design of the inland waters monitoring network that will meet the requirements of the European Environment Agency.

8. CONCLUSIONS

8.1 At the time of submitting this report, information on monitoring requirements had not been validated the Walloon and Brussels regions of Belgium.

8.2 Within the EEA area, many requirements for monitoring arise from the European Commission. However, there are also many other international commitments which make monitoring requirements.

8.3 Four types of Directive have been employed by the EU to control the pollution of water: use-related directives; industry sector directives; substance directives; and, product directives. With the exception of the products directives, most of these directives require the implementation of monitoring, either routine programmes or preliminary investigations. The extent to which monitoring requirements associated with directives overlap depends on commonalities between the national implementation of directive requirements, and the monitoring undertaken for this purpose will therefore vary from country to country.

8.4 The requirements made in directives have been designed largely independently from each other. The Commission has, however, taken some initiatives to harmonise monitoring requirements and reporting of results in the Exchange of Information Decision (77/795/EEC as amended by Directive 86/574/EEC) and in the reporting of implementation of certain directives as specified in the Reporting Decision (92/446/EEC).

8.5 In total four directives and one proposed directive make requirements for groundwater monitoring (the requirements made in the Dangerous Substances Directive have been superseded by the Groundwater Directive). The only international commitment for groundwater monitoring is the 1992 Convention on Transboundary Water Courses. At present there is no overlap in international monitoring requirements for groundwater.

8.6 In EU legislation, all monitoring requirements which apply to rivers, also apply to lakes and reservoirs. Most directives which apply to freshwaters also apply to salt waters. The Shellfish Waters Directive is the only directive which applies to estuaries and coastal waters but not freshwaters.

8.7 Of the 15 directives that require monitoring of fresh surface waters, all include water column monitoring. The Dangerous Substances Directives and the Titanium Dioxide Directive also require monitoring of sediment and biota. The Exchange of Information Decisions make the only requirements for flow measurements. There are eight international agreements which also require monitoring of water quantity in terms of flow and water level.

8.8 Barriers to the harmonisation of monitoring can be introduced at the sampling, analysis, and reporting stages, and can arise either because requirements

differ (i.e. conflict) or because requirements are not clearly specified (i.e. are weak).

8.9 The most specific requirements in terms of named water bodies and measuring stations are in the Exchange of Information Decision. These rivers are nationally significant rivers and lakes and as such are quite likely to be sampled for other national and international obligations (e.g. Rhine and Elbe Conventions).

8.10 The scope for overlap of sampling locations between directives appears to be limited to areas where use and designation overlap, which is probably a limited circumstance in many States. Many of the directives allow the competent authority of each Member State to make decisions on such aspects as the exact sampling point, the distance from this point to the nearest point where pollutants are discharged and the depth at which the samples are to be taken but the same sites and depths should be used in all surveys, in relation to physical and temporal conditions.

8.11 For international agreements sample location will generally be related to the purpose of the agreement often being at designated or fixed sites. Other agreements are less specific about sampling location perhaps being determined by the needs of signatories or monitoring programme.

8.12 For some directives, once the fate and behaviour of an effluent is known and the effects have been established, and as long as there is no deterioration, then there is also scope for the Member States to use a lower sampling frequency than specified in the directive. Sampling period is not usually specified or, if it is, the interpretation of its definition can give rise to differences between countries (for example, bathing season). These imprecise requirements can give rise to different interpretation.

8.13 The sampling frequency specified in international agreements is very variable within agreements and between agreements.

8.14 As the choice of sampling location is, for some directives, related to areas designated by the Member States rather than by the European Commission, it is unlikely that, for those directives, a comparison of quality across Europe of these designated waters will give a complete picture of quality because the degree of comparability will depend on the interpretation of the designation rules and national differences of how these are implemented. Therefore, the degree of coverage that water quality data encompasses within each country will be determined by national designations and the prevalence of the industries that are required to be regulated.

8.15 It is not apparent from most of the published directives whether there have been any, or if so, what, statistical considerations when defining the required sampling frequencies or numbers. These aspects have a significant effect on the statistical precision and confidence of the monitoring data produced. The required frequency should be derived with reference to the quantified risks that

some waters will be misclassified (against compliance criteria). Furthermore, for fairness of comparison, the frequency of sampling should be uniform throughout Europe.

8.16 Sources of error in the overall assessment of a determinand in a water body may include sampling error and analytical error. The analytical requirements made in the directives are generally very basic and defined in terms of performance criteria (i.e. limits of detection, precision and accuracy) and/or by analytical method. The degree of definition, however, varies greatly from directive to directive. Many directives make very broad requirements to use 'appropriate methods' for pre-treatment and analysis. The analytical requirements made in international agreements are also generally very basic and hardly ever defined in terms of performance criteria.

8.17 The performance criteria are the key requirements with regard to analysis. Despite this several directives, the Titanium Dioxide Directive and all the use-related directives (except the Surface Water through the Sampling Analysis Directive) fail to establish performance requirements for analysis. The laboratories concerned with applying the directives should be free to use 'appropriate methods' providing they satisfy performance criteria.

8.18 Probably the most significant omission in requirements for analytical technologies is a requirement for analytical quality control (AQC). Increasingly AQC is being recognised as essential for data from monitoring programmes to be reliable and comparable.

8.19 Microbiological methods should be standardised for efficiency of recovery and performance (accuracy, specificity, precision) and, in order to secure harmonisation of results between Member States, single reference procedures must be agreed for each determinand.

8.20 The reporting frequency is variable per directive, as well as the reporting period covered.

8.21 Another important aspect of directives, particularly when a comparison of quality across Member States is expressed as a comparison of compliance against limits and standard values (e.g. as in the Bathing Waters Directive), is how the compliance requirements in the directives are expressed, calculated and interpreted. Differences in interpretation of these requirements is another significant barrier to harmonisation of monitoring and implementation of directives across Europe.

8.22 In addition to the aspects described above, another significant barrier to obtaining valid and quantitative, temporal and spatial comparisons of water quality across Europe is the different ways in which directives are implemented and interpreted at the Member State level. A particular issue of primary importance to the process of harmonisation is the need to standardise definitions for determinands and sampling methodologies. This issue has not

been addressed in this project, but it is recommended that such an assessment is undertaken.

8.23 The outputs from Project MW1 and MW2 (inventories of current monitoring networks) will be used in the next phase of the Topic Centre's work programme for this year - the design of an inland water monitoring network to meet the needs of the European Environment Agency.

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APPENDIX A COPY OF THE QUESTIONNAIRE FORWARDED TO NATIONAL FOCAL POINTS FOR VALIDATION AND LIST OF CONVENTIONS REVIEWED

A1. COPY OF QUESTIONNAIRE FOR THE UNITED KINGDOM

A.2 INTERNATIONAL AGREEMENTS REVIEWED IN MW1

Table A.1 List of international agreements reviewed in MW1 by chronological order

International Agreement	MON	Database number
Agreement between Austria and Bavaria on the Inn River 1858	N	8
Treaty between Belgium and the Netherlands concerning the regulation of Water Supply from the Meuse 1863	Y[1]	105
Agreement concerning the Hydropower station at Rheinfelden between Germany and Switzerland 1890	NS	34
Convention between France and Switzerland on the development of Water Power in the Rhone (4/10/1913)	N	50
Agreement between Denmark and Germany relating to Watercourses and Dikes on the German-Danish frontier 1922	N	12
Convention regulating the relations between France and Switzerland with regard to certain clauses of the legal regime of the future kembs derivation with additional protocol (27/08/1926)	N	67
Convention between Germany and Switzerland regarding regulation of the Rhine between Strasbourg-Kehl and Istein 1929/1955	NS	51
Convention between Norway and Sweden on certain questions relating to the law on Watercourses 1929	NS	55
Protocol determining the methods of Technical and Administrative Co-operation between Germany, France and Switzerland in the work for the regulation of the Rhine between Strasbourg-Kehl and Istein (18/12/1929) supplemented by Protocol (3/01/1930)	N	87
Convention respecting the Chatelot falls concession between France and Switzerland 1930	N	68
Agreement on the Reno di Lei Hydraulic Power Concession 1949	NS	38
Agreement between Austria and Bavarian State on Diversion of Water in the Rissbach, Durrah and Walchein districts 1950	N	9
State Treaty between Luxembourg and the Land Rhineland Palatinate on construction of Hydro-electric power plant on the Sauer at Rosport/Ralingen 1950	N	99
Agreement between Finland and Norway on the transfer from the course of the Naatamo (Neiden) river to the course of the Gandvik river of water from the Garjoen, Kjerringvatn and Forstevannene Lakes 1951	N	14

Table A.1 continued

International Agreement	MON	Database number
Agreement between Austria and Germany and of the free State of Bavaria concerning the Donaukraftwerk Jochenstein Aktiengesellschaft 1952	N	10
The Foyle Fisheries Commission between Northern Ireland and Republic of Ireland 1952	Y	100
Agreement concerning Water Economy in respect of the Frontier sector of the Mura 1954	Y	35
Convention concerning Water Economy questions relating to the Drava 1954	Y	63
Treaty between Austria and Switzerland for the Regulation of the Rhine from Ill confluence to Lake Constance 1954	N	104
Convention between Italy and Switzerland concerning Lake Lugano 1955	Y[3]	53
Convention between the French Republic, the Federal Republic of Germany and the Grand Duche of Luxembourg concerning the Canalisation of the Moselle (27/10/1956 modified in 28 /11/1974)	N	57
Treaty between Hungary and Austria on Water Economy 1956	Y	109
Agreement between Switzerland and the Land Baden-Wurttemberg on Fishing in the waters of the reservoir at the power station Rheinau 1957	NS	26
Agreement between the Russian Federation and Norway on the utilisation of Water Power on the Pasvik (Paatso) river 1957	NS	30
Convention concerning the use of Water Power of the Spol 1957	NS	62
Agreement between the Government of the French Republic and the Spanish Government relating to Lake Lanoux (12/07/1958)	N	28
Agreement between the Russian Federation, Norway and Finland concerning the Regulation of Lake Inari by means of the Kaitakosky Hydro-electric power station and dam 1959	Y	31
Convention between France and Spain concerning Fishing in the Bidasoa River and the Bay of Figuier (14/07/1959)	N	48
Convention between Baden-Wurttemberg, Bavaria, Austria and Switzerland on the Protection of Lake Constance against Pollution 1960	Y	58
Convention between France and Italy concerning Hydroelectric development of Mont Cenis (14/09/1960)	N	46

Table A.1 continued

International Agreement	MON	Database number
Convention on the Ghent-Terneuzen Canal 1960	Y[1]	65
Treaty between Germany and the Netherlands on arrangements for Co-operation in the Ems estuary (Ems-Dollard Treaty) 1960	N	107
Treaty between Germany and the Netherlands on the course of the common frontier, the boundary waters, real property situated near the frontier, traffic crossing the frontier on land via inland waters 1960	N	108
Protocol establishing an International Commission for the River Sarre 1961	Y	129
Protocol for the Protection of the Moselle 1961	Y	128
Convention concerning the Protection of Lake Geneva against Pollution (16/11/1962)	Y[3]	61
Agreement concerning an International Commission for the Protection of the Rhine against Pollution (Bern 29/04/1963) supplemented by the Agreement of 3/12/1976	Y	33
Convention between France and Spain concerning the Upper Reaches of the Garonne 1963	N	49
Convention on the Emission Hydro-electric project (23/08/1963)	N	66
Treaty between Belgium, the Netherlands concerning the connection between the Scheldt and the Rhine 1963	Y[1]	106
Agreement between Finland and Russian Federation concerning Frontier Water Courses 1964	Y	16
Convention between Spain and Portugal concerning the use of International sections of the Duoro River and its tributaries for Hydropower production 1964	N	56
Convention between France and Italy concerning the Water Supply of the French commune of Menton (28/09/1967)	N	47
Treaty between Austria and Czech Republic on Frontiers Waters 1967	Y	103
Convention for the Regulation of the Use and Hydraulic development of the international sections of the rivers Minho, Lima, Tejo, Guadiana, Chanca and their tributaries 1968	N	64
New regulation between Portugal and Spain concerning Fishing in the international section of the Minho river 1968	N	79

Table A.1 continued

International Agreement	MON	Database number
Convention between Germany and France concerning the Development of the Rhine between Strasbourg-Kehl and Lauterbourg/Neuburgweier (4/07/1969, supplemented by the Conventions of 16/07/1975 and 6/12/1982)	N	41
Exchange of Notes between Norway and Sweden constituting an agreement concerning the free passage for Salmon to and from Lake Vaenern 1969	N	70
Operating status of the Commission created under the Convention between Spain and Portugal for the Regulation of the use and Hydraulic development of the international sections of the rivers Minho, Lima, Tejo, Guadiana, Chanca and their tributaries 1969.	N	80
Convention between Belgium and the Netherlands on the improvement of the Navigable Water way of the Western Scheldt near Vilvoorden 1970	NS	44
Treaty between the Flemish Region and the Netherlands concerning Water Supply from the River Meuse 1970	Y[1]	116
Treaty on Frontier Waters between Austria and the Slovak Republic 1970	Y	125
Agreement between Finland and Sweden concerning Frontier Rivers 1971	Y	17
Agreement between Norway and Russian Federation regulating the Fishing and Conserving the fish stock in the Greense Jakob river (Voriema) and Pasvik river (Patsojoki) 1971	NS	21
Agreement between Finland and Russian Federation concerning the Production of Electric power in the part of the Vuoksa river bounded by the Imatra and Swetogorsk hydroelectric stations 1972, 1983	Y	15
Oslo Convention (Prevention of marine pollution by dumping waste) 1972 [5]	Y	73
Convention concerning the Protection of the Adriatic Sea and its coastal areas against Pollution 1974	Y[3]	60
Helsinki Convention 1974 as revised in 1992 (Baltic Sea)	Y	1
Paris Convention 1974 [5]	Y	82
The Nordic Environmental Protection Convention between Denmark, Finland, Norway and Sweden (Stockholm) 1974	N	101

Table A.1 continued

International Agreement	MON	Database number
Treaty between the Luxembourg and the Land Rhineland-Palatinate concerning the Common Performance of tasks related to Water Management by local authorities and other communities 1974	N	110
Agreement between France and Switzerland concerning Navigation on Lake Geneva (7/12/1976)	Y	18
Agreement between Germany and Luxembourg on Maintenance, Restoration and Operation of the section of the Moselle common to the two states 1976	N	19
Agreement between Norway and the Russian Federation concerning water abstraction by Norway from the upper Reservoir of the Borisoglebsk Hydropower plant at the transboundary river Pasvik 1976	NS	23
Barcelona Convention 1976 (Mediterranean Sea) and different protocols	Y	39
Rhine Convention against chemical pollution (Bonn 3/12/1976)	Y	115
Rhine Convention against chloride pollution (Bonn 1976) supplemented by Protocol of 25/09/1991	Y[4]	95
Agreement between Finland and Norway concerning fishing in the Neiden (Naatamo) River 1977	N	13
Record of the demarcation of the extremity of waters below the area reserved to Spain in the International sections of the Duoro River, in relation with the Hydroelectric use of that river 1977	N	91
Agreement concerning co-operation on Water Management of Frontier waters between Italy and Slovenia 1978	Y[3]	32
London Dumping Convention 1978	N	74
MARPOL (International Convention for the Prevention of Pollution from ships) 1973 as modified by the Protocol of 1978	N	77
Agreement between France and Switzerland concerning Fishing in Lake Geneva (20/11/1980)	N	5
Agreement between the French Republic and the Swiss Confederation concerning the Reduction of the Phosphorus concentration in the waters of Lake Geneva (20/11/1980)	Y[3]	27
Agreement on a Finnish Norwegian Commission on Boundary Watercourses 1980	Y	36
Convention between Belgium and Luxembourg concerning the waters of the Sure 1980	N	42

Table A.1 continued

International Agreement	MON	Database number
Protocol between Finland and the Russian Federation on the participation of the Soviet socialist organisation in Pisciculture measures in order to preserve the fish stocks in Lake Inari 1983	N	83
Bucharest Declaration (Danube) 1985	Y	113
Convention between France and Luxembourg concerning certain Industrial Installations on the Moselle 1986	Y	45
Convention between Italy and Switzerland concerning Fishing in Italo-Swiss waters 1986	N	52
Convention between the Swiss cantons of Vaud, Valais and Geneva and the French Departments Ain and Haute Savoie concerning the setting up of the Council of Lake Geneva (19/02/1987)	N	59
Regensburg Agreement 1987 (Danube Basin)	Y	92
Rhine Action Programme 1987	N	94
North Sea Task Force 1987	Y	126
Frankfurt Seminar 1988	N	71
Agreement between the Republic of Finland and the Soviet Union concerning the release of water of Lake Saimaa and River Vuoski 1989	Y	130
Agreement on joint rules for the River Tana fishing area between Finland and Norway 1989	N	37
International Commission on Hydrology - Rhine 1989	Y	127
3rd North Sea Conference 1990 (The Hague)	Y	2
Agreement between the Land Baden-Wurttemberg and Switzerland concerning a joint construction and operation of a monitoring and control station downstream of Basle to monitor the water quality of the Rhine 1990	NS	29
Agreement between Norway and Sweden concerning the salmon and sea salmon fisheries in the Svinesund, the Iddefjord and the river Enningsdals 1991	NS	7
Ministerial Seminar on Groundwater 1991 (The Hague)	N	78
Protocol for Technical Co-operation between Greece and Bulgaria 1991	Y	114
Arctic Monitoring and Assessment Programme (AMAP) Ministerial Conference in Rovaniemi, Finland June 1991	Y[2]	132
5th EU Environmental Action Programme 1992	N	3

Table A.1 continued

International Agreement	MON	Database number
Agenda 21 1992 (Rio)	N	4
Agreement between Germany and Poland on Co-operation in the field of Water Management at border waters 1992	NS	20
Black Sea Convention 1992	Y	40
OSPAR (North East Atlantic Treaty) 1992 [5]	Y	81
Transboundary Watercourses and International Lake Convention 1992	Y	102
UN Conference on Water and Environment 1992 (Dublin)	N	112
Convention on Co-operation for the Protection and Sustainable Use of the River Danube 29/6/1994 (Sofia)	Y[2]	131
River Meuse Convention 1994	Y[2]	96
River Scheldt Convention 1994	Y[2]	97

Notes:

MON	Is there any monitoring requirements specified in the following commitments?
NS	Not specified (No information was received from the relevant countries, either because the agreement was not recognised as being a relevant commitment or because it was not possible to specify if monitoring was required under the commitment)
N	No monitoring requirements for water quantity and/or quality were made under the commitment
Y	Monitoring requirements for water quantity and/or quality were made under the commitment
1	Replaced
2	Under preparation
3	No copy was provided and no details could be specified further in the text
4	Monitoring details considered together with (115) Rhine Convention against chemical pollution, 1976
5	Monitoring requirements for the Oslo Convention are incorporated with those of the Paris Convention in the JMP, and, in this report, are considered under the Paris Convention. The JMP will be replaced in the future by the JAMP under OSPAR 1992.
Database number	Numbering of agreements used in the database held at ETC/IW

Table A.2 List of international agreements requiring water quality and/or quantity monitoring and reviewed in MW1 (chronological order)

