COMMON IMPLEMENTATION STRATEGY FOR THE WATER FRAMEWORK DIRECTIVE

TOWARDS A GUIDANCE DOCUMENT ON EUTROPHICATION ASSESSMENT IN THE CONTEXT OF EUROPEAN WATER POLICIES

INTERIM DOCUMENT

Note: The publication of this interim document was endorsed at the Water Directors' meeting on 28 November 2005 in London. The document should be regarded as presenting an informal consensus agreed by all partners. However, the document does not necessarily represent the official, formal position of any of the partners.

FOREWORD

In their meeting in June 2004 in Dublin, the Water Directors agreed to start an activity on eutrophication assessment under the CIS process. The objective of the activity was to develop a guidance document focussed in particular on harmonisation of assessment methods and criteria across European water policy.

The interim version of the guidance document has been presented to the Water Directors in their meeting in London in November 2005 after an extensive and fruitful consultation. It was generally recognised that the document provides already useful guidance both on technical and on policy relevant concepts. The main issues addressed in the interim document are a unified conceptual framework to understand eutrophication in all water categories, a conceptual read across EU directives (mainly Water Framework, Urban Wastewater and Nitrates Directives) and international policies (e.g. OSPAR) addressing eutrophication and a more-in-depth understanding of eutrophication in the context of WFD ecological status assessment.

A Workshop was held in Brussels in September 2005 in order to compile information on current assessment methods and criteria to serve as a basis for the chapter on harmonisation. As a conclusion of this event, it was recognised that some on-going activities will have a strong impact on the way eutrophication is assessed, in particular the intercalibration exercise and some of the projects lead by the Marine Conventions. Therefore, any attempt to harmonise eutrophication classification criteria should be informed by these on-going projects, in order to avoid any duplication of efforts.

On the other hand, the theoretical read across directives proposed in section 3.6 will need to be checked whether it is workable in practice. Guidance on how to apply the concepts of the Classification Guidance document in the context of eutrophication will be also very helpful. Particularly valuable for these developments will be the case studies which are now only outlined in Chapter 8 and will be developed in the first half of 2006.

Moreover, the current version of the document is very valuable and should be circulated widely to spread its findings and to benefit from discussions and inputs from inside and outside the WFD Common Implementation Strategy process.

For these reasons, the Water Directors have decided to update and complement the entire document when the outcome of the on-going processes and projects is available and the wider discussions indicated the applicability of the proposed approaches in practice.

To this end, the Steering Group will continue its work under the mandate of the activity with the objective of monitoring the on-going activities mentioned above and prepare a short policy summary of the document to be presented to the Strategic Coordination Group. The Steering Group will also prepare a proposal for the Water Directors meeting in Finland (December 2006) on how best to continue the activity forward taking into account in particular the issues identified in Chapter 6.

November 2005

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1. INTRODUCTION

1.1. Scope of the activity

1. European policy has consistently identified eutrophication as a priority issue for water protection. Substantial progress has been made in combating eutrophication but there remain several areas where co-ordination is necessary to achieve a harmonised result for different policy areas, in particular:

- the harmonisation of assessment methodologies and criteria for agreed eutrophication elements/ parameters/ indicators for rivers, lakes, transitional, coastal and marine waters;
- the use of type-specific objectives for biological and general physico-chemical elements;
- the co-ordination of monitoring and reporting;
- the harmonisation of models for assessing or predicting anthropogenic or natural nutrient loading into inland and marine waters based on nutrient sources information or nutrient sources scenarios (e.g. EUROHARP models);
- the systematic identification of sources of nutrients and possible rehabilitation procedures for water bodies;

2. Thus an activity was initiated under the Common Implementation Strategy of the Water Framework Directive and the European Marine Strategy to provide guidance on the first three points. Therefore it serves as a guidance document for the common assessment and monitoring of eutrophication across different European policies.

3. On the other issues, work may be started subsequently following the finalisation of this guidance. This may also include work related to:

- developing and harmonising cause-effect models linking nutrient loading to ecological impact in different water body types and categories.
- identifying the most cost-effective measures to tackle problems induced by nutrient enrichment.

4. There is a general agreement that this activity has to be firmly based on the methodological concept of the WFD and to explore thereafter to what extent this methodology can be used in the context of other directives and policies. The final outcome of this activity should be guidance for the purpose of the implementation of the above-mentioned policies. It can also be used as input for the preparation of the River Basin Management Plans.

1.2. Understanding and policy context of eutrophication

5. Nutrients in the appropriate amounts (i.e. background levels) are essential to maintain an adequate primary productivity, which in turn is essential to support all the other trophic levels in the ecosystem, i.e. to maintain a healthy structure and functioning. In general, excessive nutrients of anthropogenic origin cause an increase in plant growth, which in still waters causes increased phytoplankton biomass, often dominated by harmful or toxic species. In rivers this may be seen as increased attached algal growth or even excessive growth of higher plants. As a consequence, there is an imbalance between the processes of plant/algal production and consumption, followed by sedimentation of organic matter, stimulation of microbial decomposition and oxygen consumption with depletion of bottom-water oxygen in stratified water bodies.[1] Thus, eutrophication causes not only nuisance increases in plant growth but also adverse changes in species diversity as well as reduced suitability for human use and consumption.

6. In 1995 the European Environment Agency (EEA) report "Europe's Environment: the Dobris assessment" identified eutrophication of inland and marine waters as a European wide problem of major concern. Most recent, the EEA (2003) report "Europe's water: An indicator-based assessment" reported that progress was achieved in improving water quality and quantity particularly in the European Union but many of Europe’s rivers, lakes, estuaries and coastal waters are still impacted by human activities leading it to eutrophication.

7. It should be emphasised that aquatic systems cover a span of background fertility, depending on their catchment geology, giving rise to conditions described as oligotrophic through mesotrophic to eutrophic. However, eutrophication is widely used to refer to the undesirable effects of anthropogenic increases in nutrient loads to aquatic ecosystems. The guidance only considers anthropogenic eutrophication, i.e., resulting from nutrient enrichment caused by human activities. Further details on concept and definitions are provided in Chapter 3.

8. In case of dealing with artificial or heavily modified water bodies, all references made in the document to ecological status should be construed as references to ecological potential.

1.3. Structure of the document

9. This document compares how eutrophication is understood, defined and assessed in different EC directives and other policies and develops a conceptual representation of eutrophication, presenting a generic conceptual framework for the assessment of eutrophication. The conceptual framework attempts to extend existing cause-effect relationships to all marine and freshwater ecosystems. All references to ecological status should be understood as references to ecological potential for artificial and heavily modified water bodies.

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[1] Deep water anoxia/hypoxia can also be a purely natural phenomena in permanently stratified water bodies

10. The document is structured in two parts. The following chapters deal with the development of a common understanding of the process involved in eutrophication from a technical and scientific point of view (Chapter 2) and with the consideration of different policies that address eutrophication (Chapter 3). This first part finishes with a description on the WFD concept of ecological status in the context of impacts caused by nutrient enrichment (Chapter 4).

11. The second part of the guidance includes chapters on eutrophication assessment methods and criteria (Chapter 5), the harmonisation of classification criteria (Chapter 6), the co-ordination of monitoring requirements stemming from different policies and obligations (Chapter 7), case studies (Chapter 8) and the links of eutrophication assessment with pressure and impact analysis and programme of measures (Chapter 9).

2. OVERALL CONCEPTUAL FRAMEWORK FOR THE ASSESSMENT OF EUTROPHICATION

2.1. The need, requirements and principles of a common conceptual framework

12. A fundamental aspect of defining a common monitoring and assessment guideline for the eutrophication process is identifying a common conceptual framework that can be adapted for specific water categories. Such a common starting point should capture the commonalities in the process and manifestations of eutrophication in different water categories, and should also provide the means of linking the “process” of eutrophication (i.e. a rate process) to the requirements of the WFD for assessing the Ecological Status of all surface water bodies.

13. In addition, a common generic conceptual framework valid across all surface water categories would provide a suitable means for developing category-specific check-lists as a basis for the classification assessment and for specifying monitoring requirements (see Figure 1).

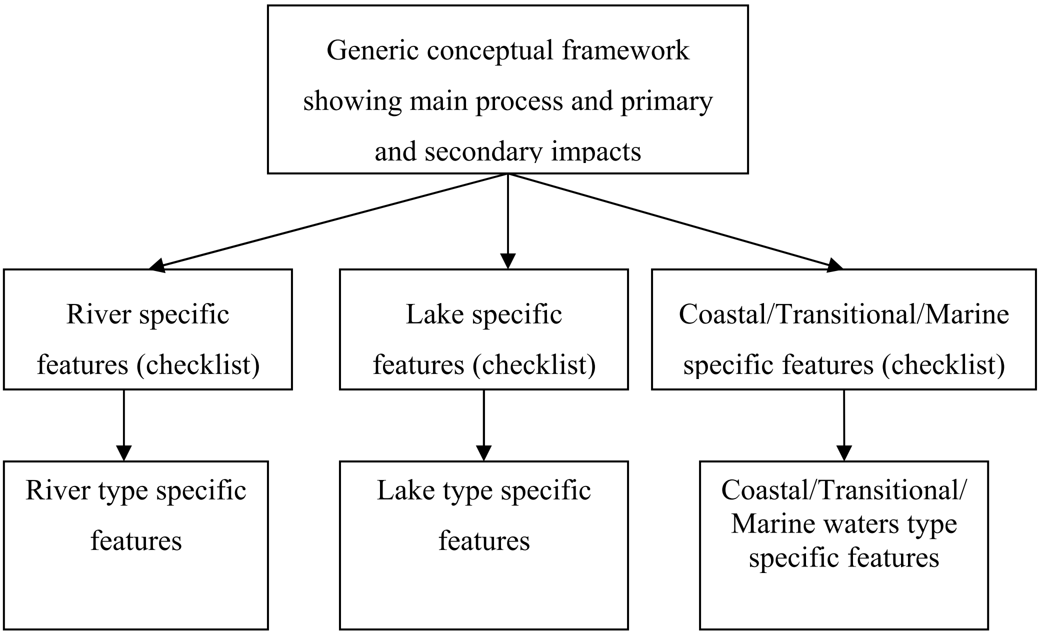

Figure 1. Schematic representation for using a conceptual framework to assess eutrophication across different aquatic environments.

