THE EC WATER FRAMEWORK DIRECTIVE AND ITS IMPLICATIONS FOR THE ENVIRONMENT AGENCY

DAVE FOSTER, ARAM WOOD AND MARTIN GRIFFITHS

(D. Foster - WFD Manager, A. Wood - WFD Business Co-ordinater and Dr M. Griffiths -Head of Water Quality, Environment Agency, Head Office, Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol, BS32 4UD, England.)
[Email: dave.foster@environment-agency.gov.uk]

Introduction

The bulk of the European Community's water policy legislation was developed in the mid 1970s and the early 1980s, followed by a second wave of Directives in the early 1990s. These existing Water Quality Directives address either specific substances, sources, uses or processes. This has been acknowledged as a piecemeal and inconsistent approach with differing and, sometimes, conflicting methods, definitions and aims. These problems have been compounded by the inconsistent implementation of the various directives throughout the EU. This unsatisfactory situation has been recognised for some time by both the Commission and the European Parliament and led to the proposal of the ill-fated Ecological Quality Directive [1]. One of the grounds for the rejection of the Ecological Quality Directive was that, although it filled a gap in terms of setting ecological, rather than chemical, targets, it did not provide any additional coherence to the mass of existing legislation. Thus it was finally acknowledged that a Framework Directive for Water was required, to parallel those for Air and Waste.

On 26 February 1997, the European Commission published a proposal for a "Council Directive establishing a Framework for Community Action in the field of water policy" [2], more commonly known as the Water Framework Directive (WFD). The proposed WFD is a major legislative initiative, which is intended to resolve the piecemeal approach to European water legislation that has developed since 1975. The significance of the proposal, its scope and the amount of work involved in successfully achieving its objectives, should not be underestimated.

Initial consideration of the proposed WFD by the European Parliament led to calls for further detail in the definition of the principal objectives in the Directive, and for incorporation of a revised Dangerous Substances provision. In the light of these demands the Commission made two additions to the initial proposal; the first in November 1997 proposed the

replacement of the Dangerous Substances Directive (76/464/EEC) and the second, in February 1998, provided a detailed specification of "good status", which is the fundamental objective for most waters under the proposed WFD. Thus the full Directive, including recitals, articles and annexes, now runs to about one hundred pages.

The Environment Agency welcomed the proposals from the Commission and supported the overall objective of establishing a coherent legislative framework for the protection and improvement of the water environment within the context of achieving sustainable development. Moreover, the Environment Agency believed that the proposed WFD represented a crucial step in ensuring an effective structure for the application of other Community measures, such as the Integrated Pollution Prevention and Control Directive [3].

Current status of the proposed WFD

The proposal is supported in principle by all three European institutions: the Commission, Council of Ministers and Parliament. Much effort has been expended by the three institutions to progress this dossier.

The proposed WFD reached "common position" in the Council of Ministers in October 1999, and had its second reading in the European Parliament in February 2000. Parliament proposed a significant number of amendments, a large number of which were not acceptable to the Council of Ministers. As the Amsterdam Treaty has now been ratified, the WFD will be adopted under the principle of codecision, giving the Parliament the effective right of veto. This has led to a series of "conciliation" meetings between the Parliament and Council of Ministers, which began formally at the end of May 2000.

The main areas of contention between Council and Parliament were as follows.

- The degree to which steps should be taken to eliminate the discharge of hazardous substances to the water environment (as required by the OSPAR declaration at Sintra in 1998).

- The issue of whether Member States will have to charge water users the full costs of providing and disposing of the water (this is a particularly contentious issue for southern Member States and Ireland).

- The degree of protection afforded to groundwaters (compared with the existing Groundwater Directive).

- The legal enforceability of the Directive.
- The overall environmental objectives to be applied (and the scope of the corresponding derogations).

The conciliation procedure has a fixed time-scale of six weeks, extendable to eight. A final "joint text" was negotiated by Council of Ministers and Parliament at the second conciliation meeting in mid July 2000. Following this both institutions have two months to accept or reject the compromise text. If one or other institution rejects the compromise text then the proposed WFD will not be adopted, and the Commission will then have to consider developing a new proposal, and starting the legislative process once again. If both institutions approve the compromise text then the WFD will be adopted, and after translation into all 15 languages of the Member States it will be published in the Official Journal of the EU, probably sometime in late 2000. [See the Editorial Preface on page 3].

Objectives and key **elements** of **the WFD**

The proposed WFD introduces an integrated and co-ordinated approach to, and represents an important step forward for, water management in Europe. It rationalises and updates existing water legislation by setting common EU-wide objectives for water.

Its key objectives, set out in Article 1 are to: prevent further deterioration and protect and enhance the status of aquatic ecosystems and associated wetlands; promote sustainable water consumption; contribute to mitigating the effects of floods and droughts.

The aim of the WFD is to take a holistic approach to water management, as water flows through a catchment from lakes, rivers and groundwaters towards estuaries and thence to the sea. Surface and groundwater are to be considered together, in both qualitative and quantitative terms.

The overriding aim of the WFD is to achieve "good surface water status" and "good groundwater status", and also to prevent deterioration in the quality of those waters that are already "good". The major change of approach in this WFD is that ecological quality is a key means by which surface waters, in particular, will be assessed against good status as well as the more traditional assessment of chemical quality.