International agreement		Reference No.	
Full name	**Short name used in this report**	**Data base**	**Report**
CATEGORY A			
Protocol for the Protection of the Moselle 1961	Moselle 1961	128	A.1
Agreement concerning an International Commission for the protection of the Rhine against Pollution (Bern 29/04/1963) supplemented by the Agreement of 3/12/1976 [3]	Rhine Commission 1963	33	
Oslo Convention (prevention of Marine pollution by Dumping Waste) 1972 [4]	North East Atlantic (Oslo) 1972	73	A.2
Helsinki Convention 1974 as revised in 1992 (Baltic Sea)	Baltic Sea (Helsinki) 1974/92	1	A.3
Paris Convention 1974 [4]	North East Atlantic (Paris) 1974	82	A.4
Barcelona Convention 1976 (Mediterranean Sea) and different Protocols	Mediterranean (Barcelona) 1976	39	A.5
Rhine Convention against Chemical Pollution (Bonn 3/12/1976) [3]	Rhine 1976	115	A.6
Rhine Convention against Chloride Pollution (Bonn 1976) supplemented by Protocol of 25/09/1991 [3]	Rhine (chloride) 1976/91	95	
North Sea Task Force 1987	North Sea (NSTF) 1987	126	A.7
International Commission on Hydrology - Rhine 1989	Rhine (hydrology) 1989	127	A.8
3rd North Sea Conference 1990 (The Hague)	North Sea (conference) 1990	2	A.9
Arctic Monitoring and Assessment Programme (AMAP) Ministerial Conference in Rovaniemi, Finland, June 1991	Arctic Sea (AMAP) 1991		A.10
OSPAR (North East Atlantic Treaty) 1992 [4]	North East Atlantic (OSPAR) 1992	81	A.11
Transboundary Watercourses and International Lake Convention 1992	Transboundary Waters 1992	102	A.12
River Meuse Convention 1994 [1]	Meuse 1994	96	A.13
River Scheldt Convention 1994 [1]	Scheldt 1994	97	A.14
CATEGORY B			
The Foyle Fisheries Commission between Northern Ireland and Republic of Ireland 1952	Foyle Fisheries 1952	100	B.1
Agreement between the Russian Federation, Norway and Finland concerning the Regulation of Lake Inari by means of the Kaitakosky Hydro-electric power station and dam 1959	Lake Inari 1959	31	B.2

Table A.2 continued

International agreement		Reference No.	
Full name	**Short name used in this report**	**Database**	**Report**
CATEGORY B (cont.)			
Convention between Baden-Wurttemberg, Bavaria, Austria and Switzerland on the Protection of Lake Constance against Pollution 1960	Lake Constance 1960	58	B.3
Protocol establishing an International Commission for the River Sarre 1961	Sarre 1961	129	B.4
Agreement between Germany, Austria, Switzerland on the Withdrawal of Water from Lake Constance 1966	Lake Constance (water withdrawal) 1966	6	B.5
Agreement between Finland and Sweden concerning Frontier Rivers 1971	Frontier Rivers (Fi/S) 1971	17	B.6
Agreement on a Finnish Norwegian Commission on Boundary Watercourses 1980	Boundary Waters (Fi/N) 1980	36	B.7
Bucharest Declaration (Danube) 1985	Danube (Bucharest) 1985	113	B.8
Convention between France and Luxembourg concerning certain Industrial Installations on the Moselle 1986	Moselle (industry) 1986	45	B.9
Regensburg Agreement 1987 (Danube Basin)	Danube (Regensburg) 1987	92	B.10
Elbe Convention 1990 (Magdeburg)	Elbe (Magdeburg) 1990	75	B.11
Convention on Co-operation for the Protection and Sustainable Use of the River Danube 29/6/1994 (Sofia) [1]	Danube (Sofia) 1994	131	B.12
CATEGORY C			
Convention concerning Water Economy questions relating to the Drava 1954	Drava 1954	63	C.1
Agreement concerning Water Economy in respect of the frontier sector of the Mura 1954	Mura 1954	35	C.2
Convention between Italy and Switzerland concerning Lake Lugano, 1955 [2]	Lake Lugano 1955	53	C.3
Treaty between Hungary and Austria on Water Economy 1956	Water Economy (Au/Hu) 1956	109	C.4
Convention concerning the Protection of Lake Geneva against Pollution (16/11/1962)	Lake Geneva 1962	61	C.5

Table A.2 continued

International agreement		Reference No.	
Full name	**Short name used in this report**	**Database**	**Report**
CATEGORY C (cont.)			
Agreement between Finland and Russian Federation concerning Frontier Water Courses 1964	Frontier Waters (Fi/Ru) 1964	16	C.6
Treaty between Austria and Czech Republic on Frontier Waters 1967	Frontier Waters (Au/Cz) 1967	103	C.7
Treaty on Frontier Waters between Austria and the Slovak Republic 1970	Frontier Waters (Au/Sl) 1970	125	C.8
Agreement between Finland and the Russian Federation concerning the Production of Electric power in the part of the Vuoska River bounded by the Imatra and Swetogorsk Hydroelectric stations 1972, 1983	Vuoska 1972/83	15	C.9
Convention between Italy and Switzerland on the protection of Italo-Swiss waters against pollution 1972/1986 [2]	Italo-Swiss Waters 1972/86	54	C.10
Convention concerning the protection of the Adriatic Sea and its Coastal areas against pollution 1974 [2]	Adriatic 1974	60	C.11
Agreement between France and Switzerland concerning Navigation on Lake Geneva (7/12/1976) [2]	Lake Geneva (navigation) 1976	18	C.12
Agreement concerning Co-operation on water management of Frontier Waters between Italy and Slovenia 1978 [2]	Frontier Waters (I/Sv) 1978	32	C.13
Agreement between the French Republic and the Swiss confederation concerning the Reduction of the phosphorus concentration of the waters of Lake Geneva (20/11/1980) [2]	Lake Geneva (phosphorus) 1980	27	C.14
Agreement between the Republic of Finland and the Soviet Union concerning the Release of water of Lake Saimaa and River Vuoski 1989	Saimaa/Vuoski 1989	130	C.15
Protocol for Technical Co-operation between Greece and Bulgaria 1991	Technical Co-operation (Bu/Gr) 1991	114	C.16
Black Sea Convention 1992	Black Sea 1992	40	C.17

Notes:
1 Under preparation
2 No copy of agreement provided and hence no details could be specified in this report
3 Monitoring details considered together with Rhine Convention (database number 115) against chemical pollution, 1976
4 Monitoring requirements for the Oslo Convention are incorporated with those of the Paris Convention in the JMP, and, in this report, are considered under the Paris Convention. The JMP will be replaced in the future by the JAMP under OSPAR 1992
Database number Numbering of agreements used in the database held at ETC/IW
Report number Numbering of agreements used in this report

APPENDIX B LIST OF ORGANISATIONS RESPONSIBLE FOR VALIDATING THE QUESTIONNAIRE

EEA Member	National Focal Point and/or respondent
Austria	Günter Liebel Umweltbundesamt
Belgium	Alain Derouane Cellule Interrégionale de l'Environnement
Denmark	Torben Moth Iversen National Environmental Research Institute
Finland	Tapani Säynätkari Finnish Environment Agency
France	Jean-Louis Weber Institut Français de l'Environnement
Germany	Karl Tietmann Umweltbundesamt
Greece	Mata Aravantinou Ministry for the Environment
Iceland	Hugi Ólafsson Ministry for the Environment
Ireland	Larry Stapleton Environment Protection Agency
Italy	Costanza Pera SINA - Ministero dell'ambiente
Luxembourg	Jean-Paul Feltgen Ministère de l'Environnement
Netherlands	Adriaan Minderhoud National Institute of Public Health and Environmental Protection
Norway	Berit Kvæven Norwegian Pollution Control Authority
Portugal	Maria Leonor Gomes Ministerio do Ambiente e dos Recursos Naturais
Spain	Angel Herrero Ministerio de Obras Públicas, Transportes y Medio Ambiente
Sweden	Ebbe Kvist Swedish Environmental Protection Agency
United Kingdom	C D Martin Department of the Environment

APPENDIX C THE PROPOSED AND ACTUAL TIMETABLE FOR COMPLETION OF MW1 QUESTIONNAIRE

Table C.1 Proposed and actual timetable for completion of MW1 questionnaire (1995 unless otherwise stated)

	Target	WRc	NERI			INAG		AWW		VMM			NIVA	CEDEX	IOW					
		UK	Denmark	Sweden	Iceland	Portugal	Greece	Austria	Italy	Flanders	Brussels	Luxem-bourg	Norway	Spain	France	Germany	Netherlands	Finland	Ireland	Walloon
Delivered to ETC/IW partners		-	16-Feb	-	-	16-Feb	-	20-Feb	-	16-Feb	-	-	16-Feb	16-Feb	16-Feb	-	-	-	-	-
Delivered to NFP/NRC	10-Feb	28-Feb	20-Feb	27-Feb	27-Feb	-	20-Feb	20-Feb	21-Feb	23-Feb	-	23-Feb	14-Mar	17-Feb	20-Feb	20-Feb	20-Feb	20-Feb	20-Feb	20-Feb
Acknowledged		-	-	-	-	08-Mar	-	-	22-Feb	-	-	-	-	-	-	28-Feb WRc	-	-	-	-
Returned	17-Mar	20-Mar	21-Apr	12-May	06-May 1996	20-Mar	20-Mar	17-Mar	04-Apr	22-Mar	-	22-Mar	28-Mar	31-Mar	19-Apr	-6-Jun	22-Mar	22-Mar	28-Mar	-

APPENDIX D SUMMARY OF BASIC MONITORING REQUIREMENTS FOR INLAND WATERS

LIST OF TABLES

Table D.1. Summary of monitoring requirements made in directives and international agreements according to water type and matrix

COMMITMENT	WATER TYPE												
	GW	RIVERS			LAKES AND RESERVOIRS			ESTUARIES			COASTAL WATERS		
	W	W	S	B	W	S	B	W	S	B	W	S	B
1. DIRECTIVES													
Surface Water (75/440/EEC) and (79/869/EEC)		X			X								
Bathing Water (76/160/EEC)		X			X			X			X		
Dangerous Substances (76/464/EEC) [a]													
- Mercury from Chlor-alkali (82/176/EEC)		X	X	X	X	X	X	X	X	X	X	X	X
- Mercury from Other Sectors (84/156/EEC)		X	X	X	X	X	X	X	X	X	X	X	X
- Cadmium (83/513/EEC)		X	X	X	X	X	X	X	X	X	X	X	X
- Carbon tetrachloride (86/280/EEC)		X	X[b]	X[b]	X	X[b]	X[b]	X	X[b]	X[b]	X	X[b]	X[b]
- Hexachlorocyclohexane (84/491/EEC)		X	X	X	X	X	X	X	X	X	X	X	X
- Aldrin, etc. (88/347/EEC)		X	X[c]	X[c]	X	X[c]	X[c]	X	X[c]	X[c]	X	X[c]	X[c]
- Dichloroethane, etc. (90/415/EEC)		X	X[d]	X[d]	X	X[d]	X[d]	X	X[d]	X[d]	X	X[d]	X[d]
Titanium Dioxide (82/883/EEC)	X	X	X	X	X	X	X	X	X	X	X	X	X
Freshwater Fish (78/659/EEC)		X			X								
Shellfish Waters (79/923/EEC)								X		X[e]	X		X[e]
Groundwater (80/68/EEC)[f]	X												
Drinking Water (80/778/EEC)[g]	X	X			X								
UWWT (91/271/EEC) [h]		X			X			X			X		
Nitrates (91/676/EEC) [i]	X	X			X			X			X		
Exchange of Information (77/795/EEC) (86/574/EEC)		X			X								
NUMBER OF DIRECTIVES	**5**	**15**	**8**	**8**	**15**	**8**	**8**	**12**	**8**	**9**	**12**	**8**	**9**
2. INTERNATIONAL AGREEMENTS													
CATEGORY A	**1**	**9**	**2**	**2**	**3**	**2**	**2**	**4**	**4**	**4**	**5**	**5**	**5**
Moselle 1961[j]		X											
North East Atlantic (Oslo) 1972[n]											(X)	(X)	(X)
North East Atlantic (Paris) 1974[n]		X						X	X	X	X	X	X
Baltic Sea (Helsinki) 1974/ 1992								X	X	X	X	X	X
Mediterranean (Barcelona) 1976 [m]								X	X	X	X	X	X
Rhine 1976 [k]		X	X	X	X[l]	X[l]	X[l]						
North Sea (NSTF) 1987								X	X	X	X	X	X
Rhine (hydrology) 1989		X											
North Sea (Conference) 1990		X											
Arctic Sea (AMAP) 1991		X	X	X	X	X	X	X	X	X	X	X	X

Table D.1 continued

COMMITMENT	WATER TYPE												
	GW	RIVERS			LAKES AND RESERVOIRS			ESTUARIES			COASTAL WATERS		
	W	W	S	B	W	S	B	W	S	B	W	S	B
North East Atlantic (OSPAR) 1992[o]		(X)						(X)	(X)	(X)	(X)	(X)	(X)
Transboundary Waters 1992[q]	X	X			X								
Meuse 1994[o]		X											
Scheldt 1994[o]		X											
CATEGORY B		**9**	**0**	**3**	**6**	**0**	**1**	**2**	**0**	**1**	**0**	**0**	**0**
Foyle Fisheries 1952		X		X	X		X	X		X			
Lake Inari 1959		X[t]			X								
Lake Constance 1960					X								
Sarre 1961 [j]		X											
Lake Constance (water withdrawal) 1966					X								
Frontier rivers (Fi/S) 1971		X[t]			X			X					

Boundary watercourses (Fi/N) 1980		X[s]			X[s]								
Danube (Bucharest) 1985		X		X[p]									
Moselle (industry) 1986[j]		X											
Danube (Regensburg) 1987		X		X[p]									
Elbe 1990		X											
Danube (Sofia) 1994 [o]		(X)											
CATEGORY C		**10**	**0**	**5**	**7**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**
Drava 1954		X		X									
Mura 1954		X		X									
Lake Lugano 1955 [j]					X								
Water Economy (Hu/Au) 1956		X		X									
Lake Geneva 1962 [j]					X	X							
Frontier waters (Fi/Ru) 1964		X			X								
Frontier waters (Au/Cz/Sl) 1970		X		X									
Vuoksa 1972/83 (Fi/Ru)		X[t]			X[t]								
Italo-Swiss waters 1972/1985 [j]		X			X								
Adriatic 1974 [j]											X		
Lake Geneva (navigation) 1976[j]					X								
Frontier Waters (It/Sv) 1978 [j]		X											
Lake Geneva (phosphorus) 1980[j]		X			X								
Technical Co-operation (Bu/Gr) 1991		X		X									
Black Sea											X		
NUMBER OF AGREEMENTS	1	28	2	10	16	3	3	6	4	5	6	5	5
TOTAL NUMBER OF COMMITMENTS	6	43	10	18	31	11	11	18	12	14	18	13	14

Table D.1 continued

Notes: Water types GW Groundwater
Matrix B Biota
S Sediment
W Water column

() Figures in brackets are not included in the calculation of totals as they are either covered by another agreement or have yet to come into place

a The provisions of this directive relating to groundwater are superseded by Directive 80/68/EEC.
b Only for DDT and pentachlorophenol (PCP).
c Only for aldrin, dieldrin, endrin and isodrin, hexachlorobenzene (HCB), hexachlorobutadiene (HCBD).
d Only for trichlorobenzene (TCB).
e For metals and organohalogenated compounds only. The requirement for faecal coliforms superseded by Directive 91/492/EEC.
f For prior investigation before granting an authorisation. The prior investigation include examination of the hydrogeological conditions of the area concerning and possible purifying powers of the soil and subsoil and the risk of pollution and alteration of the quality of groundwater form the discharge and shall establish whether the discharge of substances into groundwater is a satisfactory solution from the point of view of the environment.
g An initial analysis to be carried out before exploitation of the source. The determinands listed above plus various toxic or undesirable substances presumed present.
h For identifying sensitive areas. Member States must also monitor waters subject to discharges from STW and direct discharges from industrial sectors in cases where the receiving environment may be significantly affected. For discharges to less sensitive areas and for disposal of sludge, Member States must monitor and carry out any relevant studies to verify that the discharge or disposal does not adversely affect the environment.
i For designating vulnerable zones, Member States must monitor the nitrate concentration in fresh surface and groundwater and review the eutrophic state of fresh water, estuaries and coastal waters. In addition, the nitrate content of waters must be monitored (surface and groundwater) to assess the effects of action programmes.
j Copy of the convention could not be provided. Water only, other matrix not specified.
k The International Commission for the Protection of the Rhine against Pollution (ICPR) has established a monitoring programme reviewed periodically
l Only one sampling station on Lake Constance
m The contracting parties shall establish in close co-operation with the international bodies complementary or joint programmes for pollution monitoring in the Mediterranean sea area. The contracting parties may be required to prescribe common procedures and standards for pollution monitoring.
n Since 1978, the two Commissions have established a Joint Monitoring Programme (JMP). The Declaration of the second International Ministerial Conference on the protection of the North Sea (London 1987) advocated the setting up of a co-ordinated scientific programme for the North Sea. As requested by the Declaration, the Oslo and Paris Commissions and the International Council for the Exploration of the Sea established a North Sea Task Force to co-ordinate this work. One of the main objectives of the Task Force was to prepare a new Quality Status Report of the North Sea by the end of 1993. To achieve this, a monitoring master plan (MMP) for the whole of the North Sea environment was developed and implemented. This built on the monitoring carried out under the JMP.
o Under preparation
p Saprobic index
q The Riparian countries shall establish and implement a joint monitoring programme on the condition of transboundary waters including floods and ice drifts as well as transboundary impacts.
r Only flow
s Water quality but not specified
t Water level and flow

Table D.2 Summary of basic monitoring requirements in directives and international agreements for groundwater

COMMITMENT	Sampling location/timing	Determinands
1. DIRECTIVES		
Groundwater (80/68/EEC)	Once prior to authorising discharges	Not specified- assume general composition
Drinking Water (80/778/EEC)	Once before exploitation of the source for drinking water	Faecal coliforms, total coliform, total count of 22 and 37^{o}C, ammonia, nitrate, nitrite, pH, residual chlorine, taste, temperature, turbidity, conductivity
Titanium Dioxide (82/883/EEC)	1 per year where waste discharges are disposed of to land	Ca, Cl, Cr, Cu, Fe, Pb, Mn, Ni, pH, SO_4, Ti, Vn, Zn
Nitrates (91/676/EEC)	Within two years of notification of directive over a period of a year. Then every four years to identify vulnerable zones. If concentration below 25 mg NO_3/l then repeat only every 8 years.	Nitrate
Proposed Landfill (COM(93)275)	Every six months	Based on leachate composition determined in operational phase and on List 1 and 2 of Directive 80/68/EEC. Groundwater level.
2. INTERNATIONAL AGREEMENTS - Category A		
Transboundary Waters 1992 [a]	Harmonised rules for monitoring, analytical techniques, data processing often required.	To be agreed by riparian states

Notes: a Applies to all countries except Ireland and Greece

Table D.3 Summary of basic monitoring requirements made in directives and international agreements for surface water