14. Assessing eutrophication in specific water body categories and types will be likely to involve different category and perhaps type specific monitoring requirements. The implementation activities of the WFD have already addressed monitoring needs to a certain degree (e.g. Monitoring guidance, COAST guidance document); however the spatial and temporal monitoring requirements tend to differ for variables when we focus specifically on eutrophication issues and consider the requirements for specific water types (e.g. to capture the necessary seasonality in nutrients, chlorophyll and oxygen). Specific monitoring requirements for eutrophication are addressed in Chapter 7.

15. A common "all encompassing" conceptual framework should be able to represent generic aspects of eutrophication which are common in different aquatic environments, but also be detailed enough to be useful for deriving the aspects which are specific to individual water categories and regions. Aspects of the process that may be common to all aquatic environments should include:

- Nutrient enrichment;
- Enhanced primary production/biomass;
- Algal blooms;
- Changes to taxonomic composition of algae/ plants;
- Effects on light climate and hence on other biota;
- Increased fixation of carbon;
- Decreased/increased oxygen levels, possible anoxia and consequent effects on biota;

- Reduced diversity of benthic fauna;

2.2. Description of the conceptual eutrophication framework

16. There are numerous models of the eutrophication process: both in the scientific literature and in policy implementation documentation. Briefly, a commonality between the different approaches is that they link the cause (i.e. nutrients) and effect (e.g. excessive algal growth) of the eutrophication process. This overarching link has been long implemented in classification activities using regression models based on water body mass balance and algae element ratios, particularly in freshwaters (e.g. OECD, 1982; Vollenweider, 1976).[2] However it is now well known that manifestations of the eutrophication process may be much more subtle and non-linear in their occurrence (see Cloern 2001 for review). Regression between nutrients and biomass for example may not be applicable in all aquatic environments and will not reproduce all of the aspects of a particular water body. Regression models therefore may not always be expected to be used for classification of water bodies showing non-linear response patterns along the eutrophication gradient. In this perspective a more comprehensive approach to classification is required, that accounts for the different non-linear relationships and the different intrinsic manifestation of eutrophication.

17. An example of such an approach is the OSPAR Comprehensive Procedure, described in Annex 1, section 2.1. This procedure was developed based on a common conceptual framework of eutrophication.

18. Based upon the OSPAR conceptual framework, and taking into account discussions at:

- Joint Workshop on Marine Assessment and Monitoring with emphasis on eutrophication. JRC, Black Sea Commission and Helsinki Commission (Istanbul, Turkey, 21-22 April 2004);
- Eutrophication Workshop on a Common Assessment Methodology. JRC (Ispra, 14-15 September 2004)

the common conceptual framework of eutrophication presented in **Figure 2** was developed. This diagram represents the eutrophication process and the ecological impacts which may arise for the purpose of guiding eutrophication assessment. It does not extend to (use-related) impacts upon man, either directly or indirectly, which is part of what constitutes an undesirable disturbance. Round boxes indicate quality elements in WFD.

2 The statistical variability in such models may be too large to obtain a precise classification of single water bodies, because they are not sufficiently type-specific. The REBECCA-project is investigating the potential for improving such models by restricting the datasets used for a regression to data from single water body types.

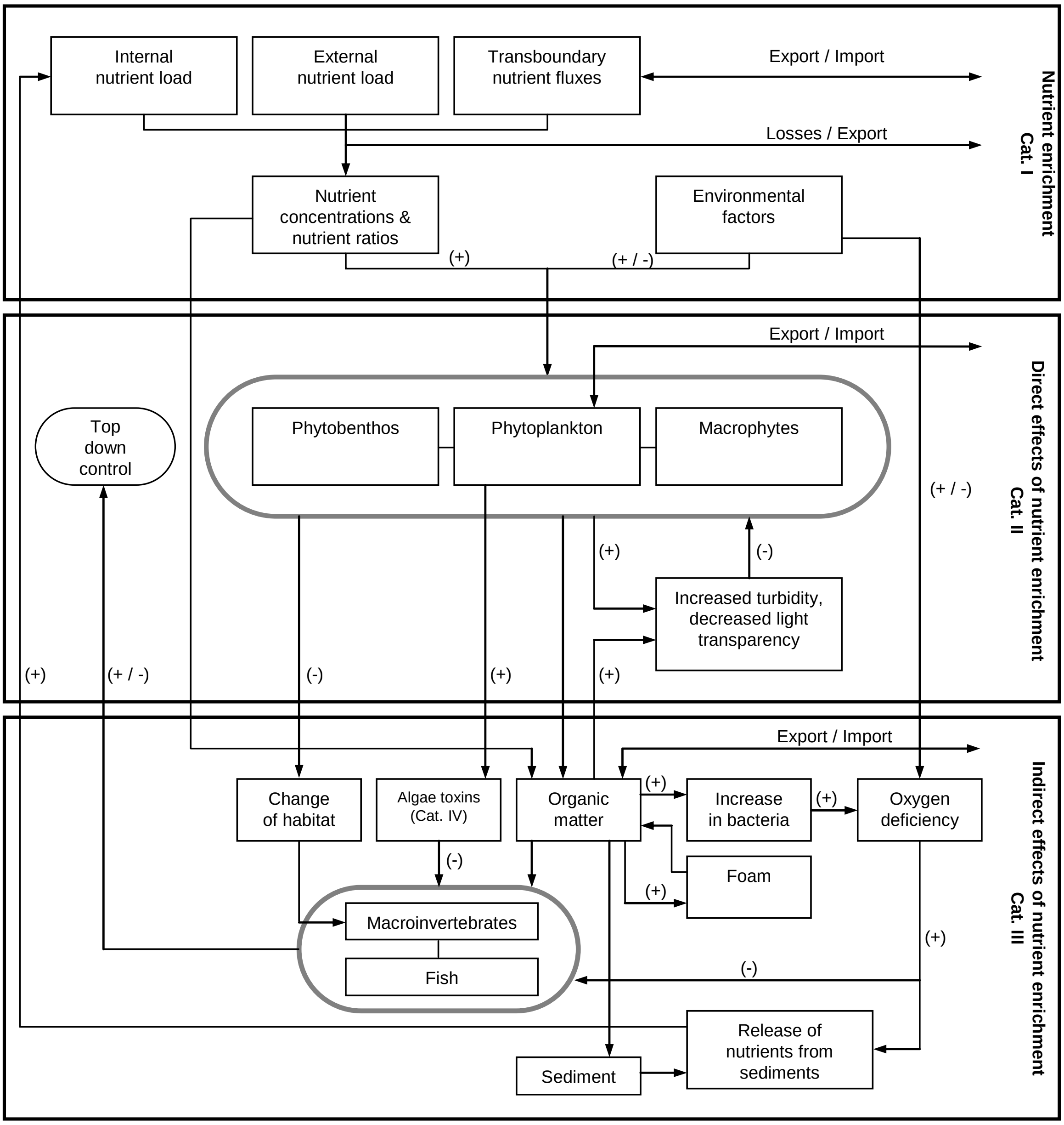

Figure 2. General conceptual framework to assess eutrophication in all categories of surface waters. '+' indicate enhancement, '-' indicate reduction. Round boxes indicate biological quality elements of WFD.

19. To understand environmental policy and related evaluation and assessment, a framework has been developed in the past which distinguished driving forces (D), pressures (P), states (S), impact (I) and responses (R) – this became known as the DPSIR framework. In the WFD context, P is addressed in the article 5 reports when assessing pressures and presenting typology/characteristics of a water body. S and I are addressed by the work on classification, intercalibration and monitoring. R is addressed in the WFD

programmes and measures. The conceptual framework for eutrophication assessment can be linked to the general DPSIR assessment framework as follows (Figure 3). Category I in the framework corresponds to pressures and state whereas Categories II and III refer to impacts. The focus of this guidance document is on state and impact assessment. Responses are not covered by the mandate to develop this guidance document although chapter 9 outlines possible future work in this area.