There will be limited exceptions to, or derogations from, achieving these objectives. In particular bodies of water which are artificial in construction or where the physical structure has been irrevocably and heavily modified will be required to achieve a status of "good ecological potential". This

status is equivalent to achieving good status, given the constraints of the physical structure of the waterbody. Derogations from good status are also allowed in unforeseen or exceptional circumstances, such as floods or droughts. In these circumstances Member States must take "any practical means" to restore the waterbody to its previous status.

The Directive also provides for protection to higher standards through the designation of *Protected Areas,* for example for water supply, recreational waters, nutrient-sensitive waters, nature conservation or economically important aquatic species.

These improvements in water status are to be achieved through a system of analysis and planning based upon the river basin, called *River Basin Management Planning* (RBMP). RBMP is the key administrative mechanism identified in the proposal for the delivery of environmental objectives. This approach accords closely with the Environment Agency's established practice in England and Wales; in particular the current practice of catchment management planning will provide an excellent basis for developing the RBMPs required by the WFD. These RBMPs set out *Programmes of Measures* for achieving good status, and are to be subject to public consultation, thus introducing an element of social participation and transparency.

Economic considerations are also an important element of the WFD; Member States are required to take account of the principle of recovery of the costs of water services, and to make judgements about the most cost-effective combination of measures in respect of water use.

The Environment Agency has welcomed the proposal from the Commission (Article 10) to bring forward new provisions to regulate pollution from Dangerous Substances. These provisions include the establishment of a *Combined Approach,* which permits the use of both Environmental Quality Standards and fixed Emission Limit Values.

Once enacted the WFD will replace a number of the existing water quality Directives that form an important constituent of current UK water management practice and for which the Agency is a competent authority; for example those concerning Surface Water Abstraction [4], Freshwater Fisheries [5], Shellfish Waters [6], Groundwater [7], and Dangerous Substances [8]. The repeal of these existing European Directives and Decisions will be phased so as to ensure that at least the same level of protection is afforded to water quality.

Scope of **the WFD**

The provisions of the WFD will apply to all inland surface waters,

groundwaters, transitional water (including estuaries and coastal lagoons) and coastal waters (to one nautical mile from the baseline). The WFD prescribes an objective-based approach to drive improvements and maintain current status. An important benefit of these objectives is that they integrate water quality and water quantity issues for surface and groundwaters.

Surface water status

Surface water status is assessed using two components: ecological status and chemical (pollutant) status, considered below.

Chemical status of surface waters

Under the proposed WFD, European-wide Environmental Quality Standards (EQSs) will be set for a "priority list" of substances, which will have been chosen on the basis of the risk that they present to the aquatic environment. To achieve "good chemical status", these European EQSs must be met.

The "priority list"

The Dangerous Substances Directive [7] **will** be repealed under the WFD. However, similar provisions to those in the Dangerous Substances Directive are made in the WFD. These revised Dangerous Substances provisions will introduce the following.

- A *Combined Approach*, whereby there will be a requirement for Member States to apply both European-wide EQSs and Emission Timit Values, as opposed to the parallel approach under 76/464/EEC which left the choice with the Member State.

- A "de minimus" provision.

- A procedure for specification of the "priority list" to initially augment and then replace 76/464/EEC List 1 substances.

The initial proposals for the priority list have been derived for the Commission by the Fraunhofer Institute (Germany). The list is based on a simplified risk assessment, which is based on a combination of monitoring data, intrinsic properties of the substances, and use patterns (as assessed by modelling). This combined monitoring and modelling approach is referred to

as the COMMPs procedure. The proposals for an initial priority list were published by the Commission in February 2000 [9]. Once the initial list is approved by the Council of Ministers and Parliament, the Commission will then derive EU-wide standards and controls for those substances appearing on the list.

Ecological status of surface waters

The exact definition of ecological status is provided in Annex V of the WFD. It will be assessed by considering biological, hydromorphological and physico-chemical elements of quality.

Biological parameters

Natural ecological variability does not allow absolute biological standards to be established for implementation across the EU. It is proposed that biological quality should be judged on the basis of the degree of deviation of the observed conditions from those that would be expected in the absence of significant anthropogenic influence (i.e. high ecological status). The WFD includes procedures that will enable this point to be identified for a given body of water, and a system for ensuring comparability between the differing biological monitoring systems used within each Member State.

The biological elements for most of the waterbody types under consideration include aquatic flora (macrophytes and diatoms), macroinvertebrates and fish.

Hydromorphological parameters

The proposed WFD specifies that Member States must assess the hydrological and morphological condition of waterbodies. Although the WFD will not set standards for these elements as such, it will require Member States to monitor and manage the hydromorphological state of the waterbody in such a way as to ensure conditions consistent with the survival and reproduction of the biota associated with good biological quality.

Physico-chemical parameters

The physico-chemical aspects of ecological quality are divided into three parts (Table 1), each of which has a different approach to standards.

Table 1. Three main divisions of physico-chemical parameters listed by the WFD.

Division	Areas of concern	Standards
General	Temperature, oxygenation, salinity, nutrient status, acidification status	Set by Member State to protect biological conditions
Pollutants not on the "priority list"	Lower toxicity chemicals similar to List II substances under 76/464/EEC	Set according to EU-wide protocol specified in Annex V of the proposal
"Priority list" pollutants*	Higher toxicity chemicals similar to List I substances under 76/464/EEC	Set according to EU-wide protocol specified in Annex V of the proposal

*Priority list pollutants are primarily dealt with under the provisions for Chemical Status, rather than under this provision (physico-ecological aspects of ecological status). This provision requires Member States to set more stringent standards for priority list pollutants in specific circumstances where the EU standard would be sufficient to protect the ecology of the waterbody because of the high sensitivity of the constituent organisms to the pollutant control.