Commitment	Sampling location/timing	determinands
FRESHWATER ONLY		
1. DIRECTIVES		
Surface Water (75/440/EEC) and (79/869/EEC)	Designated sites 4-12 times per year	pH, turbidity, colour, temperature, total suspended solids, conductivity, odour, DO[2], BOD5[2], COD,[2] substances extractable with chloroform[2], total organic carbon[1], residual organic carbon[1], ammonium[2] ,nitrogen kjeldahl[2], nitrates, fluorides, total extractable organic chlorine, dissolved Fe, Mn, Cu, Zn, Bo[2], Be[1], Co[1], Ni[1] ,Vn[1] , As, Cd, total Cr, Hg, Se, Pb, Ba, CN, sulphates, chlorides[2] , surfactants[2] , phosphates[2], phenols, dissolved/emulsified hydrocarbons, PAHs, total pesticides, total coliforms[2], faecal coliforms[2], faecal streptococci[2], salmonella[2]
Exchange of Information (77/795/EEC) as amended by (86/574/EEC)	Selected sites	flow, temperature[3], pH, conductivity, chlorides nitrates, ammonia, DO, BOD_5, COD, total phosphorous, surfactants, total Cd, Hg, faecal coliforms, total coliforms, faecal streptococci, salmonella, biological quality
Freshwater Fish (78/659/EEC)	Agreed sites in designated areas Weekly-Monthly	Temperature, DO, pH, suspended solids[2], BOD_5[2], total phosphorus[1], nitrites[2], phenolic compounds, petroleum hydrocarbons, non-ionised ammonia, total ammonium, total Zn, dissolved Cu[2], total residual chlorine
Drinking Water (80/778/EEC)	Initially before source exploited	Odour, pH, taste, temperature, turbidity, conductivity, residual chlorine, nitrates, nitrites, ammonia, total coliforms, faecal coliforms, total counts of 22 and 37°C
2. INTERNATIONAL AGREEMENTS - Category A		
Moselle 1961	NI	Monitoring of water, biota, sediments, no details provided.
Rhine 1976	Varies depending on media and determinand. Water at 9 designated sites 26 times per year (fortnightly) to continuously Suspended sediment at 6 sites 26 times per year (fortnightly) Sediment (1995) at 10 sites Biota (fish) at 39 sites	Water (86 determinands): Flow, temperature, DO, oxygen saturation, pH, conductivity, suspended sediment, total organic carbon [12], dissolved organic carbon, absorbable organic carbon, inhibition of cholinesterase, total P[12], orthophosphate, ammoniacal N, nitrate N, total N[11], silica, chloride, sulphate, sodium, potassium, calcium[11], magnesium, radioactivity (total alpha, total beta, total potassium 40, caesium 137, strontium 90, tritium), iron[12], mercury[13], nickel[12], zinc[12], copper[12], chromium[12], lead[13], cadmium[13], manganese[12], arsenic[12], aluminium[11], titanium[11], atrazine, azinphos ethyl, azinphos methyl, bentazone, chloridazon, dichlorvos, diuron, endosulphan[11], fenitrothion, fenthion, alpha HCH[13], beta HCH[13], gamma HCH[12], 6 HCH[13], isoproturon, malathion, parathion ethyl, parathion methyl, pentachlorophenol, simazine, trifluralin, 1,2-dichloroethane, 1,1,1-trichloroethane, trichlorethene, trichloromethane, tetrachloroethene, tetrachloromethane, tetrahydrofuran, 2-chloranilin, 3-chloranilin, 4-chloranilin, 3,4-chloranilin, 1-chlor-2-nitrobenzene[12], 1-chloro-3-nitrobenzene[12], 1-chloro-4-nitrobenzene[12], nitrobenzene, benzene, 1,2,3-trichlorobenzene[13], 1,2,4-trichlorobenzene[13], 1,3,5-trichlorobenzene[13], hexachlorobutadiene[15], 2-chlortoluene, 4-chlorotoluene, EDTA, NTA. Suspended solids: (46 + 4 non-mandatory determinands) as for water (noted 12) + granulometry, DDT (pp,op)[14], DDD (pp,op) [14], DDE (pp,op) [14], DDT (total) [14], alrin, dieldrin, endrin, isodrin, hexachlorobenzene, dioxins, benzo(b) fluoranthrene, benzo(k)fluoranthrene, benzo(a)pyrene, benzo(gh)pyrene,

Table D.3 continued

Commitment	Sampling location/timing	Determinands
Rhine 1976 (cont.)		fluoranthrene, indenopyrene, PCBs(29, 52, 101, 118, 138, 153, 188) Sediments: (74 + 4 non-mandatory determinands) as for suspended sediments + water (noted 11 and 12) + exchangeable organic halogens, organic silver, barium, hexachloroethane, 1,2-dichlorobenzene, 1,2,4,5-tetrachlorobenzene, pentachlorobenzene[16], pentachloroanisole[16], octochlorostyrene[16], heptachloroepoxide, anthracene, benzo(a)anthracene, chrysene, dibenzo(ah)anthracene, napthalene, pyrene, PCBs (170[16] and 194) Fish: (27 + 7 non-mandatory determinands) for water (noted 13 and 15), for suspended sediment (noted 14) and for sediment (noted 16)
Rhine (hydrology) 1979	NI	NI
Transboundary Waters 1992	In progress	Condition of transboundary waters including floods and ice drifts
Meuse 1994	Monitoring programme under preparation.	
Scheldt 1994	Monitoring programme under preparation.	
FRESH WATER, ESTUARIES AND COASTAL WATERS		
1. DIRECTIVES		
Bathing Water (76/160/EEC)	Designated sites, Fortnightly in bathing season	Total coliforms, faecal coliforms, faecal streptococci[4], salmonella[4], enteroviruses[4], pH[5], colour, mineral oils[2], surfactants, phenols, transparency, DO[4], tarry residues and floating materials, ammonia[6], nitrogen kjeldahl[6], pesticides[6], As[6], Cd[6], CrVI[6], Pb[6], Hg[6], CN[6], nitrates[6], phosphates[6]
Dangerous Substances (76/464/EEC) and daughter directives	Areas affected by discharges Monthly for water, annually for sediments	Cd, hg, HCCH, HCBD, PCP, chloroform, dichloroethane, drins, DDT, HCB, carbon tetrachloride, trichlororethene, perchloroethylene, trichlorobenzene
Titanium Dioxide (82/883/EEC)	Areas affected by discharge and neighbouring zones, 3 times for water, annually for sediment and biota	pH, temperature[7], salinity[8], DO[7], turbidity[7], or suspended matter, conductivity[9], SO4[10], Ca[10], Cl, Cr, Cd, Cu, Fe, Pb, Mn, Ni, Ti, Vn, Zn, hydrated oxides and hydroxides of iron, biota diversity
UWWT (91/271/EEC)	Areas affected by discharges	
Nitrates (91/676/EEC)	Designated sites Initially regularly or 12 times per year- repeated every four years	NO_3

Table D.3 continued

Commitment	Sampling location/timing	Determinands
2. INTERNATIONAL AGREEMENTS -Category A		
North East Atlantic (Paris) 1974	1. For estuaries: Lowest freshwater influence on estuarine/coastal waters (usually harmonised sites) At least 12 per year. Reduced sampling frequency for individual determinands at sites not contributing to 95% of the total National Low Mean Annual Load 2. For coastal waters (JMP): 44 sample locations for fish and 83 for water, sediment and shellfish monitored once every five years	Mercury, cadmium, copper, zinc, lead, PCBs (the following congeners: IUPAC No.s 28, 52, 101, 118, 138, 153, 180), γ-hexachlorocyclohexane, nitrate as N, total nitrogen (taken in UK as total inorganic N), orthophosphate as P, suspended particulate matter Arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc, dieldrin, DDT, DDE, TDE, γ-hexachlorocylohexane, PCBs (IUPAC No.s 28, 52, 101, 118, 138, 153, 180), PCB -arochlor
Arctic (AMAP) 1991	1. Sites in small lakes and rivers to determine loadings - location and sampling frequency to be agreed but suggested as, 62-75 lake sites for sediment and fish, and 1 site for major rivers 2. Sites in 21 areas in the Arctic Sea, sampling frequency being decided, max of 5 years for sediment and biota	1. Freshwaters (essential determinands for baseline study) Lake sediments: cadmium, copper, mercury, lead, zinc, nickel, arsenic, selenium, organic matter (loss on ignition), total organic carbon, Pb-210, PAH, PCBs(28,31,52,101,105,118,138, 153,156, 180), DDT, DDE, HCHs, HCB, chlordanes (cis and trans), dieldrin. Fish: Mercury, PCBs, DDT, DDE, HCHs, HCB, chlordanes, dieldrin, toxaphene. Water: Cadmium, lead, copper, zinc, chromium, arsenic, selenium, iron, suspended solids, particulate inorganic matter, particulate organic matter, acid neutralisation capacity, pH, conductivity, total organic carbon, persistent organic pollutants (as for fish) 2. Marine waters (essential determinands for baseline study) Sediments: Cadmium, copper, mercury, lead, zinc, aluminium, lithium, total organic carbon, grain size (<63um), PCBs (28,31,52, 101,105,118,138,153,156,180), HCH, HCB, p,p-DDT, p,p-DDD, p,p-DDE, PAHs(napthalene, c1, c2 and c3 alkyl derivatives, anthracene, phenanthrene, and c1 and c2 derivatives, dibenzothiophene and C1 and C2 derivatives, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzofluoranthene, benzo(e)pyrene, benzo(a)pyrene, perylene, benzo(ghi)pyrene, indeno(1,2,3-cd)pyren, dibenzo(a,h) anthracene), oil hydrocarbons, caesium 134/137. Water: Caesium 134/137 and strontium90 + recommended determinands mostly as for sediments Biota: cadmium, mercury, lead, selenium, lipids, PCBs, HCH, HCB, DDTs, PAHs (all as for sediments), caesium 134/137
North East Atlantic (OSPAR) 1992	In progress	In progress

Table D.3 continued

Commitment	Sampling location/timing	Determinands
ESTUARIES AND COASTAL WATERS ONLY		
1. DIRECTIVES		
Shellfish Waters (79/923/EEC)	Designated waters 2-12 times per year	pH, temperature[2], colour, suspended solids, salinity[2], dissolved oxygen[2], petroleum hydrocarbons, faecal coliforms[2], organohalogenated substances, Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Zn, substances affecting taste, saxitoxin
2. INTERNATIONAL AGREEMENTS - Category A		
North East Atlantic (Oslo) 1972	Monitoring for marine water quality. The requirements were co-ordinated with those of the Paris Convention in 1978 in a joint monitoring programme (JMP) see North Sea (Paris) 1974.	
Baltic Sea (Helsinki) 1974/1992	For temperature measured on board	Water (25 physicochemical determinands + 10 biological) Alkalinity, arsenic, cadmium, copper, DDT, dissolved inorganic phosphate, dissolved oxygen, hydrogen sulphide, lead, lindane, mercury, nitrate, nitrite, total nitrogen, organo-tin, PCB, petroleum hydrocarbons, pH, total phosphorus, salinity, silicate, temperature, tin, water density, zinc, 3 measures of phytobenthos, 3 measures of phytoplankton, 4 measures of micro-organisms (not pathological) Sediment (6 measures of benthos) Biota (16 determinands in female fish length stratified and also for 1-3 year olds) copper, cadmium, lead, mercury, zinc, temperature, a-HCH, chlordanes, dieldrin, g-HCH, HCB, PCBs, polychlorinated camphenes, DDD (pp), DDE (pp), DDT (pp)
Mediterranean (Barcelona) 1976	5844 coastal sites + 186 estuarine sites	Water: drins (aldrin, dieldrin, endrin), antimony, aromatics, arsenic, beryllium, BOD, cadmium, caesium, chromium, cobalt, COD, conductivity, copper, dichlorop-diphenyl dichloroethane (op and pp), dichlorop-diphenyl dichloroethene (op and pp), dichlorop-diphenyl trichloroethane (op and pp), detergents, dissolved oxygen, fluorides, halogenated hydrocarbons, heptachlor, heptachlor epoxide, hexachlorobenzene, hexachlorohexane, iron, lead, lindane, manganese, mercury, molybdenum, total nitrogen, ammonia (as N), ammonium, nickel, nitrates, nitrites, total oxidised nitrogen, organic nitrogen, DDD (op and pp), DDE (op and pp), DDT (op and pp), total DDD+DDE+DDT (op and pp), organic mercury, total phosphorus, PAHs, PCBs (as arochlor 1254 and 1260), petroleum hydrocarbons, phenols, phosphates, organic phosphorus, rubidium, selenium, silicates, silver, sodium, tin, tar ball collections, total organic carbon, suspended solids, vanadium, zinc, 7 microbiological determinands (total coliforms, salmonella, staphylococcus aureus, faecal streptococci, faecal coliforms, enteroviruses, E coli) Suspended solids: 43 determinands including 18 metals and 25 organics Sediment: 59 determinands including 21 metals (+ calcium and calcium carbonate), 28 organics and 8 microbiological measures Biota: 48 determinands including 15 metals (+ sodium), 24 organics and 8 microbiological measures.

Table D.3 continued

Commitment	Sampling location/timing	Determinands
North Sea (Conference) 1990	Lowest freshwater influence on estuarine/coastal waters (usually harmonised sites) Reduced sampling frequency for individual determinands at sites not contributing to 95% of the total National Low Mean Annual Load	Mercury, cadmium, copper, zinc, lead, arsenic, chromium, nickel, drins (aldrin, dieldrin, endrin), hexachlorocyclohexane, DDT, pentachlorophenol, hexachlorobenzene, hexachlorobutadiene, carbon tetrachloride, chloroform, trifluralin, endosulfan, simazine, atrazine, tributyltin compounds, triphenyltin compounds, azinphos-ethyl, azinphos-methyl, fenitrothion, fenthion, malathion, parathion, parathion-methyl, dichlorvos, trichloroethylene, tetrachloroethylene, trichlorobenzene, 1,2-dichloroethane, trichloroethane
North Sea (NSTF) 1987	Sites in agreed estuaries representative of the sites; annually for the 0-10 ppt, 10-20 ppt, 20-30 ppt salinity ranges; agreed intermediate coastal water sites Quarterly for water quality at estuarine sites; annually for water quality at intermediate sites; annually for sediment samples; annually (between Nov. & Feb.) for biota sampling In situ quality	Filtered water sample: ammoniacal nitrogen, nitrate, nitrite (as N), orthophosphate (as P), silica (as Si), total P, total N, cadmium, copper, lead, zinc, nickel, mercury, chromium, arsenic Unfiltered water sample: salinity, *temperature, *oxygen, suspended solids, chlorophyll a, *secchi depth, oDDT, hexachlorobutadiene, polychlorinated biphenyls, γ and α hexachlorocyclohexane, hexachlorobenzene, dieldrin, aldrin, endrin, chloroform, carbon tetrachloride, pentachlorophenol Suspended sediment: cadmium, copper, lead, zinc, nickel, mercury, chromium, arsenic, oDDT, polychlorinated biphenyls, hexachlorobenzene, dieldrin, aldrin, endrin Biota: cadmium, lead, zinc, mercury, oDDT, hexachlorobutadiene, ·polychlorinated biphenyls, γ and α hexachlorocyclohexane, hexachlorobenzene, dieldrin, aldrin, endrin, chloroform, carbon tetrachloride, pentachlorophenol Suspended sediment <63 µm size fraction: cadmium, copper, lead, zinc, nickel, mercury, chromium, arsenic

Notes:
- NI No information available
- 1 No values specified
- 2 Guide determinand
- 3 Weekly
- 4 Guide value and only to be checked if substance suspected
- 5 To be checked only if substance suspected
- 6 No value and to be checked only if substance suspected
- 7 Not in groundwater
- 8 Only in coastal waters
- 9 Only in fresh surface water
- 10 Only when waste disposed or injected to land
- 11 For water and sediment
- 12 Water, suspended sediment and sediment
- 13 Water, suspended sediment, sediment and fish
- 14 Suspended sediment, sediment and fish
- 15 Water and fish
- 16 Sediment and fish
- \+ Further clarification needed from NSTF, no samples to be taken yet

on an individual basis congener numbers 28, 52, 101, 118,153, 138, 180
op DDE, pp DDT, pp TDE, op DDE, op DDT

Table D.4 Summary of directives and international agreements requiring measurement of water quantity

Commitment	Measure	Water type	Analytical method	Sampling frequency & period	Sampling location
1. DIRECTIVES					
Exchange of Information (77/795/EEC)	Flow	Surface freshwater	Flowmeter	Not specified	Not specified
Proposed Landfill Directive (COM(93)275) final	Level [1]	Groundwater	ns	Every six months during operating and after-care period [2]	Inflow 2 measuring points at outflow
2. INTERNATIONAL AGREEMENTS					
Mura 1954	Flow	River	ni	Minimum of every two weeks - to every three years, according to sampling station. Intensive sampling between October and March	Fixed stations
Water Economy (Au/Hu) 1956	Level Flow	Lake River	ni	12 over whole year	Fixed stations
Lake Inari 1958	Flow Level	River Lake	Hydropower plant water level station	Continuous	Fixed stations
Frontier Waters (Fi, Ru) 1964	flow	River	Flowmeter	continuous	Fixed stations
Frontier Waters (Au/Sl) 1970	Flow	River	ni	6-12 over whole year, lowest frequency for Danube, highest for March	ns
Frontier Rivers (Fi, S) 1971	Flow	River	River flow station	Continuous	Fixed stations
Vuoska 1972/83	Flow Level	River Lake	Hydropower plant Water level station	Continuous	Fixed stations
Rhine 1976	Flow	River	ni	Variable according to determinand but over the whole year	Fixed stations
Danube (Bucharest) 1985	Flow	River	ni	Minimum of 12 per over whole year. Monitoring started in 1988	
Rhine (hydrology) 1989	Flow Level	River	ni	Frequency not specified but over whole year. Also variable according to country	Fixed stations
Elbe 1990	Flow	River	ni	Variable according to determinand but over the whole year	Fixed stations

Table D.4 continued

Commitment	Measure	Water type	Analytical method	Sampling frequency & period	Sampling location
2. INTERNATIONAL AGREEMENTS (cont.)					
Technical Co-operation (Bu/Gr) 1991	Flow Level	River	ni	Minimum 12 per year over the year Mean value for 1 hour, more frequently during flood	Fixed stations
Agreement between Finland and USSR	Level River	Lake Flow	Water level station Hydropower plant	Continuous Continuous	Fixed stations fixed stations

Notes: 1 Substances to be analysed depend on the leachate composition. Special surveillance should be made on substances in lists 1 and 2 of Directive 80/778/EEC

2 In cases where there are weaving ground water levels the sampling intervals shall be decreased

ns Not specified

ni No information

APPENDIX E SUMMARY TABLES OF DETAILED MONITORING REQUIREMENTS FOR INLAND WATERS

LIST OF TABLES

Table E.1. Variations in requirements for sample location specified in directives and international agreements

Requirement	Directives
BIOTA	
1. DIRECTIVES	
NS	Proposed Ecological Directive (COM(93) 680)
Designated waters	Shellfish (79/923/EEC)
Area affected by discharge	Dichloroethane (90/415/EEC) Aldrin (88/347/EEC) Carbon tetrachloride (86/280/EEC) Cadmium (83/513/EEC) HCH (84/491/EEC) Mercury (82/176/EEC) Titanium Dioxide [3] (82/883/EEC)
2. INTERNATIONAL AGREEMENTS	
Near-shore stations	Baltic Sea 1974/92 (Micro-organisms)
NS	Baltic Sea (Helsinki) 1974/92 (Dibenzofurans, dibenzodioxins) Technical Co-operation (Bu/Gr) 1991 Danube (Regensburg) 1987, Mura 1954
Designated areas	North Sea (NSTF) 1987 North East Atlantic (Paris) 1974 - JMP North East Atlantic (OSPAR) 1992
Designated areas (away from coast)	Baltic Sea (Helsinki) 1974/92 (HCH, chlordanes, HCB, PAH, PCB, dieldrin, DDD, DDE, DDT, phytoplankton, metals)
SEDIMENT	
1. DIRECTIVES	
NS	Proposed Ecological Directive (COM(93) 680)
Area affected by discharge	Dichloroethane(90/415/EEC) Aldrin (88/347/EEC) Carbon tetrachloride (86/280/EEC) Cadmium (83/513/EEC) HCH (84/491/EEC) Titanium Dioxide [3] (82/883/EEC)
2. INTERNATIONAL AGREEMENTS	
NS	Drava 1954, Frontier waters (Au/Cz) 1970 Water Economy (Au/Hu) 1956, Mura 1954
Designated areas	Baltic Sea (Helsinki) 1974/92 North Sea (NSTF) 1987 North East Atlantic (Paris) 1974 - JMP North East Atlantic (OSPAR) 1992
WATER	
1. DIRECTIVES	
NS	Nitrates [1] (91/676/EEC) Proposed Ecological Directive (COM(93) 680)
Designated waters	Freshwater Fish (78/659/EEC) Shellfish Waters (79/923/EEC) Bathing Water (76/160/EEC) Proposed Bathing Water (COM (94) 36)
Place where surface water is abstracted before being sent for purification	Surface Water (75/440/EEC)
Initial analysis at source	Drinking Water (80/778/EEC)