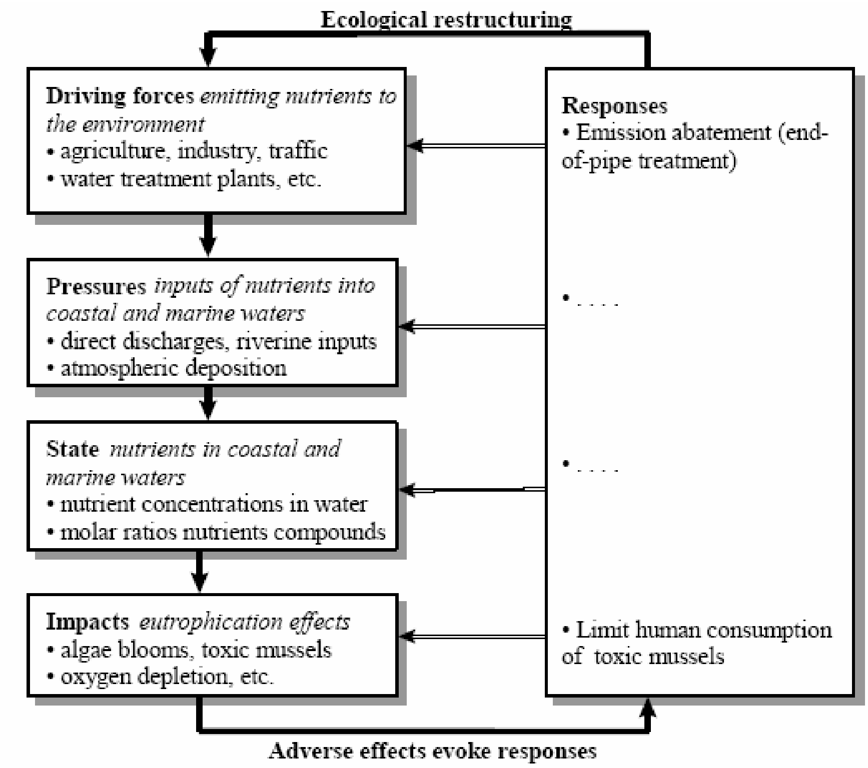

Figure 3. DPSIR assessment framework in the context of eutrophication (EEA, 2001).

20. The eutrophication conceptual framework provides an effective means of identifying the critical processes that can be adapted to processes specific to different water body categories. However in order to provide a link to the subsequent steps of the assessment process (i.e. establishing reference conditions and classification), holistic checklists have been derived for the different water categories highlighting the critical processes and variables under the headings of: causative factors, primary or direct effects and secondary or indirect effects. The level of detail included in the checklist (presented in Table 1) reflects the specificity of the eutrophication process in rivers, lakes, transitional, coastal and marine waters. The complete checklists for each water category can be found in Annex 2.

Table 1. Indicative check-list for general and category-specific features of the impact of eutrophication in rivers, lakes, transitional, coastal and marine waters.

General assessment factors for all water categories	**Additional River-specific factors**	**Additional Lake-specific factors**	**Additional Coastal [and marine] waters specific factors**
a. Causative factors:			
The degree of nutrient enrichment: With regard to inorganic/organic nitrogen With regard to inorganic/organic phosphorus With regard to silicon Taking account of: Sources (differentiating between anthropogenic and natural sources) Increased/upward trends in concentration Elevated concentrations Changed N/P, N/Si, P/Si ratios Changes in nutrient fluxes and nutrient cycles		Riverine, direct and atmospheric inputs internal nutrient loading	Across boundary fluxes, recycling within environmental compartments and riverine, direct and atmospheric inputs)
b. Supporting environmental factors:			
Light availability (irradiance, turbidity, suspended load) Hydrodynamic conditions () Climatic/weather conditions (wind, temperature) Typology factors Other pressures (toxic substances, hydromorphological pressures)	Hydromorphological conditions (current velocity, water flow, substrate type and mobility, water depth, flood frequency,) Typology factors: alkalinity, colour, size of catchment	Stratification, flushing, retention time, Zooplankton grazing (top-down control) (which may be influenced by other anthropogenic activities) Typology factors: alkalinity, colour, size, depth, share of area shallower than the stratification layer	Upwelling, salinity gradients, Typology factors: salinity, wave exposure, others
c. Direct effects of nutrient enrichment:			
i. Phytoplankton; Increased biomass (e.g. chlorophyll a, organic carbon and cell numbers) Increased frequency and duration of blooms Increased annual primary production	i. Phytoplankton in parts of rivers with low flow or lake-like structure due to damming iii. Microphytobenthos; Increased biomass and primary production, increased areal cover on substrate Shifts in species composition from diatoms	i. Phytoplankton; from chrysophytes and diatoms to cyanobacteria and chlorophytes ii. Macrophytes In very shallow lakes switches occur from macrophytes dominance and phytoplankton	i. Phytoplankton indicator species cells/L (blooms and duration) Shift from diatoms to flagellates ii. Macrophytes including macroalgae: shift from long-lived species to short-lived species, some of which are nuisance species

General assessment factors for all water categories	Additional River-specific factors	Additional Lake-specific factors	Additional Coastal [and marine] waters specific factors
Shifts in species composition to higher proportion of potentially harmful or toxic species ii. Macrophytes including macroalgae (such as Characeans); Increased biomass Shifts in species composition Reduced depth distribution until disappearance of macrophytes iii. Phytobenthos	to chlorophytes and cyanobacteria	dominance Reduction in depth distribution, consequent shift in balance of species	(Ulva, Enteromorpha) Coverage of areas
d. Indirect effects of nutrient enrichment			
i. organic carbon/organic matter; Increased organic carbon concentrations in water and sediment ii. oxygen; Decreased concentrations and saturation percentage Increased frequency of low oxygen concentrations Increased consumption rate iii. Fish; Changes in abundance Changes in species composition iv. Benthic invertebrates; Changes in abundance and biomass Changes in species composition v. pH vi. Nutrients	ii. oxygen; More extreme diurnal variation iii. Fish; Disruption of migration or movement iv. Benthic heterotrophic organisms: Increased biomass and areal cover of fungi and bacteria	ii. oxygen More extreme diurnal variation in surface waters (oversaturation at day and undersaturation at night) Reduction in hypolimnion during stratification periods Occurrence of anoxic zones at the sediment surface ("black spots") iii. Fish Mortalities resulting from low oxygen concentrations iv. Macrozoobenthos Mortalities resulting from low oxygen concentrations v. pH increase in surface waters vi. Internal loading of phosphorus vii. Increased ammonia concentration in bottom waters viii. Often changed top-down control due to changed predation on zooplankton Often reduced top-down control due to loss of habitat structure provided by macrophytes leading to heavy fish Release of soluble Fe, Mn from sediments	i. Organic carbon/organic matter; Occurrence of foam and/or slime ii. oxygen; Occurrence of anoxic zones at the sediment surface ("black spots") iii. Fish Mortalities resulting from low oxygen concentrations iv. Macrozoobenthos Mortalities resulting from low oxygen concentrations vi. Release of nutrients and sulphide from sediment Occurrence of algal toxins

General assessment factors for all water categories	Additional River-specific factors	Additional Lake-specific factors	Additional Coastal [and marine] waters specific factors
e. Other possible effects of nutrient enrichment			
• Amenity values compromised: • bad smell, turbid waters,	Clogging of pipes and filters, build up of iron deposits due to low DO	Incidence of toxic algal blooms increases Loss visual amenity due to colour in water	

3. OVERVIEW AND COMMON UNDERSTANDING OF EUTROPHICATION IN EC AND INTERNATIONAL POLICIES

3.1. Introduction

21. Eutrophication is addressed in several EU policies. Nutrient levels to describe the water quality were introduced in several early pieces of EU water legislation (e.g. Freshwater Fish Directive 78/659/EEC). The main anthropogenic sources of nutrient loadings were addressed in two directives in 1991. The Urban Wastewater Treatment Directive (91/271/EEC) addresses the major point sources, in particular the municipal waste water discharges. The Nitrates Directive (91/676/EEC) deals with the diffuse pollution of nitrogen from agriculture. Both directives define the term “eutrophication”. In addition, through the designation of sensitive areas or nitrates vulnerable zones, the UWWT and Nitrates Directives provide for measures to combat eutrophication. Starting from the 1980s and 1990s, a number of international conventions addressed eutrophication in marine waters including OSPAR (in the North East Atlantic) and HELCOM (in the Baltic Sea).

22. In 2000, the Water Framework Directive (2000/60/EC) introduced, amongst other requirements, a comprehensive ecological quality assessment for all waters, which describes the quality of the waters (looking at the whole water cycle in a holistic manner) with a number of biological, hydromorphological and physico-chemical quality elements (cf. Annex V 1.1 and V 1.2). The WFD provides a basis for a clear and detailed assessment of eutrophication, and provides the potential for a more consistent and integrated approach to managing nutrient inputs to water taking fully into account the requirements of previous EU legislation.

23. In parallel to these directives, the EU Marine Strategy (European Commission 2005) aims at reducing eutrophication in marine areas and identifies priority actions based upon the identification of the problematic marine areas through a harmonised assessment approach.

24. A workshop on eutrophication criteria was hosted by DG ENV, Brussels in May 2002. This considered eutrophication in the context of the WFD, UWWT Directive, the Nitrates Directive and the future Marine Strategy of the Commission. It launched a process to harmonise existing definitions and criteria for the assessment of eutrophication. One conclusion of this workshop was a recognised need to move from definitions to a common understanding of eutrophication, acceptable levels of deviation from reference conditions and the extent of adverse indirect effects on ecosystems and water use (European Commission 2002b).

25. This section considers and compares how eutrophication is understood, defined and assessed in European Community directives, policies and guidance documents. In addition, the understanding and the assessment of eutrophication in other regional bodies are presented, in particular in the international marine conventions OSPAR and HELCOM.

26. An overview of the understanding of eutrophication in EU legislation and policies as well as in a number of international organisations is provided in Annex 1. This annex was the basis for the following overview of approaches.