Groundwater status

Groundwater status is assessed by considering quantitative status and chemical (pollutant) status, as outlined below.

Quantitative status of groundwaters

Of the total annual recharge volume to a groundwater body a portion is needed to achieve the ecological quality objectives for connected surface waters or associated terrestrial systems such as wetlands. The WFD requires that only the volume over and above that required to sustain the surface ecology is available for abstraction.

Chemical status of groundwaters

As it is presumed that groundwaters are generally not polluted, the setting of EQSs for groundwaters would give the impression that there is a permitted level of pollution up to which Member States can allow polluting activities to continue. Therefore, a more precautionary approach is taken.

There is a prohibition on direct polluting discharges to groundwaters. In addition, there is a requirement to monitor groundwaters in order to detect changes in chemical composition of the groundwater. Any anthropogenically induced significant and sustained upward trend in a pollutant would have to be reversed.

[N.B. The requirements for chemical status of groundwater may change as a result of the conciliation process.]

Conservation requirements

The WFD's "no deterioration" provisions should prove beneficial for existing sites of high conservation value. Moreover, provisions exist to designate waters as "protected areas" in order to permit a higher level of protection for waters requiring a special level of attention. The level of benefit gained from this provision will depend on its interpretation by Member State administrations. As a minimum, *Special Protection Areas* (SPAs) under the Birds Directive [10], and *Special Areas of Conservation* (SACs) under the Habitats Directive [11] will require designation as *Protected Areas* under the WFD. The Directive also allows for, but does not require, the designation of other areas for the protection of habitats and species, e.g. SSSIs, where the maintenance or improvement of the status of water is an important factor in their protection.

Practical operation of the WFD - river basin management planning

One of the underpinning principles which the WFD adopts is that of *Integrated River Basin Management.* The WFD sets out arrangements for river basin administration and planning, based on, *inter alia,* common objectives for water status, and common monitoring and assessment strategies. The following sections look in more detail at the various components of integrated river basin management detailed in the WFD, and their implications for England and Wales.

River basin districts (RBDs)

The first activity which the WFD requires is that the Member States must identify and assign waterbodies to *River Basin Districts* (RBDs), based on hydrological catchments, with coastal and ground waters being assigned to the most appropriate district. Member States must then appoint a *Competent Authority* for each of the RBDs to co-ordinate the implementation of the WFD within it. One competent authority may act as

a co-ordinating body for other competent authorities, in which case some form of "river basin committee" might be envisaged to act as a focus for management of the basin. The competent authority is responsible for producing the *River Basin Management Plan* for that basin.

In England and Wales the Environment Agency has functions and geographical boundaries which are compatible with many of the WFD requirements. There would appear to be benefits in basing RBDs on the Agency's hydrological regional boundaries, which have been the basis for water management in England and Wales, with minor changes, since the 1973 Water Act [2]. This would result in about eight RBDs, based on the Agency's existing regions. Some further amendment to current boundaries might be necessary, for example to separate the Rivers Severn and Trent.

Recent moves towards devolution in the UK will also have an impact. For example the Rivers Severn, Wye and Dee cross the border between England and Wales, and the Tweed and rivers around the Solway Firth cross the border between England and Scotland. The need under the WFD to manage these rivers on hydrological rather than political boundaries will require additional co-operation between the constituent parts of the UK. In addition the move toward regionalisation within England, with the creation of Regional Development Agencies (RDAs) and Regional Chambers, may result in the Agency having operational boundaries based on alignment with the political boundaries of the RDAs whilst maintaining hydrological boundaries for the purposes of the WFD. The successful operation of such a duel approach will depend on the development of information systems which enable efficient management of geographically based information.

Although the Agency has many of the functions required by the WFD, and is thus likely to be a competent authority, it does not have jurisdiction over all of the areas covered by the WFD, and therefore co-ordination with a number of other bodies (some of whom may also become competent authorities) will be vital to successful implementation. Some areas where such co-operation will be important are set out in Table 2.

River basin management plans (RBMPs)

Once appointed, the competent authority will be responsible for the production of the RBMP for that basin. This is the main mechanism for achieving the WFD's environmental objectives within a river basin district and, as such, there is a wide range of requirements for what is contained in the RBMP.

- Characteristics of the river basin.

- Environmental monitoring data.
- Details of the impacts of human activity (e.g. point or diffuse pollution, abstractions, flood defence works).
- Analysis of the economic usage of water.
- Strategic plan for the achievement of "good status" - the *Programme of Measures.*

Table 2. Other bodies with important roles in the WFD.

Area of interest	Bodies involved
Land use planning	Local Authorities
Conservation	English Nature, CCW, Countryside Agency
Recreation	Countryside Agency, Sports Council, Local Authorities, British Waterways
Fisheries	MAFF, Sea Fisheries Commission
Water resources	Water Companies
Flood defence	MAFF, Local Authorities. Internal Drainage Boards
Navigation	British Waterways. Local Authorities, Port Authorities
Agriculture	MAFF, NFU
Forestry	Forestry Commission

The UK has carried out water management on a river basin planning basis for over twenty years, and during this time a number of different types of water management plans have been developed. Some examples of such plans are given in Table 3. One main difference between many of the existing plans, in particular *Local Environment Agency Plans* (LEAPs), and river basin management plans, is that the latter (and the programme of measures within them) will be statutory. It will therefore be important to obtain as much agreement as possible amongst all parties on whom the programme of measures will have an impact.