Table E.1 continued

Requirement	Directives
Area affected by discharge	Mercury (82/176/EEC) Titanium Dioxide [3] (82/883/EEC) Cadmium (83/513/EEC) Mercury (84/156/EEC) HCH (84/491/EEC) Carbon tetrachloride (86/280/EEC) Aldrin (88/347/EEC) Dichloroethane(90/415/EEC) UWWT (91/271/EEC)
Inflow region at ground (0) level and two measuring points in outflow region of groundwater	Proposed Landfill Directive (COM (93) 275)
In outflow region of groundwater around the site where waste is disposed	Titanium Dioxide (82/883/EEC)
At sampling locations specified in 75/440/EEC	Sampling and Analysis (79/869/EEC) Nitrates (91/676/EEC) (NO_3 only)
At sampling stations representative of surface waters	Nitrates (91/676/EEC)(NO_3 only)
At sampling stations representative of groundwater aquifers	Nitrates (91/676/EEC)(NO_3 only)
To check there are no adverse effects in less sensitive waters	UWWT (91/271/EEC)
2. INTERNATIONAL AGREEMENTS	
Designated areas	Baltic Sea (Helsinki) 1974/92 North Sea (NSTF) 1987 North East Atlantic (Paris) 1974 - JMP North East Atlantic (OSPAR) 1992
Mobile stations	Technical Co-operation (Bu/Gr) 1991
Fixed stations	Mura 1954 (Flow); Water economy (Au/Hu) 1956 (Flow, water level) Rhine 1976; Rhine (hydrology) 1989 Elbe 1990; Technical Co-operation (Bu/Gr) 1991
NS	Drava 1954; Mura 1954 Water economy (Au/Hu) 1956 Lake Constance 1960 Frontier waters (Au/Cz) 1970 Frontier waters (Au/Sl) 1970 Danube (Bucharest) 1985 Danube (Regensburg) 1987 North Sea (conference) 1990

Notes:
1 To review eutrophic state of surface waters
2 Temperature upstream and downstream of thermal discharge, within designated waters
3 Also in area not affected by discharge
ns Not specified

Table E.2 Variations in requirements for sampling frequency and period specified in directives and international agreements

Frequency	Period	Directives
BIOTA		
1. DIRECTIVES		
NS	NS	Aldrin (88/347/EEC) Proposed Ecological Directive (COM(93) 680) Dichloroethane (90/415/EEC) Shellfish Waters (79/923/EEC) (Taste and saxitoxin)
Half yearly	Over 1 year	Shellfish Waters (79/923/EEC) (Metals and organohalogenated substances)
1	Over 1 year	Titanium Dioxide (82/883/EEC)
Sufficient [1]	Not specified	Cadmium (83/513/EEC) HCH (84/491/EEC) Mercury (82/176/EEC) Carbon tetrachloride (86/280/EEC)(PCP)
Quarterly	Over 1 year	Shellfish Waters (79/923/EEC) (Physicochemical and faecal coliforms)
Monthly	Over 1 year	Shellfish Waters (79/923/EEC) (Dissolved oxygen and salinity)
2. INTERNATIONAL AGREEMENTS		
NS[4]	NS[4]	Baltic Sea (Helsinki) 1974/92 (PAHs, dibenzodioxins, dibenzofurans and polychlorinated camphenes)
Variable according to determinands	Whole year	Rhine 1976 Elbe 1990
1	Seasonal/whole year	North Sea (NSTF) 1987
1	August-September	Baltic Sea (Helsinki) 1974/92 (HCH, HCB, PCBs, DDT, DDE, DDD, mercury, zinc, chlordanes)
1	All year	Danube (Regensburg) 1987
2	All year	Technical Co-operation (Bu/Gr) 1991[5]
4	All year	Technical Co-operation (Bu/Gr) 1991[5]
12	Preferably in the morning	Baltic Sea (Helsinki) 1974/92 (Micro-organisms)
12	Summer (throughout the productive season)	Baltic Sea (Helsinki) 1974/92 (Phytoplankton)
12	All year	Water Economy (Au/Hu) 1956
Every 2 years	All year	North East Atlantic (OSPAR) 1992
SEDIMENT		
1. DIRECTIVES		
NS	NS	Aldrin (88/347/EEC) Carbon tetrachloride (86/280/EEC) Proposed Ecological Directive (COM(93) 680) Dichloroethane (90/415/EEC)
1	Over 1 year	Titanium Dioxide (82/883/EEC)

Table E.2 continued

Frequency	Period	Directives
Sufficient [1]	NS	Cadmium (83/513/EEC) HCH (84/491/EEC)

		Carbon tetrachloride (86/280/EEC)(PCP)
2. INTERNATIONAL AGREEMENTS		
Variable according to determinands	Whole year	Rhine 1976 Elbe 1990
1	Whole year	North Sea (NSTF) 1987
1	Late winter-early spring	Baltic Sea (Helsinki) 1974/92 (Macro-zoobenthos)
1	All year	Drava 1954 Water economy (Au/Hu) 1956
2	All year	Water economy (Au/Hu) 1956
5	Linked to sugar harvest	Frontier waters (Au/Cz) 1970
12	Summer (throughout the productive season)	Baltic Sea (Helsinki) 1974/92 (Zoobenthos)
12	All year	Water Economy (Au/Hu) 1956
2 weeks - 3 years	Variable - Intensive between October and March	Mura 1954
WATER		
1. DIRECTIVES		
NS	NS	Dichloroethane (90/415/EEC) Aldrin (88/347/EEC) Carbon tetrachloride (86/280/EEC) Mercury (84/156/EEC) UWWT (91/271/EEC) Proposed Ecological Directive (COM(93) 680) Sampling and Analysis (79/869/EEC) (As, Ba, Be, BOD, NH_3, Bo, Cd, Cl)
1	Over 1 year	Titanium Dioxide (82/883/EEC) (Ca, Cl, Cr_{gw}, Cu_{gw} , Fe $_{gw}$, Pb_{gw}, Mn, Ni, pH, SO_4, Ti, Vn, Zn) Sampling and Analysis (79/869/EEC) (NH_3, As, Ba, BOD, Bo, Cd, Cl)
2	Over 1 year	Sampling and analysis (79/869/EEC) (NH_3, As, Ba, BOD, Cd, Cu)
3	Over 1 year	Titanium Dioxide (82/883/EEC) (Cd, Cr_{sw}, Conductivity, Cu_{sw}, DO, hydrated oxides, Fe_{sw}, Pb_{sw}, Mn_{gw}, Hg_{gw}, Ni, pH, salinity, SS, temperature, Ti, turbidity, Vn, Zn) Sampling and Analysis (79/869/EEC)[2]
4	Over 1 year	Sampling and Analysis (79/869/EEC)[2]
6	Over 1 year	Sampling and Analysis (79/869/EEC)[2]
8	Over 1 year	Sampling and Analysis (79/869/EEC)[2]
12	Over 1 year	Sampling and Analysis (79/869/EEC)[2]
4	NS	Sampling and Analysis (79/869/EEC)[2] (NH_3, BOD, Cl)
6	NS	Sampling and Analysis (79/869/EEC)[2] (NH_3, BOD, Cl)
8	NS	Sampling and Analysis (79/869/EEC)[2] (NH_3, BOD, Cl)

Table E.2 continued

Frequency	Period	Directives
12	NS	Sampling and Analysis (79/869/EEC)[2] (NH_3, BOD, Cl)
Fortnightly	2 weeks before start of bathing season	Bathing Water (76/160/EEC) (Total and faecal coliforms, colour, mineral oil, surfactants, phenol, transparency, tarry residue) Proposed Bathing Water (COM(94)36) (E coli, faecal streptococci, dissolved oxygen, pH, colour, mineral oil, surfactants, phenol, transparency, tarry residue)
Monthly	Before start of bathing season	Proposed Bathing Water (COM(94)36) (Enteroviruses)
When substance thought to be present or when water quality deteriorated	2 weeks before start of bathing season	Bathing Water (76/160/EEC) (Faecal streptococci, salmonella, enteroviruses, colour mineral oil surfactants, pH, phenol, dissolved oxygen, pesticides, nitrate and phosphate, cyanide, heavy metals)
When tendency for eutrophication of water	2 weeks before start of bathing season	Bathing Water (76/160/EEC) (Ammonia and Kjeldahl nitrogen)
NS	Over 1 year	Freshwater Fish (78/659/EEC) (BOD, Cu dissolved, phenolic compounds, total phosphorus, nitrite, suspended solids) Shellfish Waters (79/923/EEC) (Saxitoxin and taste)
Weekly	Over 1 year	Freshwater Fish (78/659/EEC) (Temperature)
Monthly	Over 1 year	Freshwater Fish (78/659/EEC) (Dissolved oxygen, NH_3 petroleum hydrocarbons, total zinc, residual chlorine, pH) Shellfish Waters (79/923/EEC) (Dissolved oxygen, salinity)
Half yearly	Over 1 year	Shellfish Waters (79/923/EEC) (Metals and organohalogenated substances)
Sufficient[4]	NS	Cadmium (83/513/EEC) HCH (84/491/EEC) Mercury (82/176/EEC)
Every 6 months	Operating and aftercare phases	Proposed Landfill Directive (COM (93) 275) (Composition and level of groundwater)
Once	Once before exploitation of source	Drinking Water (80/778/EEC)
Quarterly	Over 1 year	Shellfish Waters (79/923/EEC) (Colour, faecal coliforms, petroleum hydrocarbons, pH, SS, temperature)
Monthly and more frequently in flood periods	Over 1 year [3] and then every 4 or 8 years	Nitrates (91/676/EEC) (Surface water quality)
Regular intervals	Over 1 year [3] and then every 4 or 8 years	Nitrates (91/676/EEC) (Groundwater)
Every 4 years	NS	Nitrates (91/676/EEC) (Eutrophic state)
2. INTERNATIONAL AGREEMENTS		
NS	NS	Moselle 1961 Sarre 1961 Frontier Water Courses (Fi/Ru) 1964 Lake Constance (water withdrawal) 1966 Baltic Sea (Helsinki) 1974/92[4] (Tin compounds) Danube (Bucharest) 1985 (COD) Danube (Regensburg) 1987 North Sea (Conference) 1990 Technical Co-operation (Bu/Gr) 1991 (Radioactivity) North East Atlantic (OSPAR) 1992

Table E.2 continued

Frequency	Period	Directives
NS	All year	Rhine-(hydrology) 1989
Variable according to determinands	Whole year	Rhine 1976 Elbe 1990
1	Whole year	North Sea (NSTF) 1987
1	None	Baltic Sea (Helsinki) 1974/92 (DDT, lindane)
1	Research needed	Baltic Sea (Helsinki) 1974/92 (Metals)
1	Summer	Baltic Sea (Helsinki) 1974/92 (Hydrocarbons)
1	All year	Drava 1954
2	All year	Water Economy (Au/Hu) 1956[6]
4	All year	Danube (Regensburg) 1987 Technical Co-operation (Bu/Gr) 1991[5]
5	Linked to sugar harvest	Frontier waters (Au/Hu) 1970
1-6	Winter	North Sea (NSTF) 1987
6	Four seasons	Baltic Sea (Helsinki) 1974/92 (Physico-chemical determinands)
6	Late summer-autumn	Baltic Sea (Helsinki) 1974/92 (Oxygen)
6	Winter	Baltic Sea (Helsinki) 1974/92 (Nutrients)
6-12	All year	Frontier waters (Au/Sl) 1970 [7] Technical Co-operation (Bu/Gr) 1991
12	All year	Water economy (Au/Hu) 1956 Danube (Bucharest) 1985[8] Danube (Regensburg) 1987 North Sea (Conference) 1990 Technical Co-operation (Bu/Gr) 1991[9] (Flow)
10-14	All year	Lake Constance 1960
Every 7-10 days	All year	Technical Co-operation (Bu/Gr) 1991[10]
2 weeks - 3 years	Variable - Intensive between October and March	Mura 1954
Continuously	All year	Technical Co-operation (Bu/Gr) 1991 (River level)
Continuously	At the end of the first phase	Technical Co-operation (Bu/Gr) 1991(Ammonia, nitrate, chromium VI, cyanides, hydrocarbons, manganese
Continuously	Since the implementation	Technical Co-operation (Bu/Gr) 1991 (Conductivity, dissolved oxygen, pH, temperature, turbidity)

Notes:
1 Sufficient to show any changes in aquatic environment having regard to natural variations in hydrological conditions
2 Dependent on population served, classification of water (A1, A2, A3) and type of determinand
3 Over 1 year within 2 years of notification of Directive and then every 4 years or every 8 years if below 25 mg NO_3 l^{-1}
4 To be investigated in the future
5 more frequently if alert
6 Sampling begins 1997
7 Lowest frequency for Danube, highest for the river March
8 Monitoring started in 1988
9 For flow, mean value for 1 hour more frequently during flood
10 For mobile stations
ns Not specified

Table E.3 Summary of sampling frequencies specified in directives

Sampling Frequency	2	3	5	6	7	8	9	10	11	12	16	17	18	19	25	26	27	46
Once	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-
Every four years	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-
1 per year	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
2 per year	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Every six months	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-
Half yearly	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-
3 per year	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
4 per year	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quarterly	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-
6 per year	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8 per year	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12 per year	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Monthly	-	-	-	-	-	-	-	-	-	x	-	-	x	x	-	x	-	-
Fortnightly	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-
Weekly	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-
Not specified	x	x	x	x	-	-	x	x	x	x	-	x	-	x	-	x	x	-
Regular intervals	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-
See comments	-	x	x	-	x	x	x	-	-	-	-	-	-	-	-	-	-	-

Notes:
2. Sampling and Analysis (79/869/EEC)
3. Bathing Water (76/160/EEC)
5. Mercury (82/176/EEC)
6. Mercury (84/156/EEC)
7. Cadmium (83/513/EEC)
8. Hexachlorocyclohexane (84/491/EEC)
9. Carbon tetrachloride (86/280/EEC)
10. Aldrin etc. (88/347/EEC)
11. Dichloroethane (90/415/EEC)
12. Freshwater Fish (78/659/EEC)
13. Exchange of Information Decision 77/795/EEC and 86/574/EEC)
16. Drinking Water (80/778/EEC)
17. Urban Waste Water Treatment (91/271/EEC
18. Nitrates (91/271/EEC)
19. Shellfish Waters (79/923/EEC)
25. Proposal on landfills (COM (93) 275 final)
26. Proposal on Bathing Water (COM (94) 36 final).
27. Proposal for Directive on ecological quality of surface waters (COM (93) 680 final)
46. Titanium Dioxide (82/883/EEC)

Table E.4 Summary of sampling frequencies and windows specified in international agreements

Sampling frequency per year (unless indicated)	Sampling window	1	35	81	109	113	114	125	126	127
2 weeks to every 3 years	Variable - Intensive between October and March	-	X	-	-	-	-	-	-	-
1	All year	-	-	-	X	-	-	-	-	-
1	August-September	X	-	-	-	-	-	-	-	-
1	Late winter-early spring	X	-	-	-	-	-	-	-	-
1	None	X	-	-	-	-	-	-	-	-
1	Seasonal	-	-	-	-	-	-	-	X	-
1	All year								X	
1	Research needed	X	-	-	-	-	-	-	-	-
1	Summer	X	-	-	-	-	-	-	-	-
1-6	Winter sampling	-	-	-	-	-	-	-	X	-
12	All year	-	-	-	X	X	X	-	-	-
12	Preferably in the morning	X	-	-	-	-	-	-	-	-
12	Summer (throughout the productive season)	X	-	-	-	-	-	-	-	-
2	All year	-	-	-	X	-	X	-	-	-
4	All year	-	-	-	-	-	X	-	-	-
6	Four seasons	X	-	-	-	-	-	-	-	-
6	Late summer-autumn	X	-	-	-	-	-	-	-	-
6	Winter	X	-	-	-	-	-	-	-	-
6-12	All year	-	-	-	-	-	X	X	-	-
Continuously	All year	-	-	-	-	-	X	-	-	-
Continuously	At the end of the first phase	-	-	-	-	-	X	-	-	-
continuously	Since the implementation	-	-	-	-	-	X	-	-	-
Every 2 years	Not specified	-	-	X	-	-	-	-	-	-
Every 7-10 days	All year	-	-	-	-	-	X	-	-	-
Not specified	All year	-	-	-	-	-	-	-	-	X
Not specified	Not specified	X	-	-	-	-	-	-	-	-

Table E.4 continued

Notes:
1 Baltic Sea (Helsinki) 1974/92
35 Mura 1954
81 North East Atlantic (OSPAR) 1992
109 Water Economy (Au/Hu) 1956
113 Danube (Bucharest) 1985
114 Technical Co-operation (Bu/Gr) 1991
125 Frontier waters (Au/Sl) 1970
126 North Sea (NSTF) 1987
127 Rhine (hydrology) 1989

Table E.5 Variation in requirements for sample number specified in directives

Requirement	Directives
BIOTA	
NS	Aldrin (88/347/EEC) Shellfish Waters (79/923/EEC) Titanium Dioxide (82/883/EEC) Carbon tetrachloride (86/280/EEC) Proposed Ecological Directive (COM(93) 680) Dichloroethane(90/415/EEC)
Sufficient samples representative of aquatic environment	Cadmium (83/513/EEC) HCH (84/491/EEC) Mercury * (82/176/EEC)
SEDIMENT	
NS	Aldrin (88/347/EEC) Titanium Dioxide (82/883/EEC) Carbon tetrachloride (86/280/EEC) Proposed Ecological Directive (COM(93) 680) Dichloroethane(90/415/EEC)
Sufficient samples representative of aquatic environment	Cadmium (83/513/EEC) HCH (84/491/EEC)
WATER	
NS	Dichloroethane(90/415/EEC) Aldrin (88/347/EEC) Freshwater Fish (78/659/EEC) Sampling and Analysis (79/869/EEC) Drinking Water (80/778/EEC) Shellfish Waters (79/923/EEC) Bathing Water (76/160/EEC) Proposed Bathing Water (COM (94) 36) UWWT (91/271/EEC)
Sufficient samples representative of aquatic environment	Titanium Dioxide (82/883/EEC) Carbon tetrachloride (86/280/EEC) Proposed Landfill Directive(COM) 93 275) Mercury (84/156/EEC) Nitrates (91/676/EEC) Proposed Ecological Directive (COM(93) 680) Cadmium (83/513/EEC) HCH (84/491/EEC) Mercury (82/176/EEC)
Minimum of 1 representative sample of low dissolved oxygen conditions	Shellfish Waters (79/923/EEC)

Notes: * representative numbers and species of saltwater fish
ns not specified

Table E.6 Summary of the recommended analytical methods (mode and others) specified in directives