3.2. Overview of policy instruments

27. A number of EC Directives require Member States to monitor parameters relevant to eutrophication and set ecologically relevant guideline values, however only the and UWWT Directive and the Nitrates Directive have an explicit requirement to assess eutrophication (the former through the exercise to designate Sensitive Areas, i.e. sensitive water bodies, and the latter through identification of Polluted Waters and subsequent designation of Nitrate Vulnerable Zones). The Water Framework Directive supports and upholds both these Directives in its provision for Protected Areas, and, in addition, has an implicit requirement to assess eutrophication when classifying the Ecological Status of surface water bodies. Unlike the UWWT Directive and the Nitrates Directive, the WFD stipulates a specific framework for assessing water quality. Eutrophication assessment criteria and methods have also been developed by several European conventions, including OSPAR and HELCOM and recently by UNEP/MAP.

28. The requirements of EC directives and other relevant international policies to assess or monitor eutrophication are summarised in general in Table 2.

Table 2. General overview of requirements of EC directives and regional conventions regarding eutrophication

Directive /Policy	Requirement to assess eutrophication	Minimum monitoring requirements relevant to eutrophication
WFD	Implicit in classification of Ecological Status where nutrient enrichment affects biological and physico-chemical quality elements. Protected Area's support and upholds requirements of UWWTD and Nitrates Directive.	Phytoplankton (6 months), aquatic flora (3 yrs), macro-invertebrates (3 yrs), fish (3 yrs). Hydromorphological quality elements (Hydrology continuous - 1 month; others 6 years). Physicochemical quality elements (3 months).
UWWT Directive	In order to identify Sensitive Areas under Annex IIA(a) criteria (i.e. water bodies that are eutrophic or may become eutrophic in the near future).	Review of the existing Sensitive Areas and designation of new ones at least every 4 years (Article 5(6)).
Nitrates Directive	In order to identify polluted waters and designate their catchment area as Nitrate Vulnerable Zones.	Review the eutrophic state of surface water at least every 4 years.
Freshwater Fish Directive	No specific requirements to assess eutrophication, but guideline values for phosphorus are explicitly to reduce the effects of eutrophication.	Ammonia, pH and DO (monthly)
Habitat Directive	If threatening protected habitats or species.	None
Shellfish Water Directive	No specific requirement to assess eutrophication.	DO (monthly) & algal toxins.

Directive /Policy	Requirement to assess eutrophication	Minimum monitoring requirements relevant to eutrophication
Dangerous Substance Directive	No specific requirement to assess eutrophication, but requirement on setting quality objectives for phosphorus and for substances which have an adverse effect on the oxygen balance, particularly ammonia and nitrates	No specific requirements
Bathing Water Directive	No specific requirement to assess eutrophication, but guideline and imperative values for transparency are explicitly related to eutrophication.	Transparency (fortnightly), pH, DO, nitrates & phosphate (when water quality has deteriorated. Ammonia & nitrogen (Kjeldahl) when there is a tendency towards eutrophication.
Abstraction of Drinking Water Directive	No explicit mention of eutrophication but guidelines for phosphate is specifically included to satisfy the ecological requirement of surface water bodies.	Conductivity, pH, nitrates, phosphates, dissolved oxygen.
Emission Ceilings, LRTAP	No requirement to assess eutrophication but specific national emission ceilings for ammonia and NOx emissions to reduce nitrogen atmospheric deposition and ecosystem eutrophication.	No requirement to monitor water quality under the Directive, but monitoring of nitrogen deposition and critical loads for ecosystems eutrophication under the Convention.
OSPAR Eutrophication Strategy	Explicit requirements for assessing the eutrophication status of waters in OSPAR maritime area using the OSPAR Common Procedure (in particular its Comprehensive procedure).	Monitoring of selected parameters for nutrient enrichment, direct effects, indirect effects and other possible effects according to the mandatory Eutrophication Monitoring ¨Programme (OSPAR 2005-4).
HELCOM	Explicit in quantifying and assessing emissions/discharges/losses and inputs to as well as concentrations and effects in the Baltic Sea [HELCOM Periodic Assessments of the Status of the Baltic Sea and PLCs (Air and Water)]	MONAS: Pollution Load Compilation (PLC Air and Water) Monitoring Programme (total nitrogen, nitrates, ammonia, orthophosphate and total phosphorus) and COMBINE (including total nitrogen, total phosphorus, DIN, DIP, Si, phytoplankton and zoobenthos species composition, abundance and biomass, Chl a, dissolved oxygen and Secchi depth).
Barcelona Convention-Strategic Action Programme(SAP) to address LBS	The SAP states Eutrophication as the result of input of nutrients from rivers and sewage into inshore waters such as lagoons, harbours, estuaries and coastal area which are adjacent to river mouths, so actions should be taken to reduce inputs of nutrients from Land Based Sources (LBS).	MED POL Eutrophication monitoring strategy (2003) – DIN, DIP, TP, Si, Chl A, Phytoplankton (total abundance, abundance of major groups, bloom dominance), Transparency, DO, T, S, pH

3.3. Concepts and definitions of eutrophication

29. It is recognised that different geochemical and hydromorphological conditions are reflected in different characteristics of water bodies such as different trophic and biological conditions. Thus, the assessment of eutrophication should consider these issues and assess the deviation from the type-specific condition. This concept is directly or indirectly addressed in all the relevant policies that aim at controlling the pressures stemming from human activities with an impact on the natural condition of the ecosystem. For

the purpose of this guidance, the term “eutrophic” is used to refer to this situation, when the natural trophic status (including the biology) is out of balance because of anthropogenic interventions.

30. This understanding of “anthropogenic” eutrophication corresponds with how the WFD classifies surface water ecological status in relation to type-specific reference conditions. A pressure (in this case nutrient enrichment) causes an adverse change in biological quality elements (e.g. ‘composition, abundance and biomass of phytoplankton’). This in turn might cause indirect effects on physicochemical quality elements (e.g. transparency, oxygenation conditions), and other biota (e.g. macro-invertebrates). Water bodies that fail to achieve Good Ecological Status due to the effects of human induced nutrient enrichment can be considered to be “eutrophic” due to the process of eutrophication.

31. In the context of this guidance, eutrophication involves adverse ecological changes (an undesirable disturbance) and it can apply to waters from anywhere within the trophic spectrum. It should not be confused with the same term when used in relation to limnological trophic classification, where its meaning is more limited and not necessarily linked to assessing the extent of ecological change. In that sense, an oligotrophic water body (e.g. a lake) which deteriorates to mesotrophic would require UWWTD//ND/WFD designation/action despite the fact that it would not have become “eutrophic” in terms of OECD trophic status. In contrast a naturally “eutrophic” water body, as measured through OECD classification, would require no UWWTD/ND/WFD designation/action unless its ecological status had deteriorated, or was at risk of doing so, due to nutrient enrichment.

32. The previous sections concur with conclusions from the May 2002 Eutrophication Workshop (European Commission 2002b), that the definition of eutrophication in the UWWT Directive is adequate as a starting point for further development of a guidance on the issue of eutrophication assessment. That is:

‘The 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 to the quality of the water concerned’ (cf. Art. 2(11) of the Directive 91/271/EEC).

3.4. Key terms used in different European policies

33. Table 3 compares different terms used in WFD, Nitrates, UWWT Directives and OSPAR.

Table 3: Comparison of key terms used in relevant European policies in relation to eutrophication

	Water Framework Directive	UWWT Directive	Nitrates Directive	OSPAR
Assessment result (not fulfilling the objective and requiring measures)	Water body at less than good status based on eutrophication-related biological quality elements or judged at risk of deterioration	Sensitive area (=sensitive water body)	Polluted water	Problem area
Location of pressures (other than those directly on the water body)	River basin or sub-basin	Catchment area of sensitive area	Nitrate vulnerable zone	Not applicable (any location is relevant)

34. Although different terms are used the underlying concepts are similar, e.g. there is a quality problem in a (part of a) particular river, lake or coastal area (called water body, sensitive area, polluted water or problem area) that is caused by an activity or pressure located inside the water body having less than good status, or upstream of this water body in the catchment area, river basin, sub-basin or vulnerable zone.

35. In OSPAR there is no explicit reference to river basin because in the marine area the pressures causing eutrophication may be located somewhere else. However, one of the main pillars of the OSPAR approach to combat eutrophication is the source-oriented action which should be taken in "areas from which nutrient inputs are likely, directly or indirectly, to contribute to inputs into problem areas with regard to eutrophication"[3]. This definition is broader and includes anthropogenic nutrients input to the river basin of transitional, coastal and marine areas affected by eutrophication. In addition, OSPAR is also considering transboundary transport of anthropogenic origin from other parts of the maritime area.

3.5. Overview of classification of water bodies with regard to eutrophication

36. The way in which different EC Directives and OSPAR classify eutrophic water bodies with regard to human induced eutrophication is summarised in Table 4. The comments in the table describe the focus and extent of each classification.

[3] The same wording is used in several OSPAR normative and technical documents, for instance in OSPAR Eutrophication Strategy.

Table 4. The classification of water bodies not achieving the objective with regard to eutrophication under different directives and policies (overview).

Directive/ Policy	Classification	Comments
WFD	Worse than good Ecological Status. (Deterioration in Ecological Status)	Water body is eutrophic if failure of eutrophication-related biological quality elements is due to nutrient enrichment, as compared to some other pressure. Covers all freshwaters and transitional waters and all coastal water that is on the landward side of a line that is 1 nautical mile seaward of the baseline from which the breadth of territorial waters is measured.
UWWT Directive	Sensitive Area	Sensitive Areas are water bodies (including freshwater bodies, estuaries and coastal waters) that are eutrophic or in the near future may become eutrophic if protective actions are not taken. Designation of Sensitive Area results in action regarding waste water treatment independent of the origin of the pollution (i.e. independently whether pollution comes from urban waste water discharges, or originates from agricultural-based sources, since both of them contribute to eutrophication)[4].
Nitrates Directive	Polluted waters whose catchments require designation as Nitrate Vulnerable Zones.	NVZs must be established over the catchment of polluted waters, i.e. water bodies that are eutrophic or in the near future may become eutrophic if protective actions are not taken. Only applies to pollution by nitrogen from agricultural sources.
Habitats Directive	Non-favourable condition	If affecting protected habitats or species.
Shellfish Water Directive	No direct link	Might result in a shellfish water site failing water quality criteria.
OSPAR Common Procedure	Problem Area	Applies to the OSPAR Convention Waters (estuaries and marine waters). All anthropogenic nutrient sources and inputs are taken into account in assessing the eutrophication status.