In implementing the WFD the relationship between existing water management plans and the RBMPs required by the WFD will need careful analysis to prevent duplication and to preserve elements of existing plans which are not required by the WFD. Box 1 provides a more detailed summary of LEAPs, which are the Agency's main current method of

setting out, and consulting on, its plans for environmental improvements in a local area.

Table 3. Existing water management plans in the UK.

Type of plan	Bodies involved	Purpose
Local Environment Agency Plans (LEAPs)	Agency and many others	Consultation on environmental improvements for a local area
Asset Management Plans (AMPs)	Water Companies, OFWAT, Agency	Setting out future Water Company investment and determining price limits
Catchment Abstraction Management Strategies (CAMS)	Agency, Water Companies	Sustainable use of water resources within a catchment
Shoreline Management Plans	MAFF, Maritime Local Authorities, Agency	Strategic planning for coastal defence
Coastal Zone Management Plans (CZMPs)	Local Authorities, Agency, others	Balancing flood defence needs with other coastal activities
Estuary Management Plans (a type of CZMP)	EN, CWW, Agency others	Links management of estuaries for conservation with other needs and users
Water Level Management Plans	Agency, EN	Balancing/integrating the water level requirements for a particular inland area
Habitats Directive: Management Scheme for European Marine Sites	EN, CCW, Agency, others	Management of marine Habitats Directive sites
Coastal Habitat Management Plans (CHaMPs)	Agency, EN, MAFF, DETR, Centre for Coastal & Marine Sciences, others	Balancing coastal defence needs and Conservation Objectives at Habitats Directive sites
Biodiversity Action Plans (incl. Habitat & Species Action Plans), Local Agenda 21 Plans	Many	Implementing Rio Convention and subsequent UK Biodiversity Action Plans - improving biodiversity

Box 1: Local Environment Agency Plans (LEAPs)

LEAPs set out the Environment Agency's view of the local environment and are used to involve interested parties and the local communities in planning for the future of the area, with the aim of agreeing a "vision" for the area which guides the Agency's activities over a period of 10 to 20 years. Specifically, the LEAP establishes an integrated plan of action for managing the local environment over a 5-year period. LEAPs offer an integrated catchment approach, whilst covering all mediums (land, air and water). About 130 have been produced, covering England and Wales, based primarily on hydrological catchment units. Each LEAP identifies the pressures within its geographical area and then sets out action plans to achieve environmental improvements. LEAPs undergo consultation with the public and key stakeholders, and are implemented on a local scale. However, they are not statutory and thus the actions set out within them are not binding, relying on a partnership approach with other stakeholders. With the advent of the WFD there is a need to consider what future role LEAPs will have in the river basin planning process. For example, currently they do not meet all of the WFD requirements (e.g., setting out of monitoring programmes). However, they do offer the opportunity for public consultation and to address issues at a local level.

Analysis of river basin characteristics

Having identified competent authorities, the WFD next requires that an analysis of the river basins should then be carried out by the authorities to determine the factors influencing both water quality and water quantity. These analyses would include an assessment of the inherent natural characteristics of each basin, the impact of human activity and the economic usage of water within the basin. The WFD also stipulates that a review of human activities in the river basin district will take place, including point and diffuse sources of pollution, water abstractions and other impacts such as hydromorphological alteration.

The first part of the basin analysis is to identify the location and boundaries of the surface waterbodies, and then to categorise them into rivers, lakes, transitional waters (estuaries) or coastal waters. Furthermore a decision must also be made as to which waterbodies are to be designated as artificial or heavily modified. Potentially this is a controversial process, as waterbodies so designated will have a target of "good ecological potential" rather than "good ecological status". There is likely to be an intense debate about the extent of such designations, and what "good ecological potential" means in practice for those waterbodies which are so designated. Box 2 provides more detail on the potential extent of such designations in the UK.

Box 2: Potential extent of artificial and heavily modified waterbodies*

Artificial waterbodies	*Heavily modified waterbodies*
Public water supply reservoirs: 448 in England & Wales (23,572 ha) Several are SPAs/SACs	Flood defence: (England/Wales) 64,000 km of fluvial flood defences 4700 km of tidal flood defences
Other reservoirs: 223 in England & Wales (3914 ha)	Land drainage/irrigation (Engl/Wales) 2000 impoundment licences 257 internal drainage boards
Navigation: Canals (2759 km) Mainly recreational	Abstraction: e.g. Inter-basin transfer – Ely Ouse Essex Scheme
	Navigation: e.g. Rivers Thames, Gt Ouse, Nene
	Hydroelectric schemes: Scotland – 1000 km of "dry rivers" 10–20% of land area affected by inter-basin transfers for hydroelectricity

*NB. The above information provides indicative information on the extent of artificial and heavily modified waterbodies and does not in any way represent proposals for designations under the WFD.

Having characterised the surface waterbodies into rivers, lakes, transitional waters or coastal waters, the next requirement is to discriminate the waterbodies into "types". Essentially this means dividing waterbodies on the basis of the physical and chemical factors that determine their characteristics, e.g. geology, climate/rainfall, and hence the biological population and structure.

Annex II of the WFD sets out two methods for determining the typology of surface waters. It is likely that the UK will use System B. Having derived a series of waterbody types it is then necessary to determine what the reference condition is for sites of high ecological status in all of these types. This will then provide a reference against which to judge good ecological status for all other waterbodies within the "type".