Determinand	Mode	Directives	Others	Directives
Matrix water				
Arsenic	AAS	Bathing Water (76/160/EEC), Sampling and Analysis (79/869/EEC), Shellfish Waters (79/923/EEC)	AS	Sampling and analysis (79/869/EEC)
BOD_5	BOD5 (ATU)	Freshwater Fish (78/659/EEC), Sampling and Analysis (79/869/EEC)	BOD_5	Exchange of Information (77/95/EEC)
Boron	AAS/AS	Sampling and Analysis (79/869/EEC)	AAS/AS	Sampling and analysis (79/869/EEC)
Cadmium	AAS	Bathing Water (76/160/EEC), Cadmium (83/513/EEC), Sampling and analysis (79/869/EEC), Shellfish (79/923/EEC), Titanium Dioxide (82/883/EEC), Exchange of Information (77/95/EEC)	AS EA	Titanium Dioxide (82/883/EEC), Sampling and analysis (79/869/EEC)
Chlorides	AS/Titr	Sampling and Analysis (79/869/EEC), Exchange of Information (77/95/EEC)	AS/Titr	Sampling and analysis (79/869/EEC), Exchange of Information (77/95/EEC)
Chromium	AAS	Bathing Water (76/160/EEC), Sampling and Analysis (79/869/EEC), Shellfish Waters (79/923/EEC), Titanium Dioxide (82/883/EEC)	AS	Sampling and Analysis (79/869/EEC), Titanium Dioxide (82/883/EEC)
Colour	AS	Proposed Bathing Water (COM(94)36), Sampling and Analysis (79/869/EEC), Shellfish Waters (79/923/EEC)	Visual	Bathing Water (76/160/EEC), Proposed Bathing Water (COM(94)36)
Conductivity	Elec	Drinking Water (80/778/EEC), Sampling and Analysis (79/869/EEC), Exchange of Information (77/95/EEC)	EA	Titanium Dioxide (82/883/EEC)
Copper	AAS	Freshwater Fish (78/659/EEC), Sampling and Analysis (79/869/EEC), Shellfish Waters (79/923/EEC), Titanium Dioxide (82/883/EEC)	AS/SA/EA	Sampling analysis (79/869/EEC), Titanium Dioxide (82/883/EEC)
Dieldrin	GC	Aldrin (88/347/EEC), Bathing Water (76/160/EEC)	GL or LC	Sampling and Analysis (79/869/EEC)
DO	Colour/ EA	Bathing Water (76/160/EEC), Proposed Bathing Water (COM(94)36), EQ(p) Sampling and Analysis (79/869/EEC), Shellfish Waters (79/923/EEC), Titanium Dioxide (82/883/EEC), Exchange of Information (77/95/EEC)		
Dissolved Hydrocarbons	Grav/IRS	Sampling and Analysis (79/869/EEC)		
Flow	FM	Exchange of Information (77/95/EEC)		
Fluorides	AS/ISE			
HCCH	GC	Bathing Water (76/160/EEC), Hexachlorocyclohexane (84/491/EEC)	GC or LC	Sampling and Analysis (79/869/EEC)
Hydroxides	AS/AAS	Titanium Dioxide (82/883/EEC)		
Iron	AS/AAS	Sampling and Analysis (79/869/EEC), Titanium Dioxide (82/883/EEC)		
Lead	AAS	Bathing Water (76/160/EEC), Sampling and Analysis (79/869/EEC), Shellfish Waters (79/923/EEC), Titanium Dioxide (82/883/EEC)	EA	Sampling and Analysis (79/869/EEC), Titanium Dioxide (82/883/EEC)
Manganese	AAS	Sampling and Analysis (79/869/EEC), Titanium Dioxide (82/883/EEC)	AS	Sampling and Analysis (79/869/EEC)
Mercury	AAS	Bathing Water (76/160/EEC), Mercury (82/176/EEC), Sampling and Analysis (79/869/EEC), Shellfish (79/923/EEC), Titanium Dioxide (82/883/EEC), Exchange of Information (77/95/EEC)	AS NS	Sampling and Analysis (79/869/EEC), Mercury (84/156/EEC)
Mineral oils	Visual & smell	Bathing Water (76/160/EEC), Proposed Bathing Water (COM(94)36)	Weight	Bathing Water (76/160/EEC)
Nickel	AAS	Shellfish Waters (79/923/EEC), Titanium Dioxide (82/883/EEC)	NS	Sampling and Analysis (79/869/EEC)

Table E.6 continued

Determinand	Mode	Directives	Others	Directives
Nitrate	AS	Bathing Water (76/160/EEC), Drinking Water (80/778/EEC), Nitrates (91/676/EEC), Sampling and Analysis (79/869/EEC), Exchange of Information (77/95/EEC)	ISE	Drinking Water (80/778/EEC)
Nitrogen	AS/Titr	Sampling and Analysis (79/869/EEC)	Kj	Bathing Water (76/160/EEC),
Parathion	GC	Bathing Water (76/160/EEC)	GL or LC	Sampling and Analysis (79/869/EEC)
PCP	GC/HPLC	Carbon tetrachloride (86/280/EEC)		
Pesticides	GC	Bathing Water (76/160/EEC),	GC or LC	Sampling and Analysis (79/869/EEC)
Petroleum Hydrocarbons	Vis and taste	Freshwater Fish (78/659/EEC),	Visual	Shellfish Waters (79/923/EEC)
pH	Elec	Bathing Water (76/160/EEC), Proposed Bathing Water (COM(94)36), Freshwater Fish (78/659/EEC), Sampling and Analysis (79/869/EEC), Shellfish (79/923/EEC), Titanium Dioxide (82/883/EEC)	NS	Drinking Water (80/778/EEC)
Phenols	AS	Bathing Water (76/160/EEC), Sampling and Analysis (79/869/EEC)	Taste	Freshwater Fish (78/659/EEC)
			Smell	Bathing Water (76/160/EEC), Proposed Bathing Water (COM(94)36),
Residual Chlorine	AS	Drinking Water (80/778/EEC), Freshwater Fish (78/659/EEC)	Titr	Drinking Water (80/778/EEC)
Sulphates	AS/Grav/Titr	Sampling and Analysis (79/869/EEC)		
Surfactants	AS	Bathing Water (76/160/EEC), Proposed Bathing Water (COM(94)36), Sampling and Analysis (79/869/EEC), Exchange of Information (77/95/EEC)	Visual	Bathing Water (76/160/EEC), Proposed Bathing Water (COM(94)36),
Suspended Solids	Cent/ weight	Freshwater Fish (78/659/EEC), Sampling and Analysis (79/869/EEC), Shellfish (79/923/EEC)	Grav	Titanium Dioxide (82/883/EEC)
Turbidity	FT/ Secchi/ SM	Drinking Water (80/778/EEC)	Turb	
Vanadium	AAS	Titanium Dioxide (82/883/EEC)	NS	Sampling and Analysis (79/869/EEC)
Zinc	AAS	Freshwater Fish (78/659/EEC), Sampling and Analysis (79/869/EEC), Shellfish (79/923/EEC), Titanium Dioxide (82/883/EEC)	AS	Sampling and Analysis (79/869/EEC)

Notes:

Mode	the most commonly recommended method
AAS	Atomic Absorption Spectrophotometry
AS	Absorption Spectrophotometry
EA	Electrochemical Analysis
Titr	Titrometry
Elec	Electrometry
GC	Gas Chromatography
LC	Liquid Chromatography
Colo	Colourimetry
MPN	Dilution Most Probable Number
Conf	Concentration/Confirmation
Grav	Gravimetry
IRS	Infra-red spectrometry
FM	Flowmeter
ISE	Ion selective electrode
NS	Not specified
FT	Farmazine test
HPLC	High Performance Liquid Chromatography
SM	Silicon Method
Turb	Turbidimetry

Table E.7 Summary of analytical precision requirements (mode and others) specified in directives

Determinand	Mode			Directives	Others			Directives
	LoD	CP	A		LoD	CP	A	
Physico-chemical								
Colour	nd	nd	nd	Bathing Water (76/160/EEC), Shellfish Waters (79/923/EEC)	5	1***	2**	Sampling and Analysis (79/869/EEC)
					5	2***	4**	Sampling and Analysis (79/869/EEC)
					5	5***	10**	Sampling and Analysis (79/869/EEC)
					5	10***	20**	Sampling and Analysis (79/869/EEC)
					5	20***	40**	Sampling and Analysis (79/869/EEC)
Conductivity	nd	nd	nd	Drinking Water (80/778/EEC), Titanium Dioxide (82/883/EEC), Exchange of Information (77/795/EEC)	nd	500	500	Sampling and Analysis (79/869/EEC)
pH	nd	nd	nd	Bathing Water (76/160/EEC), Proposed Bathing Water (COM(94)36), Drinking Water (80/778/EEC), Freshwater Fish (78/659/EEC), Shellfish (79/923/EEC), Titanium Dioxide (82/883/EEC), Exchange of Information (77/795/EEC)	nd	0.1	0.2	Sampling and Analysis (79/869/EEC)
Surfactants	nd	nd	nd	Bathing Water (76/160/EEC), Proposed Bathing Water (COM(94)36), Exchange of Information (77/795/EEC)	0.05	0.04**	nd	Sampling and Analysis (79/869/EEC)
					0.05	0.01**	nd	Sampling and Analysis (79/869/EEC)
Suspended solids	nd	nd	nd	Freshwater Fish (78/659/EEC), Shellfish Waters (79/923/EEC), Titanium Dioxide (82/883/EEC)	nd	1.25****	2.5***	Sampling and Analysis (79/869/EEC)
Temperature	nd	nd	nd	Drinking Water (80/778/EEC), Freshwater Fish (78/659/EEC), Shellfish Waters (79/923/EEC), Titanium Dioxide (82/883/EEC), Exchange of Information (77/795/EEC)	nd	0.5	1	Sampling and Analysis (79/869/EEC)
Organic pollution								
BOD_5	nd	nd	nd	Freshwater Fish (78/659/EEC), Exchange of Information (77/795/EEC)	2	1.5	2	Sampling and Analysis (79/869/EEC)
COD	-	-	-		nd	nd	nd	Exchange of Information (77/795/EEC)
					15	6**	6**	Sampling and Analysis (79/869/EEC)
Dissolved Oxygen	nd	nd	nd	Bathing Water (76/160/EEC), Proposed Bathing Water (COM (94) 36), Freshwater Fish (78/659/EEC), Shellfish Waters (79/923/EEC), Titanium Dioxide (82/883/EEC), Exchange of Information (77/795/EEC)	5	5***	5***	Sampling and Analysis (79/869/EEC)
					5	3***	3***	Sampling and Analysis (79/869/EEC)
					5	7***	7***	Sampling and Analysis (79/869/EEC)

Table E.7 continued

Determinand	Mode			Directives	Others			Directives
Synthetic organics								
Dissolved Hydrocarbons	-	-	-		0.01	0.01**	0.015	Sampling and Analysis (79/869/EEC)
					0.04	nd	nd	Sampling and Analysis (79/869/EEC)
PAH	-	-	-		0.00004	0.0001a	0.0001	Sampling and Analysis (79/869/EEC)
					0.00004	0.0005a	0.0005a	Sampling and Analysis (79/869/EEC)
Phenols	nd	nd	nd	Bathing Water (76/160/EEC), Proposed Bathing Water (COM(94)36), Freshwater Fish (78/659/EEC)	0.0005	0.0005	0.0005	Sampling and Analysis (79/869/EEC)
					0.001	0.0015*	0.0015a	Sampling and Analysis (79/869/EEC)
					0.001	0.003*	0.005a	Sampling and Analysis (79/869/EEC)
					0.001	0.03*	0.05a	Sampling and Analysis (79/869/EEC)
Dieldrin	-	-	-		nd	nd	nd	Bathing Water
Parathion					2.5	1.25	1.25	Aldrin (88/347/EEC)
HCH					0.0001	0.0005a	0.0005a	Sampling and Analysis (79/869/EEC)
					0.0001	0.00125	0.00125a	Sampling and Analysis (79/869/EEC)
					0.0001	0.0025a	0.0025a	Sampling and Analysis (79/869/EEC)
Chemicals								
Chlorides	-	-	-		nd	nd	nd	Exchange of Information (77/795/EEC)
					10	20***	20***	Sampling and Analysis (79/869/EEC)
Fluorides	-	-	-		0.05	0.07-0.1***	0.14-0.2**	Sampling and Analysis (79/869/EEC)
					0.05	0.15	0.3	Sampling and Analysis (79/869/EEC)
					0.05	0.07-0.17***	0.14-0.34**	Sampling and Analysis (79/869/EEC)
Sulphates	-	-	-		10	15	15	Sampling and Analysis (79/869/EEC)
					10	25	25	Sampling and Analysis (79/869/EEC)
Metals								
Arsenic	nd	nd	nd	Bathing Water (76/160/EEC), Shellfish (79/923/EEC)	0.002	0.002	0.002	Sampling and Analysis (79/869/EEC)
					0.01	nd	nd	Sampling and Analysis (79/869/EEC)
Cadmium	-	-	-		nd	nd	nd	Bathing Water (76/160/EEC)
					0.0002	0.0003*	0.0003*	Sampling and Analysis (79/869/EEC)
					0.0002	0.0025*	0.0015*	Sampling and Analysis (79/869/EEC)
					0.0002	0.3*	0.3*	Sampling and Analysis (79/869/EEC)
					0.001	nd	nd	Sampling and Analysis (79/869/EEC)
					0.1	0.03*	0.03*	Sampling and Analysis (79/869/EEC)

Table E.7 continued

Determinand	Mode			Directives	Others			Directives
Cadmium					0.5	0.15*	0.15*	Cadmium (83/513/EEC)
					0.25	0.075*	0.075*	Cadmium (83/513/EEC)
Chromium	nd	nd	nd	Bathing Water (76/160/EEC), Shellfish Waters (79/923/EEC), Titanium Dioxide (82/883/EEC)	0.01	0.01*	0.015*	Sampling and Analysis (79/869/EEC)
Copper	nd	nd	nd	Freshwater Fish(78/659/EEC), Shellfish Waters (79/923/EEC), Titanium Dioxide (82/883/EEC)	0.005	0.002***	0.004**	Sampling and Analysis (79/869/EEC)
Copper					0.005	0.005***	0.001**	Sampling and Analysis (79/869/EEC)
					0.02	0.1***	0.2**	Sampling and Analysis (79/869/EEC)
Cyanides	-	-	-		nd	nd	nd	Bathing Water (76/160/EEC)
					0.01	0.01**	0.015*	Sampling and Analysis (79/869/EEC)
Iron	-	-	-		nd	nd	nd	Titanium Dioxide (82/883/EEC)
					0.02	0.03***	0.06**	Sampling and Analysis (79/869/EEC)
					0.02	0.01***	0.02**	Sampling and Analysis (79/869/EEC)
					0.02	0.1***	0.2**	Sampling and Analysis (79/869/EEC)
					0.02	0.2***	0.4**	Sampling and Analysis (79/869/EEC)
Lead	nd	nd	nd	Bathing Water (76/160/EEC), Shellfish Waters (79/923/EEC), Titanium Dioxide (82/883/EEC)	0.01	0.001**	0.015*	Sampling and Analysis (79/869/EEC)
Manganese	-	-	-		nd	nd	nd	Titanium Dioxide (82/883/EEC)
					0.01	0.005***	0.01**	Sampling and Analysis (79/869/EEC)
					0.02	0.01***	0.02**	Sampling and Analysis (79/869/EEC)
					0.02	0.1***	0.2**	Sampling and Analysis (79/869/EEC)
Mercury	nd	nd	nd	Bathing Water (76/160/EEC), Mercury (84/156/EEC), Shellfish Waters (79/923/EEC), Titanium Dioxide (82/883/EEC)	0.0001	0.00015*	0.00015*	Sampling and Analysis (79/869/EEC)
					0.001	0.0003*	0.0003*	Sampling and Analysis (79/869/EEC)
					0.03	0.009*	0.009*	Mercury (82/176/EEC)
					0.05	0.015*	0.015*	Mercury (82/176/EEC)
					0.1	0.03*	0.03*	Mercury (82/176/EEC)
Zinc	nd	nd	nd	Freshwater Fish (78/659/EEC), Shellfish Waters (79/923/EEC), Titanium Dioxide (82/883/EEC)	0.01	0.05***	0.1**	Sampling and Analysis (79/869/EEC)
					0.02	0.3***	0.6**	Sampling and Analysis (79/869/EEC)
					0.02	0.1***	0.2**	Sampling and Analysis (79/869/EEC)
					0.02	0.5***	1*	Sampling and Analysis (79/869/EEC)
					0.02	0.015b	0.03*	Sampling and Analysis (79/869/EEC)
					0.02	0.15b	0.3*	Sampling and Analysis (79/869/EEC)

Table E.7 continued

Determinand	Mode			Directives	Others			Directives
Nutrients								
Ammonia	nd	nd	nd	Surface water (75/440/EEC) Drinking Water (80/778/EEC) Freshwater Fish (78/659/EEC) Exchange of Information (77/795/EEC)	0.01	0.03	0.03	Sampling and Analysis (79/869/EEC)
					0.1	0.005	0.01	Sampling and Analysis (79/869/EEC)
Nitrates	nd	nd	nd	Bathing Water (76/160/EEC) Drinking Water (80/778/EEC) Nitrates (91/676/EEC) Exchange of Information (77/795/EEC)	2	2.5***	5**	Sampling and Analysis (79/869/EEC)
					2	5***	10**	Sampling and Analysis (79/869/EEC)
Nitrogen	-	-	-		nd	nd	nd	Bathing Water (76/160/EEC)
					0.3	0.5	0.5	Sampling and Analysis (79/869/EEC)
Phosphates	-	-	-		nd	nd	nd	Bathing Water (76/160/EEC)
					0.02	0.04***	0.08**	Sampling and Analysis (79/869/EEC)
					0.02	0.07***	0.14**	Sampling and Analysis (79/869/EEC)

Notes:
* expressed as 30% of ref. concentration as specified in the Directive
** expressed as 20% of ref. concentration as specified in the Directive
*** expressed as 10% of ref. concentration as specified in the Directive
**** expressed as 5% of ref. concentration as specified in the Directive
a expressed as 50% of ref. concentration as specified in the Directive
b expressed as 15% of ref. concentration as specified in the Directive
LoD limit of detection
CP precision criteria
A accuracy

Table E.8 Summary of recommended analytical methods made in international agreements for surface waters

Determinand	Analysis method	Agreement
BIOTA		
Metals		
Arsenic	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Cadmium	Anodic stripping voltametry	Baltic Sea 1974/92
Cadmium	Atomic absorption spectrometry	Baltic Sea 1974/92
Cadmium	Graphite furnace atomic absorption spectrometry (pulsed-type atomisers)	Baltic Sea 1974/92
Cadmium	Neutron activation analysis	Baltic Sea 1974/92
Cadmium	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Copper	Anodic stripping voltametry	Baltic Sea 1974/92
Copper	Atomic absorption spectrometry	Baltic Sea 1974/92
Copper	Neutron activation analysis	Baltic Sea 1974/92
Copper	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Lead	Anodic stripping voltametry	Baltic Sea 1974/92
Lead	Atomic absorption spectrometry	Baltic Sea 1974/92
Lead	Graphite furnace atomic absorption spectrometry (pulsed-type atomisers)	Baltic Sea 1974/92
Lead	Neutron activation analysis	Baltic Sea 1974/92
Lead	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Mercury	Anodic stripping voltametry	Baltic Sea 1974/92
Mercury	Atomic absorption spectrometry	Baltic Sea 1974/92
Mercury	Cold vapour atomic absorption spectrometry at 253.7 nm	Baltic Sea 1974/92
Mercury	Neutron activation analysis	Baltic Sea 1974/92
Mercury	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Zinc	Anodic stripping voltametry	Baltic Sea 1974/92
Zinc	Atomic absorption spectrometry	Baltic Sea 1974/92
Zinc	Neutron activation analysis	Baltic Sea 1974/92
Zinc	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Synthetic organic substances		
Chlordane	Gas liquid chromatography/EC detector	Baltic Sea 1974/92
Chlordane	Not specified	Baltic Sea 1974/92
Chlordane	As specified in JMP of North Sea Paris (1974)	NSTF 1987
DDD	Gas liquid chromatography/EC detector (63Ni)	Baltic Sea 1974/92
DDE	Gas liquid chromatography/EC detector (63Ni)	Baltic Sea 1974/92
DDT	Gas liquid chromatography/EC detector (63Ni)	Baltic Sea 1974/92
DDT	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Dibenzofurans	Not specified	Baltic Sea 1974/92
Dieldrin	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Dioxins	Not specified	Baltic Sea 1974/92
Dioxins	As specified in JMP of North Sea Paris (1974)	NSTF 1987
HCH	Gas liquid chromatography/EC detector (63Ni)	Baltic Sea 1974/92
HCH	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Hexachlorobenzene	Gas liquid chromatography/EC detector (63Ni)	Baltic Sea 1974/92
Organo-tin	As specified in JMP of North Sea Paris (1974)	NSTF 1987
PAH	Not specified	Baltic Sea 1974/92
PAH	As specified in JMP of North Sea Paris (1974)	NSTF 1987