37. For the purpose of this guidance, it is proposed that the process of eutrophication may occur in water bodies regardless their natural status, but that water bodies are not considered to be ”eutrophic” or to fall in the “may become eutrophic” category unless the nutrient enrichment causes, or could cause in the near future, the ecological status to be moderate or worse. This ensures the same level of protection in all EC directives as far as nutrient enrichment is concerned.

38. From the legal point of view the terms “eutrophic” and “may become eutrophic in the near future” as used in Nitrates and UWWT directives are similar and require similar consequence, i.e. the designation of those areas as “polluted waters” (Nitrates) or “sensitive areas” (UWWT). However, technically speaking, they reflect different situations. These concepts will be further addressed in the following sections.

4 According to the Judgement of the Court in the case C-280/02 (for more details, see Annex 1, Section 1.2.4)

3.6. Assessment results under various policies

39. The consideration and comparison of assessment results is an important starting point for the development of a harmonised assessment framework. Ultimately, the assessment should lead to a comparable and consistent conclusion under different policies. In general, the outcome of the assessment is used to determine whether or not certain measures need to be taken under the different policies. At this stage, it is important to recall two basic principles when interpreting the content of this document:

a. in case that the assessment under different policies lead to a different level of protection, the most stringent requirement shall apply.

b. for EC legislation, it is ultimately up to the Court of Justice to interpret legal requirements of directive; recently, the Court has interpreted the designation of sensitive areas under the UWWT Directive in a broad sense (see EJC judgement C-280/02 in section 1.2.4 of Annex 1). In consequence, the application of this guidance must lead, at least, to the same level of protection provided by this ruling independent which EC directive is applied.

40. In Table 5, the WFD ecological status classes are compared with (i) Sensitive Areas and not sensitive areas (so called 'normal' areas) (cf. the UWWT Directive), (ii) polluted waters requiring designation of Nitrate Vulnerable Zones (cf. Nitrates Directive) and (iii) Problem and Non-Problem Areas (cf. OSPAR Comprehensive Procedure) respectively. The comparison considers when action is required to address eutrophication under each directive /policy. As regards the obligation to designate sensitive areas under UWWT Directive or polluted waters/vulnerable zones under Nitrates Directive, Table 5 is not applicable to Member States that have chosen to implement the whole territory approach (see paragraphs 48-50 for more information on the whole territory approach).

41. As stated in the previous section, the use of the terms "eutrophic" and "may become eutrophic in the near future" in the Nitrates and UWWT Directives are interchangeable from the legal point of view and both have similar consequences (designation of "polluted waters/NVZ" or of "sensitive areas"). However, in order to establish a consistent link with the WFD status classes, they can be interpreted as the result of different degrees of ecological deviation from reference conditions. The term "eutrophic" can be identified with a situation where undesirable disturbances are common place, whereas the term "may become eutrophic in the near future" corresponds with a situation where undesirable disturbances are not necessarily present, but there is a greater than negligible probability of undesirable disturbances occurring[5]. Therefore, the "may become eutrophic in the near future" situation corresponds with a current moderate status under WFD (provided it is confirmed using the checking procedure explained in the next paragraph) (see Chapter 4, section 4.4 for a more detailed interpretation of eutrophication in the context of WFD ecological status

[5] On the definition of undesirable disturbances see Annex 1, section 1.2.4 Relevant Case Law. Some examples of significant undesirable disturbances can be found in Chapter 4, Table 8.

assessment). As the degradation of water quality increases, so does the probability of undesirable disturbances to occur, and from a certain point in the moderate class, the status would be identified as "eutrophic". The moderate class is interpreted as a transition class between good status, where no undesirable disturbances are present, and poor or bad, where those are clearly present.

42. In order to assess the probability of occurring undesirable disturbances, nutrient concentrations and all other environmental factors that influence eutrophication should be taken into account, in particular light availability/turbidity, hydrodynamic conditions, temperature, etc. (see category specific check list in Annex 2). According to the CIS Classification Guidance (see section 1.1.6 in Annex 1), a water body may be classified as moderate ecological status under the Water Framework Directive because values for physico-chemical quality elements (in the context of eutrophication, notably nutrients) exceed levels established so as to ensure the functioning of the ecosystem and the achievement of the biological quality required for good status. As scientific understanding of the causal link between the levels of physico-chemical quality elements in a water body and the condition of the biological quality elements is incomplete, the CIS Classification Guidance proposes a checking procedure where mismatches between the two monitoring results can be identified. In this sense it is proposed that the read across between classification as moderate, poor or bad ecological status and identification as polluted waters (Directive 91/676/EC) or sensitive areas (Directive 91/271/EC) (or OSPAR problem areas) applies only where:

- The classification of the body of water as moderate, poor or bad ecological status results from monitored impacts on the biological quality elements; or
- The checking procedure confirms that the elevated physico-chemical quality elements (notably nutrient concentrations) in the water body are such as to likely cause moderate or worse biological impacts (and therefore there is a greater than negligible probability of undesirable disturbances occurring).

This is important to avoid water bodies being wrongly considered "polluted waters", "sensitive areas" or "problem areas" without there being any of the biological impacts that define a water as "eutrophic" and without signs that the bodies "may become eutrophic in the near future".

43. Table 5 and the preceding two paragraphs address the assessment of current status only. However, the WFD also requires Member States to undertake a risk assessment to estimate the status in the future. This task is linked to the analysis of pressures and impacts (Article 5 and Annex II) and its objective is to identify water bodies at risk of not achieving the WFD objectives due to the breaching of the prevent deterioration principle. This means water bodies that are currently in good or even high status and that may deteriorate in the future due to increasing pressures will need to be part of the Programme of Measures under the WFD. This forecasting of future breaching of the prevent deterioration principle equates also well with the forecast/estimation of "may become eutrophic in the near future" of the UWWT and Nitrates Directives, at least if the deterioration may result in a moderate or worse status due to eutrophication. However, at least

until the WFD first River Basin Management Plan is in place in 2009, the time scales of the WFD objectives and 'the near future' estimation may not be necessarily coincident.

44. The initial results of the Article 5 analysis under WFD will be further refined with the information from the monitoring networks, due to start in December 2006 and by further characterisation and classification. The final designation of water bodies that are subject to the Programme of Measures is foreseen in the River Basin Management Plan (RBMP) by December 2009. Along this process from the Article 5 analysis to the RBMP, increasing certainty will be attained on the evaluation of future status of water bodies. At any point, designation under UWWT and/or Nitrates Directives must take place if sufficient certainty is attained that a water body may become eutrophic in the near future. These judgements could be based on various information sources of Member States such as the risk assessments, classification and monitoring results and predictive analyses e.g. trend evaluation or modelling. Action requirements under the various Directives should be considered together in order to produce the final outcome of the RBMP in December 2009. Therefore, whenever pressures addressed by UWWT and Nitrates Directives are present, the list of water bodies subject to WFD Programme of Measures should be coherent with the designation of sensitive areas and polluted waters under UWWT and Nitrates Directives. It should be recalled that measures under these Directives are part of the Programme of Measures foreseen in the Article 11.3 and Annex VI part A of the WFD.

45. In summary, it is proposed that in terms of WFD status classification and environmental objectives, the term “may become eutrophic in the near future” from the UWWT and Nitrates Directives can be interpreted in two complementary ways:

- In the context of **current status** assessment, as corresponding to moderate status (undesirable disturbances are not necessarily present, but the conditions are such that there is a greater than negligible probability of nutrients causing undesirable disturbances occurring) or,
- In the context of **future status** evaluation, as corresponding to a risk of breaching the Water Framework Directive prevent deterioration principle.

The interpretation set out in the preceding paragraphs ensures a coherent action against eutrophication across the various policies.

46. It is worth noting that both Sensitive Areas under Directive 91/271/EEC and Polluted Waters within Nitrate Vulnerable Zones under Directive 91/676/EEC become Protected Areas under Article 6 and Annex IV of the WFD.

47. As regard concrete measures foreseen in the various Directives to combat eutrophication, according to Art. 5(2) of Directive 91/271/EEC, Member States shall ensure that urban waste water entering collecting systems shall before discharge into sensitive areas be subject to a more stringent treatment to reduce the nutrient load, for agglomerations of more than 10 000 p.e. In addition, in accordance with Art. 5(5), discharges which are situated in the relevant catchment areas of sensitive areas and which contribute to the

pollution of these areas shall also be subject of a more stringent treatment[6]. Similarly, Art. 5(1) of Directive 91/676/EEC requires Member States to establish action programmes consisting on mandatory measures in respect of designated vulnerable zones (Art. 5(4)), and additional measures or reinforced actions if necessary to achieve the objectives of the Directive (Art 5(5)).

48. Nevertheless, following Article 5.8 of Directive 91/271/EEC, Member States do not have an obligation to identify sensitive areas (i.e. sensitive water bodies) if they implement, on their whole territory, more stringent treatment (Art. 5.2 and 5.3) or apply 75% reduction of the overall load of total nitrogen and of total phosphorus entering all urban waste water treatment plants (Art. 5.4).