As well as characterising the surface waters within a river basin district, a similar task needs to be carried out for groundwaters. The main elements of such a characterisation are as follows.

- The location and boundaries of the groundwater bodies, and identification of the pressure to which they are subject.

- General characterisation of the overlying strata from which the groundwater receives its discharge.

- Identification of directly dependant surface water systems.

- More detailed information for those groundwaters at risk of failing to meet their environmental objectives, e.g. rates of exchange between the groundwater body and the associated surface water systems.

Impact of human activities

Having characterised the *River Basin District* the next task in the planning cycle is to carry out an analysis of the impact of human activity on the waterbodies within that district, and in particular the identification of the pressures that such activities might be causing. This analysis would need to include the impact of point-source pollution - e.g. sewage treatment work for which the Agency has extensive information - and diffuse pollution resulting from land use practice. The Agency is currently developing a series of models that assess the impact of land use on water quality, which will assist in this process. Other pressures might arise from the impact of abstractions or physical modifications. The River Habitat Survey [13] scheme, developed by the Agency, SEPA, DoENI (EHS) and others, provides an objective methodology for assessing the degree of modification to which a stretch of river has been subjected and the impact of this modification on the waterbody.

On the basis of the characterisation of the river basin, and the analysis of human impact outlined above, and in line with the criteria in the WFD, the river basin authorities are then required to establish the environmental objectives for each waterbody. For waters not subject to the derogation criteria the objectives are "good status" and to "prevent deterioration" of present status. For waters subject to the derogation criteria, interim environmental objectives and deadlines are set which are subject to review. As well as establishing reference conditions for each waterbody type, this will also involve defining good status, using framework provided in Annex V of the WFD. Given its fundamental importance to the WFD, the definition of "good status" is likely to be intensely scrutinised by a number of parties, from non-governmental organisations to representatives of industry and agriculture.

Having derived the environmental objective for each waterbody, the next task for competent authorities is to identify those waterbodies at risk of failing to meet these objectives, i.e. where in a river basin plan is good status not likely to be met? Since this analysis has to take place before monitoring programmes are put in place, essentially it will have to be carried out on a risk analysis basis. The WFD acknowledges this by allowing the analysis to consider characteristics such as natural variability in biological populations, and the natural vulnerability of a waterbody; e.g. groundwater vulnerability maps or information on areas of low flow. Provision is also made for the use of models or other assessment techniques; e.g. to link to effects of diffuse pollution on biological communities.

After the analysis of those waterbodies at risk of failing to meet their environmental objectives has been completed, the information is then to be used to design the monitoring programmes required by the WFD to determine whether or not the objectives are actually being met.

Monitoring

The first deadline in the WFD relating to monitoring is at the end of 2007 (assuming that the WFD is adopted by the end of 2000). By this date, the WFD requires that monitoring programmes have been defined by Member States, and are ready for commencement. The main objectives of such monitoring programmes are as follows.

- To provide a coherent and comprehensive overview of ecological and chemical status.
- To permit the classification of waterbodies into five classes of ecological status: high, good, moderate, poor and bad.
- To be based upon the characterisation and impact assessment carried out for the river basin district.
- To cover parameters which are indicative of the status of each relevant quality element.

Monitoring groundwaters

Member States are required to establish a groundwater monitoring network which will:

- provide a reliable assessment of quantitative status;
- provide a coherent and comprehensive overview of chemical status;
- enable detection of long-term anthropogenically induced upward trends in pollutants;
- support the establishment of both surveillance and operational monitoring programmes.

The UK has undertaken systematic observation of groundwater levels and quality since at least the 1950s; indeed, an archive of water level measurements, in some cases going back to the last century, is maintained by the British Geological Survey. Historically the network of groundwater monitoring points is based on, or around, abstraction boreholes, usually public supply wells. This reflects the fact that the main historical use of groundwater monitoring data has been in the management of public water supplies.

In recent years there have been developments aimed at producing a strategically based national groundwater monitoring network [14, 15], and the Agency is currently developing a national groundwater monitoring strategy. One of its specific aims is to meet the requirements of European legislation, in particular the Water Framework Directive and Nitrates Directive [16], as well as providing relevant information for the European Environment Agency.

Monitoring surface waters

For surface waters three types of monitoring are defined: surveillance, operational and investigative. *Surveillance monitoring* is required to be carried out for one year in six, with the aim of validating the impact assessment, assessing long-term changes in the river basin district, and providing information to inform the design of operational monitoring programmes. *Operational monitoring* is required to be carried out for five years in five, with the aim of establishing the actual status of those waterbodies identified as representing a risk of failure to meet their environmental objectives, and assessing the effectiveness of the programme of measures. *Investigative monitoring* is to be carried out as required, where the reasons for a failure of the WFD's environmental objectives are unknown or to ascertain the impacts of accidental pollution.

The monitoring of a variety of biological elements is required by the WFD to enable (along with physico-chemical and hydromorphological elements) an overall assessment of ecological status to be made for each

surface waterbody. Amongst the biological elements for which monitoring is specified, is the composition and abundance of benthic invertebrate fauna and aquatic flora (phytoplankton, phytobenthos and macrophytes), along with the composition, abundance and age structure of fish fauna. Not all waterbody types have to be monitored for all biological elements; for instance, fish fauna is excluded from coastal waters. The following sections consider the current monitoring carried out by the Agency for different biological elements and surface waterbody types, and considers how well these meet the WFD's requirements for reference-based classification.