Table E.8 continued

Determinand	Analysis method	Agreement
PBB	As specified in JMP of North Sea Paris (1974)	NSTF 1987
PBDE	As specified in JMP of North Sea Paris (1974)	NSTF 1987
PCB	Gas liquid chromatography/EC detector (63Ni)	Baltic Sea 1974/92
PCB	As specified in JMP of North Sea Paris (1974)	NSTF 1987
PCC	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Polychlorinated camphenes	Not specified	Baltic Sea 1974/92
Radioactivity		
Radioactivity	Not specified	Co-operation with Bulgaria 1991
Biological		
Ecotox test	Not specified	Co-operation with Bulgaria 1991
Benthic fauna	Pantle-Puck	Regensburg Danube 1987
Fish	Not specified	Co-operation with Bulgaria 1991 NSTF 1987
Microbiological	Acriding Orange direct count (AODC)	Baltic Sea 1974/92
Microbiological	Pour plate method	Baltic Sea 1974/92
Microbiological	Tritiated Thymidine Incorporation	Baltic Sea 1974/92
Planktonic flora	Annual mean values (see formulae)	Baltic Sea 1974/92
Planktonic flora	Fluorometer	Baltic Sea 1974/92
Planktonic flora	Radioactivity uptake followed by Geiger counting	Baltic Sea 1974/92
Planktonic flora	Not specified	Water economy 1956
Planktonic flora	Radioactivity uptake followed by scintillation counter	Baltic Sea 1974/92
Planktonic flora	Spectrophotometer	Baltic Sea 1974/92
Phytoplankton	Centrifugation or sedimentation, qualitative and quantitative microscopic evaluation of autotrophes	Elbe 1990 (1993)
SEDIMENT		
Metals		
Arsenic	Not specified	Water economy 1956
Arsenic	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Cadmium	Not specified	Water economy 1956
Cadmium	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Chromium	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Copper	Not specified	Water economy 1956
Copper	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Lead	Not specified	Water economy 1956
Lead	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Mercury	Not specified	Water economy 1956
Mercury	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Nickel	Not specified	Water economy 1956
Nickel	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Zinc	Not specified	Water economy 1956
Zinc	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Synthetic organic substances		
Chlordane	As specified in JMP of North Sea Paris (1974)	NSTF 1987
DDT	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Dieldrin	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Dioxins	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Organo-tin	As specified in JMP of North Sea Paris (1974)	NSTF 1987
PAH	Not specified	Water economy 1956
PAH	As specified in JMP of North Sea Paris (1974)	NSTF 1987
PBB	As specified in JMP of North Sea Paris (1974)	NSTF 1987

Table E.8 continued

Determinand	Analysis method	Agreement
PBDE	As specified in JMP of North Sea Paris (1974)	NSTF 1987
PCB	Not specified	Water economy 1956
PCB	As specified in JMP of North Sea Paris (1974)	NSTF 1987
PCC	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Biological		
Benthic fauna	Not specified	Baltic Sea 1974/92
Benthic fauna	Saprobic Index (DIN 38 410, parts 1 and 2)	Elbe 1990 (1993)
Benthic fauna	Weighing	Baltic Sea 1974/92
WATER		
Physico-chemical parameters		
Alkalinity	Acid capacity to pH 4.5 (CSN 83 0530/12); to pH 4.3 (DIN 38 409/7)	Elbe 1990 (1993)
Alkalinity	Titration (Gripenberg - standard acid addition method)	Baltic Sea 1974/92
Alkalinity	Methyl orange titration	Regensburg Danube 1987
Bicarbonate	Calculation	Regensburg Danube 1987
Bicarbonate	Not specified	Water economy 1956
Colour	Filtration - Spectral absorption coefficient at 254 nm (CSN 75 7360; DIN 38 404-C3)	Elbe 1990 (1993)
Conductivity	Electrometrically	Regensburg Danube 1987
Conductivity	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Conductivity	Measure within 24h - Electrometrically with platinum cell (CSN 83 0530/10; DIN 38 404-C8)	Elbe 1990 (1993)
Conductivity	Electrometrically with platinum cell (DIN 38 404-C8; NF T 90 031)	Rhine 1993
Density	Calculated from temperature and salinity	Baltic Sea 1974/92
Detergents	Not specified	Co-operation with Bulgaria 1991
Hardness	Complexometrically - EDTA	Regensburg Danube 1987
Hardness	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
pH	Electrometrically with glass electrode	Baltic Sea 1974/92
pH	Electrometrically	Regensburg Danube 1987
pH	Not specified	Regensburg Danube 1987 Co-operation with Bulgaria 1991
pH	Measure within 24h -Electrometrically with glass electrode (CSN 83 0530/4; DIN 38 404-C5)	Elbe 1990 (1993)
pH	pH sensors	Baltic Sea 1974/92
pH	Electrometrically with glass electrode (DIN 38 404-C5; NF T 90 008)	Rhine 1993
Salinity	Salinometer	Baltic Sea 1974/92
Suspended solids	Gravimetrically	Regensburg Danube 1987
Suspended solids	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Suspended solids	Filtration , drying at 105^{o}C (CSN 83 0530/9 C; DIN 38 409-H2)	Elbe 1990 (1993)
Temperature	Conductivity-temperature-depth (CTD)	Baltic Sea 1974/92
Temperature	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Temperature	Precision mercury thermometer; or Electrometrically with resistivity thermometer (CSN 83 0530/3; DIN 38 404-C4-1,2)	Elbe 1990 (1993)

Table E.8 continued

Determinand	Analysis method	Agreement
Temperature	Reversing thermometer	Baltic Sea 1974/92
Temperature	Precision mercury thermometer; or Electrometrically with resistivity thermometer (DIN 38 404-C4-2)	Rhine 1993
Turbidity	Not specified	Co-operation with Bulgaria 1991
Turbidity	Secchi disk	Regensburg Danube 1987
Organic Pollution Indicators		
BOD	Not specified	Water economy Mura 1954 Water economy 1956
BOD	Unfiltered - BOD_{21}, without inoculation, without inhibition of nitrification, aeration, dilution method (CSN 83 0530/37A; DIN 38 409-H52)	Elbe 1990 (1993)
BOD	Without inhibition of nitrification	Water economy 1956
COD	Dichromate method	Bucharest Danube 1985
COD	Kubel method - KMnO4	Regensburg Danube 1987
COD	Permanganate method	Bucharest Danube 1985
COD	Not specified	Water economy Mura 1954 Water economy 1956 Co-operation with Bulgaria 1991
COD	Unfiltered - Dichromate method (CSN 83 0530/29B; DIN 38 409-H41)	Elbe 1990 (1993)
COD	Solution K2Cr2O7	Regensburg Danube 1987
Dissolved organic carbon (DOC)	Filtration 0.45 µm - Catalytic (high temperature) oxidation, IR-spectrophotometry (CSN 757516; ISO 8245; DIN 38 409-H3-1)	Elbe 1990 (1993)
Dissolved organic carbon (DOC)	Filtration 0.45 µm - Catalytic (high temperature) oxidation, IR-spectrophotometry (DIN 38 409-H3); or Na-peroxydidulphate/UV oxidation, IR-spectrophotometry	Rhine 1993
Dissolved oxygen	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Dissolved oxygen	On-site determination or fixing - Electrometrically with oxygen probe or Winkler method (CSN 83 0530/11B; DIN 38 408-G22 or G21)	Elbe 1990 (1993)
Dissolved oxygen	Electrometrically (EN 25814; DIN 38 408-G22)	Rhine 1993
Dissolved oxygen	Oxygen sensor	Baltic Sea 1974/92
Dissolved oxygen	Winkler's method- sodium azide	Regensburg Danube 1987 Baltic Sea 1974/92
Total organic carbon (TOC)	Catalytic (high temperature) oxidation, IR-spectrophotometry (CSN 757516; ISO 8245; DIN 38 409-H3-1)	Elbe 1990 (1993)
Total organic carbon (TOC)	Separate analysis in water and suspended solids: Catalytic (high temperature) oxidation, IR-spectrophotometry (DIN 38 409-H3); or Na-peroxydidulphate/uv oxidation, IR-spectrophotometry	Rhine 1993
Nutrients		
Ammonia	Method intercalibrated at the BIW	Baltic Sea 1974/92

Table E.8 continued

Determinand	Analysis method	Agreement
Ammonia	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Ammonia	Filtration, centrifugation or decanting - Photometric determination - Nessler reagent/indophenol blue (CSN 83 0530/26B; DIN 38 406-E5-1)	Elbe 1990 (1993)
Ammonia	Ion-sensitive electrode; or NH_3 gas exchange/FIA/ AA; or Salicylate/indophenol blue AA (DIN 38 406-E5-1)	Rhine 1993
Nitrate	Filtration, centrifugation or decanting - Photometric - Na-salicylate method; or Catalytic (Cd) reduction, Isotacho-phoresis/UV-spectrophotometry at 220 nm (CSN 83 0530/25; DIN 38 405-D9); or Ion chromatography (DIN 38 405-D19)	Elbe 1990 (1993)
Nitrate	Ion-sensitive electrode; or Reduction to nitrite/ sulphanilamide absorption photometry; or Ion chromatography (DIN 38 405-D19)	Rhine 1993
Nitrite	Filtration, centrifugation or decanting - Photometric determination - sulphanilic acid/sulphanilamide and N-(1-Naphthyl)-ethylenediamine, isotachophoresis (CSN 83 0530/24; DIN 38 405-D10); or Ion chromatography (DIN 38 405-D19)	Elbe 1990 (1993)
Nitrogen (total)	Digestion	Baltic Sea 1974/92
Nitrogen (total)	Method intercalibrated at the BIW	Baltic Sea 1974/92
Nitrogen (total)	Not specified	Water economy 1956 Protection Lake Constance 1960 Co-operation with Bulgaria 1991
Nitrogen (total)	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Nitrogen (total)	Peroxydisulphate oxidation - nitrate determination	Baltic Sea 1974/92
Nitrogen (total)	Addition of individual N-components; or Persulphate oxidation - NO_3 determination; or Oxidative, thermal-catalytic conversion (NO/NO_2), photometric chemoluminescence detection	Rhine 1993
ortho-Phosphate-P	Filtration, centrifugation or decanting - isotachophoresis, ammonium molybdate/absorption photometry (CSN 83 0530/22A; DIN 38 405-D11-1)	Elbe 1990 (1993)
ortho-Phosphate-P	Ammonium molybdate/absorption photometry (DIN 38 405-D11-1; NF T 90-023)	Rhine 1993
Phosphorus (total)	Digestion	Baltic Sea 1974/92
Phosphorus (total)	Method intercalibrated at the BIW	Baltic Sea 1974/92
Phosphorus (total)	Not specified	Water economy Mura 1954 Water economy 1956 Co-operation with Bulgaria 1991
Phosphorus (total)	Mineralisation with Peroxydisulphate, H_2O_2/H_2SO_4; or Koroleff method; or DIN 38 405-D11-4; photometric PO_4 determination or ion chromatography	Elbe 1990 (1993)
Phosphorus (total)	Separate analysis in water and suspended solids (SS): Digestion, ammonium molybdate/ absorption photometry (DIN 38 405-D11-4; NF T 90-023); or ICP (SS)	Rhine 1993

Table E.8 continued

Determinand	Analysis method	Agreement
Major Anions/Cations		
Barium	Not specified	Co-operation with Bulgaria 1991
Boron	Not specified	Co-operation with Bulgaria 1991
Calcium	Complexometrically - EDTA	Regensburg Danube 1987
Calcium	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Calcium	Acidification/digestion, AAS; or Complexometric 2-step (Ca/Mg) titration (CSN 83 0530/17; DIN 38 406-E3-3); or ICP-MS (DIN 38 406-E22)	Elbe 1990 (1993)
Calcium	Complexometric (EDTA) titration (DIN 38 406-E3-2); or Flame-AAS (NEN 6446)	Rhine 1993
Magnesium	Calculation	Water economy 1956 Regensburg Danube 1987 Co-operation with Bulgaria 1991
Magnesium	AAS; or Complexometric 2-step (Ca/Mg) titration (CSN 83 0530/17; DIN 38 406-E3-3); or ICP-MS (DIN 38 406-E22)	Elbe 1990 (1993)
Magnesium	Complexometric (EDTA) titration (DIN 38 406-E3-3); or Flame-AAS (NEN 6446); or ICP/AES	Rhine 1993
Chloride	Mercury nitrate titration	Regensburg Danube 1987
Chloride	Mohr method	Regensburg Danube 1987
Chloride	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Chloride	Filtration, centrifugation or decanting - Silver nitrate or mercury nitrate titration (CSN 83 0530/20; DIN 38 405-D1-2); or Ion chromatography (DIN 38 405-D19)	Elbe 1990 (1993)
Chloride	Ion-selective electrode; or Reaction with Hg-Ag-thiocyanate, Fe(III) absorption photometry; or Silver nitrate titration (DIN 38 405-D1-2; NF T 90-014); or Ion chromatography (DIN 38 405-D19)	Rhine 1993
Cyanide	Not specified	Co-operation with Bulgaria 1991
Fluoride	Not specified	Co-operation with Bulgaria 1991
Potassium	Not specified	Water economy 1956
Potassium	Flame photometry (CSN 83 0530/19; DIN 38 406-E13); or IPC-MS (DIN 38 406-E22)	Elbe 1990 (1993)
Potassium	ICP-AES; or Emission flame photometry (DEV E14-2; NEN 6442)	Rhine 1993
Residual chlorine	Not specified	Co-operation with Bulgaria 1991
Silicon	Ascorbic acid method	Baltic Sea 1974/92
Silicon	Method intercalibrated at the BIW	Baltic Sea 1974/92
Silicate	Ammonium molybdate/ascorbic acid absorption photometry (DIN38 405-D21); or Colorimetry (Merck Spectroquant method)	Rhine 1993
Sodium	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Sodium	Flame photometry (CSN 83 0530/18; DIN 38 406-E14); or IPC-MS (DIN 38 406-E22)	Elbe 1990 (1993)
Sodium	ICP-AES; or Emission flame photometry (DEV E14-2; NEN 6442)	Rhine 1993

Table E.8 continued

Determinand	Analysis method	Agreement
Sulphate	Complexometrically - EDTA	Regensburg Danube 1987
Sulphate	Gravimetrically - $BaCl_2$	Regensburg Danube 1987
Sulphate	Not specified	Water economy 1956 Regensburg Danube 1987
Sulphate	Gravimetrically - $BaCl_2$; or EDTA titration; or isotachometry (CSN 83 0530/16; DIN 38 405-D5-1); or Ion chromatography (DIN 38 405-D19)	Elbe 1990 (1993)
Sulphate	Ion chromatography (DIN 38 405-D19); or Methylthymol blue/absorption photometry; or Nephelometrically - $BaSO_4$ (NF T 90-009)	Rhine 1993
Sulphate	Volumetrically - dithizone	Regensburg Danube 1987
Total salts	Gravimetrically	Regensburg Danube 1987
Total salts	Sum of dissolved ions	Regensburg Danube 1987
Total salts	Conductimetry	Regensburg Danube 1987
Metals		
Arsenic	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Arsenic	Acidification /digestion, ETA-AAS/Hydride-AAS (DIN 38 405-D18)	Elbe 1990 (1993)
Arsenic	Separate analysis in water and suspended solids: Hydride-AAS (DIN 38 405-D18); or Graphite furnace-AAS (NEN 6457); or ICP-AES	Rhine 1993
Cadmium	Not specified	Water economy 1956 Baltic Sea 1974/92 Co-operation with Bulgaria 1991
Cadmium	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Cadmium	Flame-AAS (CSN 83 0530/42 B); or Flameless AAS (DIN 38 406-E19)	Elbe 1990 (1993)
Cadmium	Separate analysis in water and suspended solids: Graphite furnace-AAS DIN 38 406-E19-2 or 3; NEN 6458); or ICP-AES	Rhine 1993
Chromium	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Chromium	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Chromium	ETA-AAS; or Flameless-AAS (CSN 83 0530/45); or APDC complexation/flameless-AAS; or ICP-MS (DIN 38 406-E22)	Elbe 1990 (1993)
Chromium	Separate analysis in water and suspended solids: Graphite furnace-AAS DIN 38 406-E10-2; NEN 6444); or ICP-AES	Rhine 1993
Copper	Anodic stripping voltametry	Baltic Sea 1974/92
Copper	Atomic absorption spectrometry (AAS) (graphite furnace or flame)	Baltic Sea 1974/92
Copper	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Copper	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Copper	Flame-AAS or flameless-AAS (CSN 83 0530/39); or APDC complexation/flameless AAS (DIN 38 406-E-7-1); or ICP-MS (DIN 38 406-E22)	Elbe 1990 (1993)
Copper	Separate analysis in water and suspended solids: Graphite furnace-AAS (DIN 38 406-E7-2; NEN 6454); or ICP-AES	Rhine 1993

Table E.8 continued

Determinand	Analysis method	Agreement
Iron	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Iron	Flame-AAS after pre-concentration; or ICP-MS (CSN 83 0530/27 B; DIN 38 406-E22)	Elbe 1990 (1993)
Iron	Separate analysis in water and suspended solids: Flame-AAS (DIN 38 406-E7-1); or ICP-AES	Rhine 1993
Lead	Not specified	Water economy 1956 Baltic Sea 1974/92 Co-operation with Bulgaria 1991
Lead	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Lead	ETA-AAS; or Flame-AAS (CSN 83 0530/44); or Graphite furnace-AAS (DIN 38 406-E6-3); or APDC complexation/flameless AAS; or ICP-MS (DIN 38 406-E22)	Elbe 1990 (1993)
Lead	Separate analysis in water and suspended solids: Graphite furnace-AAS (DIN 38 406-E19-2; NEN 6458); or ICP-AES	Rhine 1993
Manganese	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Manganese	Flame-AAS CSN 83 0530/28 B); or IPC-MS ((DIN 38 406-E22)	Elbe 1990 (1993)
Manganese	Separate analysis in water and suspended solids: Graphite furnace or flame AAS (DIN 38 406-E7-1); or ICP-AES	Rhine 1993
Mercury	Collection on gold followed by cold vapour AAS	Baltic Sea 1974/92
Mercury	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Mercury	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Mercury	Mercurimetry; or AAS - cold vapour method (CSN 83 0530/43; DIN 38406-E12); or IPC-MS (DIN 38 406-E22)	Elbe 1990 (1993)
Mercury	Separate analysis in water and suspended solids: AAS - cold vapour method (DIN 38 406-E12-3; NEN 6445)	Rhine 1993
Nickel	Separate analysis in water and suspended solids: Graphite furnace-AAS (DIN 38 406-E11-2; NEN 6430)	Rhine 1993
Nickel	ETA-AAS; or Flame-AAS (CSN 83 0530/46); or Graphite furnace-AAS (DIN 38 406-E11-2); or APDC complexation/flameless-AAS; or ICP-MS (DIN 38 406-E22)	Elbe 1990 (1993)
Selenium	Not specified	Co-operation with Bulgaria 1991
Silver	Not specified	Co-operation with Bulgaria 1991
Zinc	Not specified	Water economy 1956 Baltic Sea 1974/92 Co-operation with Bulgaria 1991
Zinc	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Zinc	Separate analysis in water and suspended solids: Flame-AAS (DIN 38 406-E8-1); or AAS - cold vapour method; or ICP-AES	Rhine 1993
Zinc	Acidification/digestion of unfiltered sample, flame-AAS after pre-concentration or flameless AAS (CSN 83 0530/41; DIN 38 406-E8-1); or ICP-MS (DIN 38 406-E22)	Elbe 1990 (1993)