49. The same way, following Article 3.5 of Directive 91/676/EEC, Member States shall be exempt from the obligation to designate specific vulnerable zones, if they establish and apply action programmes referred to in Article 5 throughout their whole national territory.

50. Member States may decide to apply the whole territory approach without taken into consideration the status of water bodies. Therefore, the fact that Member States have chosen to apply in their whole territory the control measures mentioned in the previous two paragraphs does not prejudge the result of the status assessment under WFD.

6 See ECJ judgement in §§18 to §§ 20 of the case C-396/00, of 25 April 2002 (Milano case).

Table 5. Comparison of assessment results under various policies for waters responding to nutrient enrichment (based on the assumption that the WFD classification is the starting point and that the different sources of pollution are relevant).

ASSESSMENT OF CURRENT STATUS				
Ecological Status	**WFD normative definition**	**UWWT Directive**[7]	**Nitrate Directive**[7]	**OSPAR**
High	Nearly undisturbed conditions	Non Eutrophic, designation of sensitive area is **not required**[8]	Non Eutrophic, not a Polluted Water, designation of NVZ is **not required**	Non-Problem Area
Good	Slight change in composition, biomass	Non Eutrophic, designation of sensitive area is **not required**	Non Eutrophic, not a Polluted Water, designation of NVZ is **not required**	Non-Problem Area[9]
Moderate	Moderate change in composition, biomass	Eutrophic or may become eutrophic in the near future, designation of sensitive area is **required**	Eutrophic or may become eutrophic in the near future, polluted water, designation of NVZ is **required**	Problem Area[9]
Poor[10]	Major change in biological communities.	Eutrophic, designation of sensitive area is **required**	Polluted water, designation of NVZ is **required**	Problem Area
Bad	Severe change in biological communities.	Eutrophic, designation of sensitive area is **required**	Polluted water, designation of NVZ is **required**	Problem Area

51. Table 5 does provide a general comparison but has to be interpreted with care. The following aspects should be considered in more detail, in particular:

a. the designation of many "Sensitive Areas" (SA) as defined in the Urban Waste Water Treatment Directive (UWWTD), or identification of "Polluted waters" (PW) requiring designation of "Nitrate Vulnerable Zones" (NVZ) as defined in the Nitrates Directive, and "Problem Areas" as

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7 It is recalled that if Member States have chosen to apply the whole territory approach, there is no obligation to designate sensitive areas under UWWT Directive or polluted waters/vulnerable zones under Nitrates Directive.

8 In coastal zones, with good water exchange and other conditions described in the Directive 91/271/EEC annex II.B even less sensitive areas can be designated.

9 If insufficient data is available 'good' or 'moderate' Ecological Status could correspond to a Potential Problem Area. Nevertheless, in the case of potential problem areas with regard to eutrophication, preventive measures should be taken in accordance with the Precautionary Principle. Furthermore, there should be urgent implementation of monitoring and research in order to enable a full assessment of the eutrophication status of each area concerned within five years of its being characterised as a potential problem area (see OSPAR Strategy to Combat Eutrophication § 3.2b.).

10 Indirect effects of eutrophication (e.g. decline in dissolved oxygen) will be evident at poor Ecological Status.

defined in OSPAR Comprehensive Procedure has taken place in advance of the entry into force of the Water Framework Directive. All existing designations will be unchanged by the WFD independent of the ecological status of the water bodies concerned, although that status will be important in determining what nutrient control measures will be required. "Sensitive areas" and the "nitrate vulnerable zone" will become protected areas under Article 6 and Annex IV of the WFD. After 2006, any classification of the status of these water bodies under the WFD will not change this designation, but will affect decisions on the range and extent of control measures required to achieve WFD objectives [11].

b. after 2006, however, when the monitoring programmes under the WFD become operational, the ecological status classification may also be helpful to designate new water bodies in accordance with the other policies. For waters where UWWT and Nitrate Directives apply, a complementary approach to eutrophication assessment across the various directives is desirable as these two Directives are basic measures under WFD.

c. designation of SA or NVZ/PW is only necessary when pressures covered by the UWWT or Nitrates Directives are significant (regarding the latter see paragraph 35 of Judgement Case C-293/97). Recent ruling by the Court of Justice helps to interpret this concept of significant contribution (see paragraphs 40, 52, 77 and 87 of Judgement Case C-280/02 and paragraphs 81 to 88 of the Case C-221/03).

d. water bodies may still be in moderate-bad status for a long time after pressures have been reduced, due to delayed soil leaching/run off response, internal loading and/or time-lagged response in the biological quality elements. In such cases, the clause on "natural processes" in the exemption of the WFD (Article 4.4 WFD) may be checked to see whether it is applicable. Alternatively, other internal restoration measures may be required to speed up the recovery back to good status.

e. finally, also other criteria (independent from eutrophication of surface water) may lead to designation of Nitrate-Vulnerable Zones and Sensitive Areas (for example high nitrate concentrations in surface and groundwater for the protection of drinking water resources)[12]. However, these are not part of the deliberations in this guidance.

52. The pressures causing eutrophication may originate a long way from the water body being affected. In accordance to UWWT and Nitrates Directives, measures have to be taken in the relevant catchment areas of sensitive areas and which contribute to the pollution of these areas (Art. 5(5) of Directive 91/271/EEC), or in

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11 The requirements on review of sensitive areas and polluted waters and vulnerable zones every four years remains unchanged according to Art.5(6) of 91/271/EEC and Art. 3(4) of 91/676/EEC.

12 See section A of Annex II of Directive 91/271/EEC, and Section A of Annex I of Directive 91/676/EEC.

all known areas of land which drain into affected waters and which contribute to pollution (Art. 3(1), 3(2) and 5(1) of Directive 91/676/EEC). However, from the WFD perspective, this does not mean that all the water bodies upstream will need to be classified as less than good status.

53. Moreover, there may be situations where the nutrient pressures on affected water bodies may be located in another river basin (district) or adjacent areas of the marine waters (e.g. different parts of the Baltic Sea). This situation mainly occurs in transitional and coastal waters, where nutrient loads and/or eutrophication effects may be transported from one coast to another (e.g. north Adriatic Sea or German Bight, parts of the Baltic Sea, etc), or from estuaries to coastal waters[13]. The assessments needed in this type of situation can be complex in nature.

54. In comparing class boundaries used by the WFD and OSPAR it is helpful to describe the criteria for assessing Ecological Status in terms of primary and secondary impacts of eutrophication; this is done in Table 6. Environmentally significant undesirable impacts are expected to start at moderate Ecological Status (see Chapter 4 for more detail). It is proposed that the probability and severity of adverse effects increases from moderate to bad status.

Table 6. Examples of qualitative criteria for assessing WFD Ecological Status in terms of primary and secondary eutrophication impacts.

Ecological Status	WFD normative definition	Primary impacts (e.g. phytoplankton biomass)	Secondary impacts (e.g. O_2 deficiency)
High	Nearly undisturbed conditions	None	None
Good	Slight change in abundance, composition or biomass for relevant biological quality elements.	Slight	None
Moderate	Moderate change in composition or biomass for relevant biological quality elements.	Change in biomass, abundance & composition begins to be environmentally significant, i.e. pollution tolerant species more common.	Occasional impacts from increased biomass.
Poor	Major change in biological communities.	Pollution sensitive species no longer common. Persistent blooms of pollution tolerant species	Secondary impacts common & occasionally severe.
Bad	Severe change in biological comm.	Totally dominated by pollution tolerant species	Severe impacts common

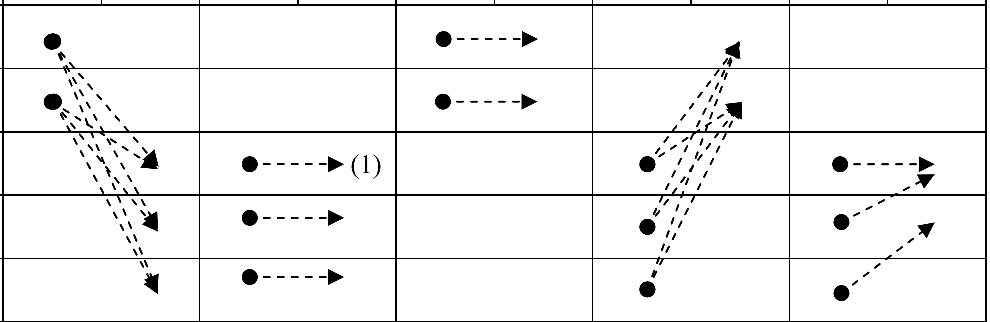
3.7. Examples of class comparisons

55. In this section, some examples are given to clarify the relationships between different policies and, in particular, the differentiation between current status and the evaluation of status in the future, as set out in the

13 Recent European Court of Justice ruling is relevant to interpret this concept. See Annex I, section 1.2.4.

preceding section. Table 8 summarises those examples. In all cases, it is assumed that pollution from urban waste water and agriculture sources are significant.