Monitoring invertebrates

England and Wales have used benthic macroinvertebrates to provide a biological classification of river quality for several years. The Agency's current classification, the General Quality Assessment (GQA), is based on the River In Verterbrate Prediction and Classification Scheme (RIVPACS) [17, 18], originally developed by the Freshwater Biological Association and the Institute of Freshwater Ecology (CEH). The system is reference-based as required by the WFD, i.e. the community found by sampling a particular site is compared with the community that is expected to be present, based on prediction from reference sites of similar physical and habitat properties. Each site is given an Ecological Quality Index (EQI), which is the Observed Score (from the monitoring site) divided by the Expected Score (from the reference sites). This system enables the rivers of England and Wales to be classified in biological terms by using six classes, rather than the five required by the WFD. Future developments include the development of biological quality objectives which will be expressed as biological targets, as required by the WFD.

Other aquatic media (lakes, transitional waters and coastal waters) are not currently subject to a comprehensive classification scheme for benthic invertebrates.

Monitoring aquatic flora

Classification schemes exist for macrophytes in rivers and in lakes. Both schemes are based around the tolerances of plants to differing nutrient concentrations. For rivers the Mean Trophic Rank [19] was developed, originally for assessing the impact of large sewage treatment works (STWs) on potential Sensitive Areas under the Urban Waste Water Treatment Directive. For lakes a similar approach, the Trophic Ranking System [20], has been developed for conservation purposes and applied

across Great Britain. However, neither system is reference-based, as required by the WFD, although initial work has begun on developing a reference-based classification scheme for macrophytes in rivers [21; also see Palmer, this volume, pages 82-90]. Similarly, a classification scheme for diatoms in rivers has been developed, the Trophic Diatom Index [22], based on tolerance or otherwise of varying nutrient concentrations. This scheme has been less widely applied and also is not reference-based.

Monitoring phytoplankton is carried out to varying degrees in all aquatic media, but there is no national classification scheme, reference-based or otherwise. However, models are available for lakes that will predict the type of phytoplankton community which would be expected, given a particular set of physical and physico-chemical variables. Such models might lend themselves to further development to meet the needs of the WFD.

Monitoring fish

Although the Agency carries out extensive monitoring in fresh waters, to support its fisheries duties, the majority of this monitoring is carried out for purposes of fisheries management, e.g. estimating biomass, rather than for the purposes of assessing the ecological quality (species composition and abundance) as required by the WFD. However, the Agency is currently reviewing its fisheries monitoring programmes, and in doing so is taking the development of the WFD into account.

Monitoring lakes

The Agency has developed a classification scheme for lakes [23], which is reference-based, using a hindcasting approach (i.e. a temporal rather than spatial reference). The system classifies lakes on the basis of the impacts of nutrients and acidification, and uses chemical parameters, although work to incorporate the use of macrophytes is being considered. Although the scheme's developmental stages are complete it has yet to be fully implemented in England and Wales, though a similar scheme has been more fully implemented in Scotland.

For small lakes and ponds a different, biologically-based, assessment protocol (Predictive SYstem for Multimetrics; PSYM [24]) has been developed by the Agency and Pond Life (now the Research & Policy Division of The Ponds Conservation Trust). The scheme has the advantage of using a variety of biological elements, i.e. it is multimetric. However, its suitability for the WFD may depend on what, if any, cut-off criterion for size is used to include lakes within the WFD's requirements.

Monitoring transitional and coastal waters

Currently there is relatively little monitoring of transitional and coastal waters in England and Wales. What monitoring there is tends to be mainly chemical, rather than biological, and is often for the purposes of other EC Directives, e.g. Bathing Water [25], Shellfish Water [6], Dangerous Substances [8]. For classification purposes, England and Wales use the National Water Council's Coastal & Estuary Working Party system [26] on a five-yearly basis. However, this system is relatively old, mainly chemical, somewhat subjective and not reference-based. The Agency and English Nature have recently carried out research into the impacts of nutrients in estuaries [27]. This research proposed a screening tool to enable development of a risk classification for estuaries, based on their susceptibility to enhanced nutrient concentrations and also the idea of ecological quality objectives as targets to enable management of estuaries with respect to nutrient impacts. However, it is clear that in common with many other Member States, England and Wales will need to develop new classification systems for transitional and coastal waters to meet the requirements of the WFD.

Physico-chemical and hydromorphological parameters

As well as the biological elements of ecological quality, the WFD also requires provision of information on physico-chemical and hydromorphological parameters. For the physico-chemical parameters this includes temperature, nutrients, salinity, oxygenation conditions, transparency and specific pollutants. Physico-chemical parameters have been used for some time to classify rivers and estuaries in England and Wales. This development of a nationally consistent classification was made possible, in particular, with the introduction of National Water Council classification schemes in 1980 [26, 28, 29]. The Environment Agency currently has a well developed monitoring network in rivers for physico-chemical parameters, which is uses for the purposes of both classification via the General Quality Assessment [30] (oxygenation conditions, nutrients) and objective setting via River Quality Objectives [31] (oxygenation conditions and specific pollutants). These systems, and the information that they provide on physico-chemcial quality , have been used as the basis for identifying a significant amount of investment in improving point-source discharges over the period 2000 to 2005 [32]. Equivalent systems do not currently exist for lakes or transitional/coastal waters.

For hydromorphology the requirements vary depending on the type of waterbody, summarised below.

- Rivers: flow, connection to groundwater bodies, river continuity and morphology.
- Lakes: residence time, connection to groundwater bodies, lake morphology.
- Transitional and coastal waters: morphology and tidal regime.