Table E.8 continued

Determinand	Analysis method	Agreement
Biological		
Chlorophyll-a	Determination within 8 h of sampling - Extraction of filter residue, spectro-photometric determination (ISO 10 260)	Elbe 1990 (1993)
Coliforms	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Coliforms	Endo-agar 37°C, 24h and 48h count (red colonies only)	Elbe 1990 (1993)
Faecal coliforms	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Faecal coliforms	Endo-agar 43°C, 24h count (red colonies only)	Elbe 1990 (1993)
Faecal streptococci	Not specified	Water economy 1956
Salmonella	Not specified	Water economy 1956
Pathogens	Not specified	Co-operation with Bulgaria 1991
Total bacteria	22°C	Water economy 1956 Frontier waters -Czech Republic 1970 Frontier waters -Slovak Republic 1970
Total bacteria	37°C	Frontier waters -Czech Republic 1970 Frontier waters -Slovak Republic 1970
Total bacteria	Not specified	Water economy 1956
Volume		
River Level	Not specified	Rhine-ICH 1989 Co-operation with Bulgaria 1991
Flow	Not specified	Water economy Mura 1954 Water economy 1956 Frontier waters -Slovak Republic 1970 Rhine Convention 1976 Bucharest Danube 1985 Rhine-ICH 1989 Co-operation with Bulgaria 1991 Elbe 1990 (1993)
Levels of lake water	Not specified	Water economy 1956
Synthetic organic substances		
AOX	Not specified	Water economy 1956
AOX	Acidification (HNO_3) to pH 1-2, then ISO 9562 or DIN 38 409-H 14	Elbe 1990 (1993)
Acid Binding Capacity	Not specified	Water economy 1956
Aliphatic hydrocarbons	Not specified	Water economy 1956
Benzene	Determination in unfiltered sample within 48h - Closed loop stripping or solvent extraction, GC-FID (DIN 38 407-F9-2)	Elbe 1990 (1993)
Benzene	Purge and trap/GC-FID	Rhine 1993
Chlorobenzene	Determination in unfiltered sample within 48h - Closed loop stripping, solvent extraction, or solid phase extraction, GC-FID, GC-ECD or GC-MS (DIN (draft) 38 407-F2)	Elbe 1990 (1993)
DDT	Not specified	Baltic Sea 1974/92
DDT/DDD/DDE	In suspended solids: Extraction/GC-ECD	Rhine 1993

Table E.8 continued

Determinand	Analysis method	Agreement
Dichlorobenzene	Determination in unfiltered sample within 48h - Closed loop stripping, solvent extraction, or solid phase extraction, GC-FID, GC-ECD or GC-MS (DIN (draft) 38 407-F2)	Elbe 1990 (1993)
Dichloroethane	Determination in unfiltered sample within 48h - Closed loop stripping, solvent extraction, or solid phase extraction, GC-FID, GC-ECD or GC-MS (DIN 38 407-F4 or F5)	Elbe 1990 (1993)
Dichloroethane	Purge and trap/GC-ECD/FID	Rhine 1993
EDTA	Pre-concentration, derivatisation (butanol/acetyl chloride) GC-NPD	Rhine 1993
HCH	Not specified	Baltic Sea 1974/92
HCH	As specified in JMP of North Sea Paris (1974)	NSTF 1987
HCH isomers	Determination in unfiltered sample within 48h - Solvent extraction or solid phase extraction, GC-ECD or GC-MS (DIN (draft) 38 407-F2)	Elbe 1990 (1993)
HCH isomers	Various methods based on extraction (solid phase or solvent extraction) and GC-ECD, GC-FID or GC-MS)	Rhine 1993
Hexachlorobenzene	Determination in unfiltered sample within 48h - Solvent extraction or solid phase extraction, GC-ECD or GC-MS (DIN (draft) 38 407-F2)	Elbe 1990 (1993)
Hexachlorobenzene	In suspended solids: Extraction/GC-ECD	Rhine 1993
Hydrocarbons	Not specified	Co-operation with Bulgaria 1991
Hydrogen sulphide	Colorimetric method	Baltic Sea 1974/92
Hydrogen sulphide	Dilution	Baltic Sea 1974/92
Hydrogen sulphide	Volumetrically	Baltic Sea 1974/92
Methyl-parathion	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Methyl-parathion	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Methyl-parathion	Various methods based on extraction (solid phase or solvent extraction) and GC-NPD or GC-MS	Rhine 1993
NTA	Pre-concentration, derivatisation (butanol/acetyl chloride) GC-NPD	Rhine 1993
Organic carbon	Not specified	Water economy 1956
Organo-tin	Extraction and graphite furnace atomic absorption spectroscopy	Baltic Sea 1974/92
Organo-tin	As specified in JMP of North Sea Paris (1974)	NSTF 1987
PAH	Not specified	Water economy 1956
PAH	In suspended solids: Extraction/HPLC-fluorescence	Rhine 1993
PCB	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
PCB	Determination in unfiltered sample within 48h - Solvent extraction or solid phase extraction, GC-ECD or GC-MS (DIN (draft) 38 407-F2)	Elbe 1990 (1993)
PCB	In suspended solids: Extraction/GC-ECD	Rhine 1993
PCDD+PCDF	In suspended solids: Extraction/GC-MS	Rhine 1993
Pentachlorophenol	Determination in unfiltered sample within 48h - Derivatisation (acetanhydryde) GC-MS; or Acidification/petroleum ether/acetic acid ester extraction, GC-ECD	Elbe 1990 (1993)
Pentachlorophenol	Various methods based on extraction, derivatisation, HPLC or GC-MS or GC-ECD	Rhine 1993

Table E.8 continued

Determinand	Analysis method	Agreement
Pesticides	Not specified	Co-operation with Bulgaria 1991
Pesticides	24 specific compounds (and isomers): Various methods based on extraction (solid phase or solvent extraction) and GC-ECD, FID, NPD or MS, or HPLC-UV	Rhine 1993
Petroleum hydrocarbons	UV-spectrofluorometric method	Baltic Sea 1974/92
Phenols	Not specified	Water economy 1956 Co-operation with Bulgaria 1991
Phosphoric acid ester	Determination in unfiltered sample - Solvent extraction, GC-NPD	Elbe 1990 (1993)
Tetrachloroethene	Determination in unfiltered sample within 48h - Closed loop stripping, solvent extraction, or solid phase extraction, GC-ECD or GC-MS (DIN 38 407-F4 or F5)	Elbe 1990 (1993)
Tetrachloroethene	Purge and trap/GC-ECD	Rhine 1993
Tetrachloromethane	Determination in unfiltered sample within 48h - Closed loop stripping, solvent extraction, or solid phase extraction, GC-ECD or GC-MS (DIN 38 407-F4 or F5)	Elbe 1990 (1993)
Tetrachloromethane	Purge and trap/GC-ECD	Rhine 1993
Trichloroethene	Purge and trap/GC-ECD	Rhine 1993
Trichloromethane	Purge and trap/GC-ECD	Rhine 1993
Total tin	Extraction and graphite furnace atomic absorption spectroscopy	Baltic Sea 1974/92
Toluene	Determination in unfiltered sample within 48h - Closed loop stripping or solvent extraction, GC-FID (DIN 38 407-F9-2)	Elbe 1990 (1993)
Triazines	As specified in JMP of North Sea Paris (1974)	NSTF 1987
Triazines	Not specified	Water economy 1956
Triazines (atrazine, simazine)	Solvent extraction/GC-NPD ; or Solid phase extraction/GC-MS or HPLC-UV	Rhine 1993
Trichlorobenzene	Determination in unfiltered sample within 48h - Closed loop stripping, solvent extraction, or solid phase extraction, GC-FID, GC-ECD or GC-MS (DIN (draft) 38 407-F2)	Elbe 1990 (1993)
Trichlorobenzene	In suspended solids: Extraction/GC-ECD	Rhine 1993
Trichloroethene	Determination in unfiltered sample within 48h - Closed loop stripping, solvent extraction, or solid phase extraction, GC-ECD or GC-MS (DIN 38 407-F4 or F5)	Elbe 1990 (1993)
Trichloromethane	Determination in unfiltered sample within 48h - Closed loop stripping, solvent extraction, or solid phase extraction, GC-ECD or GC-MS (DIN 38 407-F4 or F5)	Elbe 1990 (1993)
Xylene	Determination in unfiltered sample within 48h - Closed loop stripping or solvent extraction, GC-FID (DIN 38 406-F9-2)	Elbe 1990 (1993)
Radioactivity		
Radioactivity-alpha	Bledtionn	Regensburg Danube 1987
Radioactivity-alpha	GM Counter	Regensburg Danube 1987
Radioactivity-alpha	Proportional gas flow counter (argon/methane); or Scintillation counter	Rhine 1993
Radioactivity-beta	Bledtionn	Regensburg Danube 1987
Radioactivity-beta	GM Counter	Regensburg Danube 1987
Radioactivity-beta	Proportional gas flow counter (argon/methane or helium/isobutanol) ; or GM counter	Rhine 1993

Table E.8 continued

Determinand	Analysis method	Agreement
Radioactivity	Not specified	Co-operation with Bulgaria 1991
Potassium 40-beta activity	Calculation from Potassium concentration determined by flame-AAS	Rhine 1993
Tritium	Bledtionn	Regensburg Danube 1987
Tritium	Scintillation spectrometry	Rhine 1993
Tritium	GM Counter	Regensburg Danube 1987

Table E9 Summary of analytical precision requirements in international agreements in respect of analysis of all determinands

Determinand	LoD	CP	A	Agreement
Physico-chemical				
Dissolved oxygen[1]	nd	nd	nd	Baltic Sea 1974/92
Salinity[2]	nd	nd	nd	Baltic Sea 1974/92
Temperature[3]	nd	nd	nd	Baltic Sea 1974/92
Radioactivity				
Radioactivity-alpha	<2% of lower limit of detection	nd	nd	Regensburg Danube 1987
Radioactivity-alpha	0.02	nd	<2% of lower limit of detection	Regensburg Danube 1987

Notes:

nd not defined

LoD limit of detection

CP precision criteria

A accuracy

1. Regular checks on reproducibility required.
2. Salinometer must be standardised with IAPSO standards.
3. Temperature measurement must be calculated once every two years. Standard method stipulated.

Table E.10 Summary of the analysis requirements by determinand for microbiological parameters in EU directives and international agreements for surface waters

Determinand	Analytical methods and comments	Directive/International Agreement
1. DIRECTIVES		
Total coliforms[1]	Multiple tube (MPN), Confirmation of positive tubes	Bathing Water (76/160/EEC)
Total coliforms[2]	MPN (multiple tube) or membrane filtration, with an appropriate medium, such as Tergitollactose agar, Endo agar or 0.4% Teepol broth. Confirmation. Incubation at 37°C for total coliforms, 44°C for faecal coliforms.	Surface Water (75/440/EEC) and Sampling and Analysis (79/869/EEC) Drinking Water (80/778/EEC)
Faecal coliforms[1]	Membrane filtration (Tergitol lactose agar, Endo agar, 0.4% Teepol broth) Confirmation. Media are given as examples. An 'appropriate medium' should be used. Teepol broth is obsolete, Endo agar inhibitory to organisms exposed to seawater and sunlight. All are recommended in ISO 9308-1 (under revision).	Bathing Water (76/160/EEC)
Faecal coliforms	MPN (multiple tube) or membrane filtration, with an appropriate medium, such as Tergitollactose agar, Endo agar or 0.4% Teepol broth. Confirmation. Incubation at 37°C for total coliforms, 44°C for faecal coliforms.	Surface Water (75/440/EEC) and Sampling and Analysis (79/869/EEC) Drinking Water (80/778/EEC)
Faecal coliforms[3]	Multiple tube (at least three tubes in three successive dilutions) Confirmation. Incubation at 44°C	Shellfish Waters (79/923/EEC)
Escherichia coli [4]	Incubation at 44°C. Multiple tube MPN or membrane filtration, using an appropriate medium (examples unchanged from Directive (76/160/EEC.) Confirmation	Proposed Bathing Water COM(94) 36
Faecal streptococci[5]	Membrane filtration (or direct plating) or multiple-tube (MPN) method, using appropriate medium, such as sodium azide	Surface Water (75/440/EEC) and Sampling and Analysis (79/869/EEC)
Faecal streptococci[6]	MPN or membrane filtration - Litsky method (Litsky, Mallman and Fifield (1953) - now obsolete, poor efficiency)	Bathing Water (76/160/EEC)
Faecal streptococci[4]	Litsky method, incubation at 37°C; MPN or membrane filtration. Unchanged from 76/160/EEC.	Proposed Bathing Water COM(94) 36
Faecal streptococci[7]	Sodium azide method (Litsky), MPN	Drinking Water (80/778/EEC)
Salmonella	Bare details	Surface Water (75/440/EEC) and Sampling and Analysis (79/869/EEC)[8] Bathing Water (76/160/EEC)[9] Drinking Water (80/778/EEC)[10]
Salmonella	Not specified	Shellfish hygiene (91/492/EEC)
Enteroviruses	Bare details.	Bathing Water (76/160/EEC)[11] Proposed Bathing Water COM(94) 36[4] Drinking Water (80/778/EEC)[12]

Table E.10 continued

Determinand	Analytical methods and comments	Directive/International Agreement
Escherichia coli [13]	Test of mollusc flesh and intervalvular liquid using multiple tube MPN (at least five tubes in three successive dilutions) or any other test of equivalent accuracy.	Shellfish Hygiene (91/492/EEC)
Bacteriophages[14]	No details	Proposed Bathing Water COM(94) 36
Faecal bacteriophages[15]	Guélin's process	Drinking Water (80/778/EEC)
Sulphite - reducing Clostridia[16]	Spore count after heating sample to 80°C. Colony count in glucose, sulphite iron medium, membrane filtration or differential reinforced clostridial medium (DRCM), with confirmation.	Drinking Water (80/778/EEC)
Total bacteria[17]	Nutritive agar; incubation at 37° for 48 hours and at 22°C for 72 hours	Drinking Water (80/778/EEC)
Pathogenic staphylococci[18]	Membrane filtration; specific medium, e.g. Chapman's agar, test for pathogenic characters.	Drinking Water (80/778/EEC)
2. INTERNATIONAL AGREEMENTS		
Total coliforms	Not specified	Drava Water economy 1954 Water economy 1956 Frontier Waters -Czech Republic 1970 Frontier Waters -Slovak Republic 1970 Bucharest Danube 1985 Regensburg Danube 1987 Co-operation with Bulgaria 1991
Total coliforms	Endo-agar 37^{o}C, 24h and 48h count (red colonies only)	Elbe 1990
Faecal coliforms	Not specified	Water economy 1956 Frontier Waters -Czech Republic 1970 Frontier Waters -Slovak Republic 1970 Bucharest Danube 1985 Regensburg Danube 1987 Co-operation with Bulgaria 1991
Faecal coliforms	Endo-agar 43^{o}C, 24h count (red colonies only)	Elbe 1990
Escherichia coli	Not specified	Drava Water economy 1954
Enterococcus	Not specified	Drava Water economy 1954
Faecal streptococci	Not specified	Water economy 1956 Frontier Waters -Slovak Republic 1970 Regensburg Danube 1987
Salmonella	Not specified	Water economy 1956 Frontier Waters -Czech Republic 1970 Frontier Waters -Slovak Republic 1970 Regensburg Danube 1987
Thermophilic bacteria	Not specified	Drava Water economy 1954
Pathogens	Not specified	Co-operation with Bulgaria 1991
Micro-organisms - biomass	Acridine Orange direct count (AODC) Shaking and addition of formalin and refrigerate	Baltic Sea 1974/92

Table E.10 continued

Determinand	Analytical methods and comments	Directive/International Agreement
Micro-organisms - number of colony	Pour plate method Shaking, dilution with sterile water if necessary 30-300 and inoculation into three sterile Petri dishes and incubation	Baltic Sea 1974/92
Micro-organisms - production	Tritiated Thymidine Incorporation Incubation with TT, filtration, solubilisation with ethyl acetate	Baltic Sea 1974/92
Micro-organisms - total number	Acridine Orange direct count (AODC) Shaking and addition of formalin and refrigerate	Baltic Sea 1974/92
Bacterial Plate count	Not specified	Bucharest Danube 1985 Water economy 1956
Bacterial Plate count	22^{o}C	Frontier waters -Czech Republic 1970 Frontier waters -Slovak Republic 1970
Bacterial Plate count	37^{o}C	Frontier waters -Czech Republic 1970 Frontier waters -Slovak Republic 1970
Bacterioplankton - biomass	Not specified	Protection Lake Constance 1960
Total bacteria	22^{o}C	Water economy 1956
Total bacteria	Not specified	Water economy 1956

Notes:

1 ISO 9308-1 permits all three methods to be used. UK now uses membrane filtration with 0.1% sodium lauryl sulphate broth; incubation at 30°C for 14 hours for faecal coliforms. Faecal coliform isolates are confirmed, giving a count of *Escherichia coli*. This procedure gives the best recovery (highest counts) of various media tested and is standardised in NRA microbiological methods manual (National Rivers Authority (1992)).

2 Methods are given in ISO 9308-2, which is being revised. Teepol broth is obsolete, Endo agar inhibitory to damaged coliforms. UK uses long-established procedures in The Microbiology of Water 1994 - Part 1 - Drinking Water, HMSO, London. UK always confirms for presence of *Escherichia coli*.

3 Examination of the Shellfish flesh and intervalvular liquid. Guideline value of 300 per 10 ome must be observed in shellfish harvested for direct human consumption in the waters in which they are reared. This requirement is now superseded by the microbiological requirements of the Shellfish Hygiene Directive (91/492/EEC)

4 Examples of analytical methods unchanged; the same comments apply.

5 Standard methods of ISO 7899/1 and /2, now under revision. Favoured medium is Slanetz and Bartley's (1957) m-Enterococcus agar with membrane filtration. UK procedure given in *The Microbiology of Water 1994* - Part 1 - *Drinking Water*. HMSO, London.

6 The most used medium is Slanetz and Bartley's (1957) m-Enterococcus agar with membrane filtration. Incubation either at 37°C for 48 hours or at 37°C for 48 hours or at 37°C for 4 hours and 44°C for 44 hours. Latter procedure is very specific for enterococci and is used by UK. Former procedure is less specific for faecal streptococci and gives higher counts. Neither method, nor Litsky method is given in ISO 7899/2, which is being revised.

7 Litsky, Mallman and Fifield (1953) method is of low efficiency and obsolete. Generally replaced by membrane filtration, using Slanetz and Bartley's (1957) m-Enterococcus agar. See Note 2 for Bathing Water Directive.

8 A difficult test. UK guideline document. (Note 2) gives procedures. Draft International Standard, ISO/DIS 6340

9 Salmonella method used in UK is specified in NRA's manual. A difficult test. Salmonellae are ubiquitous in surface water and can originate from birds, waterfowl and animals, hence not specific indicator of faecal pollution. To be examined if bathing water has deteriorated or if it is suspected that they may be present

10 Not an analysis for routine use, but when waterborne Salmonellosis is suspected. UK guideline (see note 1) has procedures. Draft International Standard ISO/DIS 6340.

11 Enteroviruses are detected with difficulty, using an expensive and poorly efficient method. They are not the viruses thought to be responsible for gastro-enteritis in bathers, hence are yet another indicator of faecal contamination. To be examined if bathing water has deteriorated or if it is suspected that they may be present

12 Not a routine test.

13 The UK shellfish industry has long used a draft standard procedure (West and Coleman 1986); a multiple tube method with minerals modified glutamate medium, with confirmation of *E.col*}. Impedimetric methods are under development as a possible European alternative.