Table 7: Examples illustrating the relationship between WFD assessment classes, the result of the assessment of status in the future and the need for action under UWWT Directive, Nitrates Directive (ND) and WFD Programme of Measures

	Example A		**Example B**		**Example C**		**Example D**		**Example E**	
	Today	**Future**	**Today**	**Future**	**Today**	**Future**	**Today**	**Future**	**Today**	**Future**
High										
Good										
Moderate				(1)						
Poor										
Bad										
Action under UWWTD or ND needed?	Yes, in this case status may become eutrophic in the near future, action is needed		Yes, current status is eutrophic or may become eutrophic in the near future (case 1), action is needed		No		This can reflect the case in which measures under UWWTD or ND have already been taken and it is forecasted that they will be effective to achieve the WFD objectives		This can reflect the case in which measures under UWWTD or ND have already been taken but it is forecasted that they will NOT be effective to achieve the WFD objectives	
Action under WFD Programme of Measures needed?	Yes, status is forecasted to deteriorate if no action is taken, therefore this case is at risk of not achieving WFD objectives		Yes, status less than good, this case does not achieve the WFD objectives		No		No additional measures than that already taken are necessary		Yes, additional measures under WFD Programme of measures are needed	

56. Some comments on the examples:

EXAMPLE A: In this case it is forecasted that the status of the water body will deteriorate in the future. Action is needed under UWWT and Nitrates Directive because the water body "may become eutrophic in the near future". This water body would also be included in the WFD Programme of Measures because it is at risk of breaching the non-deterioration principle.

EXAMPLE B: The water body is eutrophic or it may become eutrophic in the near future (case 1 corresponding to current moderate status). Therefore action is needed under UWWT and Nitrates Directives and it will also be included in the WFD Programme of Measures as this water body will not achieve the WFD objective of good status if no action is taken.

EXAMPLE C: This is the case where no eutrophication problem exist today and none could be envisaged for the future. It should be noted that if it is forecasted that the water body will deteriorate from high to good status, action should be taken under WFD Programme of Measures as this water body would be at risk of breaching the non-deterioration principle.

EXAMPLE D: In this case it is forecasted that the status of the water body will improve and it will reach good or high status. This can reflect the case in which measures under UWWT and Nitrates Directives have already been taken and are forecasted to be sufficient to achieve WFD objectives. No further action under WFD is thus necessary.

EXAMPLE E: The last case has also the same starting point as D, but it is not expected that the measures taken according to the requirement of the Nitrates and UWWT Directives will give sufficient improvement in order to achieve a non-eutrophic status. This means that this water body has been designated as polluted waters and/or sensitive area. WFD assessment would not change this designation. The WFD assessment results in a "less than good" status in the future as concerns nutrient enrichment. Additional measures to achieve WFD objectives are necessary under WFD Programme of Measures.

57. Linked with Example E, it is important to recall that under article 5.5 of the Nitrates Directive "Member States shall take, in the framework of the action programmes, such additional measures or reinforced actions as they consider necessary if, (…) the measures referred to in paragraph 4 will not be sufficient for achieving the objectives specified in Article 1". Therefore, in case of pollution from agricultural sources, the obligation to take additional measures, and to review their effectiveness every four years (Art 5(7)), is already in force. In case of UWWT Directive, according to the Annex IB.4, more stringent measures must be applied where required to ensure that the receiving waters satisfy any other relevant Directives, for example the WFD.

58. It is important to note also that measures under UWWT and Nitrates Directives are considered basic measures in the WFD Programme of Measures, and therefore are minimum requirements to be complied with (Article 11.3 and Annex VI, Part A of the WFD).

59. The comparison of assessment results under various policies introduced in the preceding section and illustrated with the examples in Table 7, ensure a coherent and reinforced action against eutrophication across different policies.

60. In the examples a generic "future" scenario is used, deliberately omitting any deadline for implementation of different directives. Measures under Nitrates and UWWT directives should have already been taken to combat eutrophication as appropriate. Nevertheless, as stated previously, from 2006 onwards

and for new developments and newly identified problems, WFD assessment framework may help in the implementation of these other directives.

4. THE WFD CONCEPT OF ECOLOGICAL STATUS IN THE CONTEXT OF EUTROPHICATION

61. This section summarises the main outcomes of the paper drafted by the Working Group on Ecological Status under the WFD Common Implementations Strategy, on interpretation of the WFD concept of ecological status on the context of eutrophication (the full paper is available as a background document). This paper is based and further develops the Classification Guidance Document which was adopted by the Water Directors in November 2003 (see Annex 1, section 1.1.6 for a summary of this document).

62. The objective of this chapter is to set out a proposed common understanding of the Water Framework Directive’s normative definitions in the context of nutrient enrichment. Such an understanding is necessary to underpin the ecological status classification in the context of eutrophication and thus the intercalibration exercise and the design of monitoring programmes. The proposed understanding focuses on those key principles of the normative definitions that are relevant across the water categories.

4.1. Most sensitive biological quality elements

63. As a general rule, aquatic flora quality elements will have an earlier response to nutrient conditions than benthic invertebrates or fish fauna. The relative ‘sensitivity’ of different aquatic flora to nutrient enrichment may vary, depending on local circumstances, e.g. water category, surface water body type and the nature of the pressure and transport of nutrient loading.

64. For instance phytoplankton, phytobenthos and macroalgae derive their nutrients from the water column and, under the right conditions, can colonise, grow and reproduce quickly. As a consequence, they tend to respond rapidly to changes in nutrient concentrations. However, these quality elements can also be characteristically highly variable. This may make reliable assessments of their condition difficult.

65. Rooted macrophytes and angiosperms derive their nutrients from sediments or from a combination of sediments and the water column. Their response to nutrient enrichment tends to be slower than that of phytoplankton, phytobenthos and macroalgae, and therefore may enable reliable assessments to be achieved more easily. On the other hand, this relative ‘stability’ means that assessments based solely on macrophytes and angiosperms may in some situations fail to detect the early onset of eutrophication.

4.2. Role of the normative definitions in the development of ecological assessment methods

66. The normative definitions are the basis for identifying suitable boundary values for each of the indicator parameters. After selecting the metric or metrics to be used to assess the condition of the quality element, the common interpretation of the normative definition will drive the setting of the boundaries for

each metric. Once a boundary has been set up, the monitoring results can be used to classify the condition of the quality element.

4.3. Shared principles in the normative definitions for the different water categories

67. The type-specific conditions defined for good and for moderate ecological status in rivers, lakes, transitional and coastal waters represent equivalent stages in the process of eutrophication in the different water categories, even if the conditions are sometimes expressed in the Annex V normative definitions using different wording.

4.4. Description given for abundance and taxonomic composition of aquatic flora

68. The condition of phytoplankton, phytobenthos, and macroalgae would not be consistent with good status unless there was a negligible probability (i.e. risk) that accelerated algal growth would result in a significant undesirable disturbance to the aquatic ecosystem (see Figure 4). The condition of macrophytes and angiosperms would not be consistent with good status unless there was a negligible probability that accelerated growth of higher forms of plant life would result in a significant undesirable disturbance to the aquatic ecosystem.

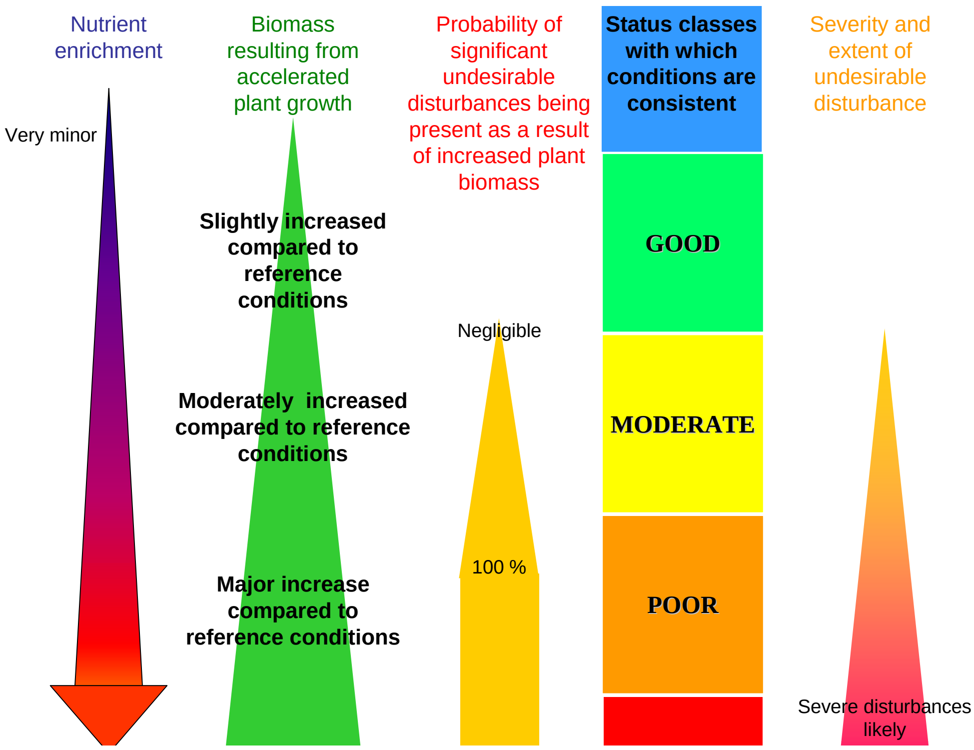


Figure 4. Once phytoplankton biomass; macroalgal cover; average phytobenthic abundance; average macrophytic abundance or angiosperm abundance has reached levels at which the probability of a significant undesirable disturbance to the aquatic ecosystem is no longer negligible, the condition of the water body would not be consistent with good status.

69. A significant undesirable disturbance is a direct or indirect anthropogenic impact on an aquatic ecosystem that appreciably degrades the health or threatens the sustainable human use of that ecosystem (see Table 8). For a water body to be at good status there must be a negligible probability of such disturbances being present as a result of human activity.