As stated earlier [13] the Agency and other UK regulators have developed the River Habitat Survey scheme which provides a hydromorphological assessment of rivers, but currently not other types of waterbody.

One of the most important issues for implementation of the WFD will be understanding the relationship between the different elements (biology, physico-chemical and hydromorphology) which together make up ecological quality.

In summary, the WFD will considerably increase the scope of environmental monitoring. However, given the current constraints on resources under which many environmental bodies are working, the net increase in monitoring attributable to the WFD may not be as large as might initially be expected. Rather, there may be a refocusing of existing monitoring, with a greater emphasis on the biological rather than chemical elements, although both are obviously fundamental to the WFD. It seems that most aquatic media will require the development of some new, reference-based classification schemes, with lakes and transitional/coastal waters needing the most development.

Programme of measures

Having carried out monitoring to determine the status of the waterbodies within a river basin district, competent authorities must then use this information in developing an integrated *Programme of Measures* to meet the WFD's environmental objectives, in particular that of "good water status" within the basin. These will be made up of compulsory basic measures which include, *inter alia,* meeting the requirements of other relevant Directives* and the licensing of discharges and abstraction, and where necessary complemented by supplementary measures if the basic measures are not sufficient to meet the environmental objectives. Supplementary measures are set out in an Annex to the WFD as a non-exhaustive list of potential initiatives for improving water status, ranging from economic instruments to negotiated agreements, rehabilitation projects and R&D.

As stated earlier, the programme of measures and other detailed information regarding the river basin will be packaged and presented in a document called a river basin management plan. These plans will be subject to a period of public consultation.

River basin management takes place on a 6-year cycle, with the first plan published 10 years after adoption of the WFD, and reviewed and updated every six years thereafter to take account of further measures needed to meet the WFD environmental objectives for any particular waterbody.

Timetable for implementation of the WFD

The final timetable for implementation, and indeed the exact requirements of the WFD, will depend on the outcome of the conciliation process between the European Parliament and the Council of Ministers. The following outline is based on the Common Position text (October 1999) and assumes adoption of the WFD by the end of 2000.

- Define basins; appoint competent authorities (End 2003).
- Analyse basins; review impact of human activity (End 2005).
- Commence monitoring programmes (End 2007).
- State issues and objectives for RBMP (End 2008).
- Derive a programme of measures; consult on draft RBMP (End 2009).
- Plan enacted (End 2010-End 2013).
- Plan reviewed (End 2014 - End 2016).
- Initial deadline for meeting environmental objectives (End 2016).

Despite what might at first glance seem a lengthy deadline for meeting the environmental objectives (End 2016), the earlier part of this paper, detailing exactly what is required in the river basin management planning process, should indicate that the timescale set out in the WFD is challenging and will require considerable effort over a long period of time to achieve. The earlier the process of implementation begins the better.

Role of the Environment Agency

The Agency has been strongly supportive of the principles underlying the WFD since it was first proposed. It has been heavily involved in the development of the WFD text, in the role of technical adviser to the Department of Environment, Trade and Industry (DETR) (particularly during the UK presidency of the EU) and in providing detailed comments to the former rapporteur to the European Parliament Environment Committee.

The Agency has also been actively discussing the implications of the WFD with other European Regulators, in particular through a series of joint workshops with the German Lander Working Group on Water (LAWA) and a joint R&D project with the French Agences de l'Eau [39]. In addition the UK and German Working Groups are jointly managing a pan-European R&D project, looking at implications of the designation of waterbodies as artificial or heavily modified.

As well as developing links with European regulators the Agency has been involved in extensive discussions with UK regulators about issues of implementation, in particular the Scottish Environmental Protection Agency (SEPA), Department of the Environment Northern Ireland (DoENI; EHS), the countryside agencies and British Waterways.

A small project team is being set up within the Agency to look at the implications of the WFD on the organisation. This team will include a full time R&D manager to ensure that the Agency is commissioning the necessary research needed to enable effective implementation, and is developing appropriate links to other relevant UK and European research.

Conclusions

There can be little doubt that when adopted the Water Framework Directive will represent a major step forward for water management. In particular it should be recognised that the WFD will:

- apply to all waters;
- utilise ecological (biology, hydromorphology and physico-chemistry) and chemical standards and objectives;
- integrate the consideration of groundwater and surface water;
- involve the public in management of river basins;
- require the use of river basin management planning throughout Europe.

In many respects the UK already utilises the basic principles and philosophies set out in the WFD. Much progress in water quality improvement has been made by the UK over the past 10 years, particularly the contributions made by investment programmes of the water industry. For the future the UK Government has recognised the importance of the relationship between the WFD and the targeting of Water Industry investment to contribute to maintaining and improving ecological quality.

Although the WFD has yet to reach final adoption, many practitioners are beginning to assess the developments that will need to be made in our technical knowledge in order to ensure full implementation. There can be no doubt that there is much to be done. However, it is crucial that even if current techniques are less than perfect, the UK must take implementation of this WFD forward as early as possible in order to reap the many benefits that it promises.

Acknowledgement

The authors would like to thank the Environment Agency for permission to publish this paper, and wish to point out that views expressed in it are personal ones and do not necessarily represent Agency policy.

References

[1]. Commission of the European Communities. *Proposal for a Council Directive on the ecological quality of water.* COM(93)680 final.