Table E.10 (contd)

14	Awaits a decision on parameter level, to be inserted at a later date when information is available. Parameter could be either somatic coliphages or more likely 'male-specific' coliphages (F+ RNA coliphages), for which a draft international standard now exists ISO/DIS 10705-1. It is intended to replace the Enterovirus parameter.
15	Guélin's method obsolete. Not a routine test. Standard for F+ RNA coliphages in water now being developed as ISO/DIS 10705-1; methods for somatic coliphages in draft stages ISO/CD 10705-2 and 3. A faecal indicator parameter, not a pathogen.
16	ISO 6461-1 and 6461-2 give standard methods for multiple tube and membrane filtration methods. Suggested by WHO as a test for water treatment efficiency, since chlorine resistant (*Guidelines for Drinking-Water Quality* - Vol. 1 Recommendations, WHO, Geneva).
17	ISO 6222 gives procedures, but is being revised within CEN/TC230 and ISO/TC 147. UK uses incubation at 37° for 24 hours.
18	Not a routine test. Staphylococcal infections are not waterborne. Not an appropriate parameter.

Table E.11 Summary of requirements for reporting monitoring programmes under directives

Directive	Determinands	Qualifier	Comments
Dangerous substance (76/464/EEC) and Daughter Directives	17 List I substances Candidate List I and List II substances	Number of stations for each substance Date of first measurement Method of measurement As above plus other determinands	The number/figure should be related to each major river basin in Exchange of Information decisions, and to coastal zones in order to obtain regionalised information Others determinands for example as included in Annex II of Decision (77/795/EEC)
Freshwater Fish (78/659/EEC) and Shellfish Waters (79/923/EEC):	Determinands stipulated in directives Those determinands with reduced monitoring frequency (Freshwater Fish only) Additional determinands Derogated determinands	Yes or no answer only required	No numerical data reported
Titanium Dioxide (82/883/EEC)	Description of sampling points Sampling methods Method of measurement and analysis Results of measurements	Only required once after initial designation With where appropriate limit of detection, accuracy and precision	
Groundwater (80/68/EEC):	In accordance with Article 13 of the Directive	To assess compliance with authorisations to discharge dangerous substances to groundwater, and the effects of those discharges on groundwater	
Sampling and Analysis (79/869/EEC)	For each determinand listed in directive	Method of measuring. CEN or ISO number, or other standard method if used Range of annual frequency of Sampling and Analysis	
Bathing Water (76/160/EEC)	Geographic location General data Determinand data Analytical methods	For example of designated waters For example, year, beginning of bathing season, number of samples For example, number of results exceeding mandatory value, frequency of monitoring Used to assess compliance with directive	Information to be provided in digital form

Table E.12 Reporting requirements specified in directives

Directive	Reporting authority	Frequency	Date for first report	Period
Surface Water (75/440/EEC)	Commission through a central national agency	every 12 months	before 1 October of the following year	one year
Sampling and Analysis (79/869/EEC)	Commission	every 3 years	9 months before the end of period covered	1993-1995
Bathing Water (76/160/EEC)	Commission	regular intervals after	4 years after notification	bathing season
Dangerous Substances (76/464/EEC)	Commission	every 5 years	4 years after notification	five years (1980/ 1985/1990/1995)
Mercury (82/176/EEC)	Commission	every 5 years	4 years after notification	five years (1980/ 1985/1990/1995)
Mercury (84/156/EEC)	Commission	every 5 years	4 years after notification	five years (1980/ 1985/1990/1995)
Cadmium (83/513/EEC)	Commission	every 5 years	4 years after notification	five years (1980/ 1985/1990/1995)
Hexachlorocyclohexane (84/491/EEC)	Commission	every 5 years	4 years after notification	five years (1980/ 1985/1990/1995)
Carbon Tetrachloride (86/280/EEC)	Commission	every 5 years	4 years after notification	five years (1980/ 1985/1990/1995)
Aldrin (88/347/EEC)	Commission	every 5 years	4 years after notification	five years (1980/ 1985/1990/1995)
Dichloroethane (90/415/EEC)	Commission	every 5 years	4 years after notification	five years (1980/ 1985/1990/1995)
Freshwater Fish (78/659/EEC)	Commission	regular intervals	5 years after implementation (before 1 Oct. 1996)	one year
Exchange of Information (77/795/EEC and 86/574/EEC)	Commission through a central national agency	every 12 months	before 1 October of the following year	one year
Reporting Decision (92/446/EEC)	Commission	Specific to directives	specific to directives	Specific to directives
Groundwater (80/68/EEC)	Commission	on request	on request	three years (1993/1994/1995)
Drinking Water (80/778/EEC)	Commission	ns	within 15 days	ns
UWWT (91/271/EEC)	Commission	on request	within 6 months of the request	one year
Nitrates (91/676/EEC)	Commission	four years period	4 years after notification	four years
Shellfish Waters (79/923/EEC)	Commission	regular intervals	6 years after implementation (before 1 Oct. 1996)	one year
Proposal on Landfill (COM(93)275)	Commission	every 3 years	3 years after implementation	three years
Proposal on Bathing Water (COM(94)36)	Commission	every year	31 Dec. 1996	one year
Proposal on Ecological Quality (COM(93)680)	Commission	every 3 years	9 months of the end of period covered	three years (1999/2000/2001)
Titanium Dioxide (82/883/EEC)	Commission	ns	1981 and 1986	one year (1981)

Table E.13 Summary of requirements for reporting monitoring programmes under international agreements

Agreement	Reporting requirement	Report frequency	Reporting authority	Reporting composition
Helsinki Convention 1974 as revised in 1992 (Baltic Sea)	on a voluntary basis	every 5th year (starting in 1993)	contracting authorities report to Commission	very detailed format
Agreement between Finland and Russian Federation concerning frontier water courses 1964	resolution of commission under agreement	annually, two months after sampling	Working group under commission	Results and conclusions exchanged with other party. Commission produces a joint report
Regensburg Agreement 1987 (Danube Basin)	not specified	annual	Ständige Gewässerkommission nach dem Regensburger Vertag	Protokoll der Tagung der Gewasserkommission nach dem Regensburger Vertag, 1992
Convention concerning water economy questions relating to the Drava 1954	ni	annual	Österreichisch-Slowensiche Kommission für die Drau	ni
Agreement concerning water economy in respect of the frontier sector of the Mura 1954	ni	annual	Österreichisch-Slowensiche Kommission für die Mura	ni
Convention between the Land Baden-Wurttemberg, the free State of Bavaria, Austria, Switzerland on the protection of Lake Constance against pollution 1960	ni	ni	Internationalen Gewässerschutzkommission für den Bodensee (IKGB)	ni
Treaty between Hungary and Austria on water economy 1956	ni	annual	Österreichisch-Ungarische Gewässerkommission	ni
Treaty between Austria and Czech Republic on frontiers waters	ni	annual	Österreichisch-tschechische Grenzgewässerkommission	ni
Treaty between Austria and Slovak Republic on frontiers waters	ni	annual	Österreichisch-Slowakische Grenzgewässerkommission	ni
Bucharest Declaration (1985)	ni	ni	Expertentreffen der Bukarester Deklaration Koordinatonationsstelle der Bukarester deklaration Romani	ni
Rhine Convention 1976		Annually	International Commission for the Protection of the Rhine	Tables of figures and a quality report
Elbe Convention 1990	ni	Annually	International Commission for the Protection of the Elbe	

Table E.13 continued

Agreement	Reporting requirement	Report frequency	Reporting authority	Reporting composition
OSPAR (North East Atlantic Treaty) 1992	ni	annual report	Oslo and Paris Commissions	Annual review plus addition publications in specific areas e.g. Nutrients and Mercury
North Sea Task Force, 1990	North Sea Quality Status Report	once so far	North Sea Task Force	Related to OSPAR and ICES
Protocol establishing an International Commission for the Protection of the Moselle (20/12/1961)	ni	annually since 1964	ni	ni

APPENDIX F DEFINITION OF TERMS USED IN DIRECTIVES AND INTERNATIONAL AGREEMENTS

Table F.1 Directives

Directive	Term	Definition
Surface Water Directive (75/440/EEC)	Category A1	Simple physical treatment and disinfection, e.g. rapid filtration and disinfection.
	Category A2	Normal physical treatment, chemical treatment and disinfection, e.g. pre-chlorination, coagulation, flocculation, decantation, filtration, disinfection (final chlorination).
	Category A3	Intensive physical and chemical treatment, extended treatment and disinfection, e.g. chlorination to break-point, coagulation, flocculation, decantation, filtration, adsorption (activated carbon), disinfection (ozone, final chlorination).
	Drinking Water	all surface water intended for human consumption and supplied by distribution networks for public use.
	Surface water	freshwater used or intended for use in the abstraction of Drinking Water.
Sampling and Analysis Directive (79/869/EEC)	accuracy	the difference between the true value of the determinand examined and the average experimental value obtained.
	limit of detection	the minimum value of the determinand examined which it is possible to detect
	precision	the range within which 95 per cent of the results of measurements made on a single sample, using the same method, are located.
	reference method of measurement	the designation of a measurement principle or a succinct description of a procedure for determining the value of the determinands listed in Annex I to this Directive;
Bathing Water Directive (76/160/EEC) and Proposal for Bathing Water (COM(94)36)	Bathing area	any place where Bathing Water is found. Where the daily average density of bathers is highest
	Bathing season	the period during which a large number of bathers can be expected, in the light of local custom, an any local rules which may exist concerning bathing and weather conditions.
	Bathing Water	all running or still fresh waters or parts thereof and sea water, in which:- bathing is explicitly authorised by the competent authorities of each Member State, or- bathing is not prohibited and is traditionally practised by a large number of bathers;
Dangerous Substances Directive (76/464/EEC)	waters	inland surface water, territorial waters, internal coastal waters, excluding groundwater
	fresh-water limit	the place in the watercourse where, at low tide and in a period of low fresh-water flow, there is an appreciable increase in salinity due to the presence of sea-water;
	inland surface water	all static or flowing fresh surface water situated in the territory of one or more Member States

Table F.1 continued

Directive	Term	Definition
Dangerous Substances Directive (76/464/EEC)	internal coastal waters	waters on the landward side of the base line from which the breadth of territorial waters is measured, extending, in the case of watercourses, up to the fresh-water limit;
	substances	those dangerous substances, belonging to the families and groups of substances appearing in List I in the Annex to Directive 76/464/EEC, which are specified in Annex II to this Directive;
Mercury Directives (82/176/EEC and 84/156/EEC)	waters	inland surface water, territorial waters, internal coastal waters, excluding groundwater
Cadmium Directive (83/513/EEC)	waters	inland surface water, territorial waters, internal coastal waters, excluding groundwater
Hexachlorocyclohexane Directive (84/491/EEC)	waters	inland surface water, territorial waters, internal coastal waters, excluding groundwater
Carbon Tetrachloride Directive (86/280/EEC)	waters	inland surface water, territorial waters, internal coastal waters, excluding groundwater
Aldrin Directive (88/347/EEC)	waters	inland surface water, territorial waters, internal coastal waters, excluding groundwater
1,2-Dichloroethane Directive (90/415/EEC)	waters	inland surface water, territorial waters, internal coastal waters, excluding groundwater
Freshwater Fish Directive (78/659/EEC)	cyprinid waters	waters which support or become capable of supporting fish belonging to the cyprinids (Cyprinidae), or other species such as pike (Esox lucius), perch (Perca fluviatilis) and eel (Anguilla anguilla).
	Fisheries designated waters	Fresh waters designated by the Member States as needing protection or improvement in order to support fish life:- running or standing fresh waters- not apply to waters in natural or artificial fish ponds used for intensive fish-farming.
	salmonid waters	waters which support or become capable of supporting fish belonging to species such as salmon (Salmo salar), trout (Salmo trutta), grayling (Thymallus thymallus) and whitefish (Coregonus),
Nitrates Directive (91/676/EEC)	eutrophication	the enrichment of water by nitrogen compounds, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned;
	freshwater	naturally occurring water having a low concentration of salts, which is often acceptable as suitable for abstraction and treatment to produce Drinking Water;
	groundwater	all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil;
	nitrogen compound	any nitrogen-containing substance except for gaseous molecular nitrogen;
	pollution	the discharge, directly or indirectly, of nitrogen compounds from agricultural sources into the aquatic environment, the results of which are such as to cause hazards to human health, harm to living resources and to aquatic ecosystems, damage to amenity

Table F.1 continued

Directive	Term	Definition
Nitrates Directive (91/676/EEC)	Vulnerable zones	surface freshwaters, in particular those used or intended for the abstraction of Drinking Water, contain or could contain more than 50 mg/l; groundwaters contain more than 50 mg/l nitrates or could contain more than 50 mg/l nitrates if action pursuant to a
Urban Waste Water Treatment Directive (91/271/EEC)	coastal waters	the waters outside the low-water line or the outer limit of an estuary.
	estuary	the transitional area at the mouth of a river between
	eutrophication	enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and
	Less Sensitive Areas	A marine water body if the discharge of waste water does not adversely affect the environment as a result of morphology, hydrology or specific hydraulic conditions which exist in that area.
	Sensitive areas	natural freshwater lakes, other freshwater bodies, estuaries and coastal
Groundwater Directive (80/68/EEC)	direct discharge	the introduction into groundwater of substances in lists I or II without percolation through the ground or subsoil;
	groundwater	all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil;
	indirect discharge	the introduction into groundwater of substances in lists I or II after percolation through the ground or subsoil;
Exchange of Information Decision (77/795/EEC as amended by 86/574/EEC)	sampling or measuring stations	the stations listed in Annex 77/795/EEC.
Titanium Dioxide (82/883/EEC)	sampling point	the point at which samples are taken
	environment affected	the water, the land surface and underground strata and the air in or into which waste from the Titanium Dioxide industry is discharged, dumped, stored, tipped or injected.
Proposed Ecological Quality Directive (COM(93)680)	Community surface waters	all surface waters within the territory of each Member States, together with their internal waters and territorial sea defined according to international law

Table F.1 continued

Directive	Term	Definition
Proposed Ecological Quality Directive (COM(93)680)	ecological water quality	overall expression of the structure and function of the biological community taking into account natural physiographic, geographical and climatic factors as well as physical and chemical conditions including those resulting from human activities. The aesthetic of the area should also be taken into account. It is determined by the state of the following elements: -dissolved oxygen; -concentrations of toxic or other harmful substances in water, -sediments and biota; -levels of disease in animal life including fish and in plant populations due to anthropogenic influence; -diversity of invertebrate communities; -diversity of aquatic plant communities; -diversity of fish population; -diversity of higher vertebrate community; -the structure and quality of the sediments and its ability to sustain the biological community in the ecosystem; -the riparian and coastal zones, including the biological community and the aesthetics of the site.
	good ecological quality	the quality which is suitable for the needs of the ecosystem, taking into account the need to maintain the capacity for self-purification, and which satisfied the following elements: -dissolved oxygen should allow survival and reproduction of indigenous animals; -concentrations of toxic or other harmful substances in water, sediments and biota should not go beyond levels which have been demonstrated to pose no threat to aquatic species and should not prevent the normal uses of the water body; -there should be no evidence of elevated levels of disease in animal life including fish and in plant populations due to anthropogenic influence;

Table F.1 continued

Directive	Term	Definition
Proposed Ecological Quality Directive (COM(93)680)	good ecological quality	-the diversity of invertebrate communities should resemble that of similar water bodies with insignificant anthropogenic disturbance. Key species/taxa normally associated with the undisturbed condition of the ecosystem should be present; -the diversity of aquatic plant communities should resemble that of similar water bodies with insignificant anthropic disturbance. Key species/taxa normally associated with the undisturbed condition of the ecosystem should be present. There should be no evidence of excessive macrophyte or algal growth due to elevated nutrient levels of anthropogenic origin; -the diversity of fish population should resemble that of similar water bodies with insignificant anthropic disturbance. Key species/taxa normally associated with the undisturbed condition of the ecosystem should be present. There should be no significant artificial hindrance to the passage of migratory fish; -higher vertebrate community should reflect that of similar water bodies with insignificant anthropogenic disturbance. Key species/taxa normally associated with the undisturbed condition of the ecosystem should be present; -sediment structure and quality of the sediments should allow the occurrence of biological communities typical of the region; -the status of riparian and coastal zones should in non-urban areas, reflect either the absence of any significant influence by human activity, or care for the preservation of the biological community and for the aesthetics of the site.
	high ecological quality	the quality inherent in a given ecosystem which is demonstrated not to be significantly influenced by human activities

Table F.2 International Obligations

Agreement	Term	Definition
Convention for the Protection of the Mediterranean Sea Against pollution 1976	Pollution	the introduction by man, directly or indirectly, of substances or energy into the marine environment resulting in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing, impairment of quality for use of sea water and reduction of amenities
PARCOM Convention 1992	Maritime area	internal waters and the territorial seas of the Contracting Parties, the sea beyond and adjacent to the territorial sea under the jurisdiction of the coastal state to the extent recognised by international law, and the high seas, including the bed of all those waters and its sub-soil, situated within the following limits: those parts of the Atlantic and Arctic Oceans and their dependent seas which lie north of 36° north latitude and between 42° west longitude and 51° east longitude, but excluding: 1. the Baltic Sea and the Belts lying to the south and east of lines drawn from Hasenore Head to Gniben Point, from Korshage to Spodsbjerg and from Gilbjerg Head to Kullen, 2. the Mediterranean Sea and its dependent seas as far as the point of intersection of the parallel of 36° north latitude and the meridian of 5°36' west longitude; 3. that part of the Atlantic Ocean north of 59° north latitude and between 44° west longitude and 42° west longitude.
	internal waters	waters on the landward side of the baselines from which the breadth of the territorial sea is measured, extending in the case of watercourses up to the freshwater limit.
	freshwater limit	the place in a watercourse where, at low tide and in a period of low freshwater flow, there is an appreciable increase in salinity due to the presence of seawater.
	pollution	the introduction by man, directly or indirectly, of substances or energy into the maritime area which results, or is likely to result, in hazards to human health, harm to living resources and marine ecosystems, damage to amenities or interference with other legitimate uses of the sea
	land-based sources	the point and diffuse sources on land from which substances or energy reach the maritime area by water, through the air, or directly from the coast. it includes sources associated with any deliberate disposal under the sea-bed made accessible from land by tunnel, pipeline or other means and sources associated with man-made structures placed, in the maritime area under the jurisdiction of a Contracting Party, other than for the purpose of offshore activities.

Table F.2 continued

Agreement	Term	Definition
Convention on the Protection and Use of Transboundary Watercourses and International Lakes 1992	transboundary waters	any surface or ground waters which mark, cross or are located on boundaries between two or more States; wherever transboundary waters flow directly into the sea, these transboundary waters end at a straight line across their respective mouths between points on the low water line or their banks;
	transboundary impact	any significant adverse effect on the environment resulting from change in the conditions of transboundary waters caused by a human activity, the physical origin of which is situated wholly or in part within an area under the jurisdiction of a Party, within an area under the jurisdiction of another Party. Such effects on the environment include effects of human health and safety, flora, fauna, soil, air, water, climate, landscape and historical monuments or other physical structures or the interaction among these factors; they also include effects on the cultural heritage or socio-economic conditions resulting from alterations to those factors;
	Riparian Parties	The Parties bordering the same transboundary waters
	hazardous substances	substances which are toxic, carcinogenic, mutagenic, teratogenic or bio-accumulative, especially when they are persistent;
Baltic Sea Area, 1992	Pollution	introduction by man, directly or indirectly, of substances or energy into the sea, including estuaries, which are liable to create hazards to human health, to harm living resources and marine ecosystems, to cause hindrance to legitimate uses of the sea including fishing, to impair the quality for use of sea water, and to lead to a reduction of amenities.

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