[2]. Commission of the European Communities. *Proposal for a Council Directive establishing a framework for Community action in the field of water policy.* 97/0049/COM, 97/0614/COM, 98/0076/COM, 1997/1998.

[3]. Council of the European Communities. *Directive concerning integrated pollution prevention and control* (96/61 /EEC).

[4]. Council of the European Communities. *Directive concerning the quality of surface waters intended for the abstraction of drinking water* (75/440/EEC).

[5]. Council of the European Communities. *Directive concerning the quality of fresh waters needing protection or improvement in order to support fish life* (78/659/EEC).

[6]. Council of the European Communities. *Directive on the quality required of shellfish waters* (79/923/EEC).

[7]. Council of the European Communities. *Directive concerning the protection of groundwater against pollution caused by certain*

[8]. Council of the European Communities. *Directive concerning pollution caused by dangerous substances discharged into the aquatic environment* (76/464/EEC).

[9]. Commission of the European Communities. *Proposal for a European Parliament and Council decision establishing the list of priority substances in the field of water policy.* COM(2000)47 final. 2000.

[10]. Council of the European Communities. *Directive on the conservation of wild birds* (79/409/EEC).

[11]. Council of the European Communities. *Directive on the conservation of natural habitats and of wild fauna and flora.* (92/43/EEC).

[12]. Water Act 1973. Chapter 37.

[13]. Raven, P. J. et al. (1998). *River habitat survey report No. 2 - The physical character of rivers and streams in the UK and Isle of Man.* Environment Agency.

[14]. National Rivers Authority (1994a). *Groundwater quality assessment: a national strategy for the NRA.* NRA R&D Technical Report WD/94/40C, National Rivers Authority, Bristol.

[15]. National Rivers Authority (1994b). *National groundwater levels monitoring network review.* NRA R&D Technical Report WD/94/41C, National Rivers Authority, Bristol.

[16]. Council of the European Communities. *Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources.* (91/676/EEC).

[17]. Wright, J. F., Furse, M. T. & Armitage, P. D. (1993). RIVPACS - A technique for evaluating the biological quality of rivers in the UK. *European Water Pollution Control* 3, 5-25.

[18]. Wright, J. F., Sutcliffe, D. W. & Furse, M. T. (2000). *Assessing the biological quality of fresh waters: RIVPACS and other techniques.* Freshwater Biological Association, Ambleside, xxiv + 373 pp.

[19]. Environment Agency (1999). *Assessment of the trophic status of rivers using macrophytes: evaluation of the mean trophic rank.* R&D Technical Report E39, Environment Agency, Bristol.

[20]. Palmer, M. A., Bell, S. L & Buttefield, I. (1992). A botanical classification of standing waters in Britain: Applications for conservation and monitoring. *Aquatic Conservation: Marine & Freshwater Ecosystems,* 2, 125-143.

[21]. Environment Agency (2000). *PLANTPACKS (phase 1): A study into the feasibility of producing a predicative system to assess river water quality and ecological status using macrophytes.* R&D Project Record Wl/017/01, Environment Agency, Bristol.

[22]. Environment Agency (1996). *The trophic diatom index: a user's guide.* R&D Technical Report E2, Environment Agency, Bristol.

[23]. Environment Agency (2000). *Trial lake classification of lake water quality in England and Wales: a proposed approach.* R&D Technical Report E53, Environment Agency, Bristol.
[24]. Environment Agency (2000). *Biological techniques for Stillwater quality assessment (Phase 3).* R&D Technical Report El 10, Environment Agency, Bristol.
[25]. Council of the European Communities. *Directive concerning quality of bathing waters.* (76/160/EEC).
[26].National Water Council (1981). *River quality - the 1980 survey and future outlook.* NWC, London. ISBN 0 901090 36 0.
[27]. Environment Agency (2000). *Sources and impacts of nutrients in estuaries.* R&D Technical Report P269, Environment Agency, Bristol.
[28]. Department of the Environment/Welsh Office (1986). *River quality in England and Wales 1985: a report of the 1985 survey.* HMSO, London. ISBN 0 117519 14 6.
[29]. NRA (1991). *The quality of rivers, canals and estuaries in England and Wales: report of the 1990 Survey.* Water Quality Series No.4. National Rivers Authority, Bristol.
[30]. Environment Agency (1997). *The quality of rivers and canals in England and Wales 1995.* Environment Agency, Bristol.
[31]. *Surface waters (river ecosystem) (classification) regulations 1994.* SI No. 1057, ISBN 0 110440 57 9.
[32]. Environment Agency (2000). *Achieving the quality: the Environment Agency's view of the benefits to the environment of water company investment over the next five years.* Environment Agency, Bristol.
[33]. Council of the European Communities. *Directive relating to the quality of water intended for human consumption.* (890/778/EEC).
[34]. Council of the European Communities. *Directive on the control of major-accident hazards involving dangerous substances.* (96/82/EEC).
[35]. Council of the European Communities. *Directive on the assessment of the effects of certain public and private projects on the environment.* (85/337/EEC).
[36]. Council of the European Communities. *Directive on the protection of the environment and in particular of the soil, when sewage sludge is used in agriculture.* (86/278/EEC).
[37]. Council of the European Communities. *Directive concerning urban waste water treatment.* (91/271 /EEC).
[38]. Council of the European Communities. *Directive concerning the placing of plant protection products on the market.* (91/414/EEC).
[39]. WRC (1998). *Comparability of ecological quality assessments in the UK and France in relation to the reporting of ecological quality under the proposed EU Water Framework Directive* (WRC Ref: CO 4621).