Table 8. Significant undesirable disturbances that may result from accelerated growth of phytoplankton, macroalgae, phytobenthos, macrophytes or angiosperms[14]

a.	Causes the condition of other elements of aquatic flora in the ecosystem to be moderate or worse (e.g. as a result of decreased light availability due to increased turbidity & shading)
b.	Causes the condition of benthic invertebrate fauna to be moderate or worse (e.g. as a result of increased sedimentation of organic matter; oxygen deficiency; release of hydrogen sulphide; changes in habitat availability)
c.	Causes the condition of fish fauna to be moderate or worse (e.g. as a result of oxygen deficiency; release of hydrogen sulphide; changes in habitat availability)
d.	Compromises the achievement of the objectives of a Protected Area for economically significant species (e.g. as a result of accumulation of toxins in shellfish)
e.	Compromises the achievement of objectives for a Natura 2000 Protected Area
f.	Compromises the achievement of objectives for a Drinking Water Protected Area (e.g. as a result of disturbances to the quality of water)
g.	Compromises the achievement of objectives for other protected areas, e.g. bathing water.
h.	Causes a change that is harmful to human health (e.g. shellfish poisoning; toxins from algal blooms in water bodies used for recreation or drinking water)
i.	Causes a significant impairment of, or interference with, amenities and other legitimate uses of the environment (e.g. impairment of fisheries)
j.	Causes significant damage to material property

70. In some cases, undesirable disturbances in the balance of the taxonomic composition of a plant quality element may occur at a level of nutrient enrichment that is insufficient to produce a plant biomass that has potential to be the cause of significant undesirable disturbances to other quality elements (Figure 5).

[14] See also §§18 and 22 of the ECJ judgement for the case C-280/02.

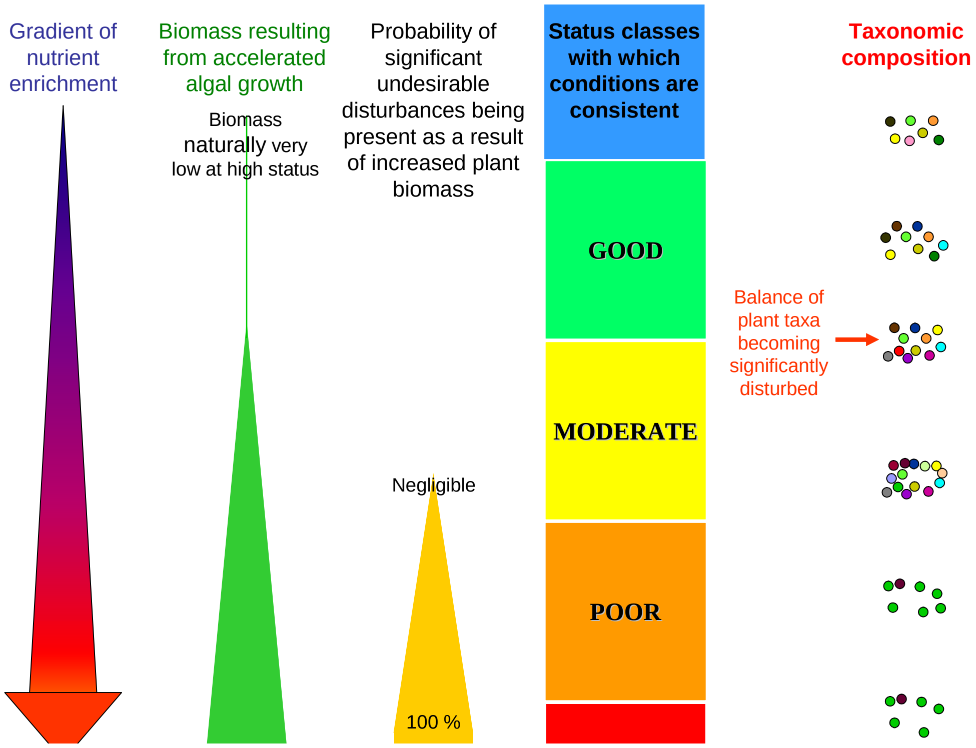


Figure 5. Ecologically undesirable changes in the balance of aquatic flora taxa may occur earlier along an increasing nutrient enrichment gradient than ecologically undesirable disturbances resulting from changes in the biomass of that flora (e.g. in some lakes that at reference conditions are low in nutrients and plant biomass)

71. The condition of phytoplankton, phytobenthos, macrophytes, macroalgae or angiosperms would not be consistent with good ecological status where, as a result of anthropogenic nutrient enrichment, changes in the balance of taxa are likely to adversely affect the functioning or structure of the ecosystem (see Table 9). For a water body to be at good status there must be a negligible probability of such disturbances to the balance of organisms being present.

Table 9. Examples of ecologically significant undesirable changes to the balance of taxa.

Moderate conditions	Poor or bad conditions
The composition of taxa differs moderately from type-specific reference conditions such that:	
• nutrient-tolerant taxa or a functional group[15] of taxa that are absent or rare at reference conditions is no longer rare	• communities are dominated by nutrient-tolerant functional groups normally absent or rare under reference conditions
• moderate number of taxa are absent or rare compared to reference conditions such that a functional group of taxa is in significant decline; or • The condition of the functional group of taxa is exhibiting clear signs of stress such that there is a significant risk of localised extinctions at the limits of its normal distributional range	• one or more functional groups of taxa normally present at reference conditions has become rare or absent • the distribution of a functional group of plant taxa is so restricted compared to reference conditions that a significant loss of function has occurred (e.g. invertebrates or fish are in significant decline because of the loss of habitats normally provided by functional groups of macrophyte; macroalgal or angiosperm taxa)
• a group of taxa normally present at reference conditions is in significant decline	• a group of taxa normally present at reference conditions has become rare or absent

72. It is relevant here to introduce the interpretation of the European Court of Justice of the concept of “undesirable disturbances of the balance of organism present”. A recent court ruling states that this concept means species changes involving loss of ecosystem biodiversity, nuisances due to proliferation of opportunistic macroalgae and severe outbreaks of toxic and harmful phytoplankton (see Annex 1, section 1.2.4).

4.5. The role of general physico-chemical quality elements

73. The relative significance of nitrogen and phosphorus enrichment in different surface water categories and types of surface waters will vary. In transitional and coastal waters anthropogenic nitrogen enrichment could be the most important cause of eutrophication whereas in many fresh surface waters, phosphorus enrichment is likely to be more important.

74. If the monitoring results for (a) the biological quality element or elements most sensitive to nutrient enrichment and (b) the nutrient or nutrients being discharged in significant quantities meet the relevant type-specific conditions required for good ecological status, the level of nutrient enrichment in the water body will be consistent with good ecological status.

75. However, if either (a) one of the most sensitive biological quality elements to nutrient enrichment; or (b) one of the nutrients being discharged in significant quantities do not meet the conditions required for good ecological status, the ecological status of the water body will be moderate or worse.

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15 Functional groups of taxa are different groups of taxa within a biological quality element that serve particular ecological roles

76. Further guidance on classification and, in particular, on the role of general physico-chemical quality elements is provided in CIS Guidance on the Classification of Ecological Status. The guidance describes a checking procedure aimed at helping to ensure that the good status type-specific levels for nutrient concentrations are neither more stringent nor less stringent than required to support the achievement of good status for the type-specific conditions for the biological quality elements and the functioning of the ecosystem (see also Annex 1, section 1.1.6).

5. OVERVIEW OF CURRENT EUTROPHICATION RISK ASSESSMENT METHODOLOGIES AND CRITERIA IN EUROPEAN COUNTRIES

5.1. Introduction

77. Eutrophication assessment methodologies and criteria have been used to date by Member States in the classification of water quality status and in the implementation of the Urban Waste Water Treatment and Nitrate Directives. Most recently, Member States have completed WFD Article 5 risk assessments and in some cases have used existing impact criteria or newly derived pressure criteria to determine whether surface water bodies are at risk of failing their environmental objectives in 2015 from eutrophication related pressures. New eutrophication-related assessment methodologies and criteria are under development in Member States for the classification of ecological status in surface water categories and some of these are subject currently to intercalibration. The EU research project REBECCA is supporting the development of these methodologies and criteria and the timetable for the project deliverables has been synchronised to some extent with the timetable for the intercalibration process. This process will be finalised in autumn 2006.

78. The present overview of current eutrophication assessment methodologies and criteria is based on a preliminary compilation of information provided by Member States during the development of this guidance document and on currently known examples of new methodologies and criteria from the REBECCA project and the intercalibration process.

79. Sections 5.2 to 5.4 summarise the information available from these sources for lakes, rivers and transitional/coastal/marine waters respectively.

5.2. Lakes

80. The following information is based on data and information presented in Annex 3.

5.2.1. Existing assessment methodologies and criteria used for water quality status classification

81. Many Member States have existing water quality assessment systems that include assessment methods and criteria for eutrophication related parameters. Information collated in previous syntheses (i.e. Cardoso *et al*., 2001) and as part of this activity (see Annex 3 Table 1a) indicates that the assessment of the degree of eutrophication in lakes to date has been primarily determined through the application of nutrient (phosphorus

and nitrogen) concentration criteria supplemented with the use of the direct effect criteria chlorophyll a and secchi depth. Occasionally other direct effect criteria, such as phytoplankton composition, are used. Also a variety of other criteria are used in some member states (see Annex 3 Table 1a). Indirect effect criteria (dissolved oxygen concentrations and responses in benthic invertebrate and fish communities) are rarely used in existing systems for eutrophication assessment in lakes. Some of the existing water quality assessment schemes recognise the existence of different lake types in broad terms but many schemes are currently applied to all lakes in a Member State.

82. With few exceptions these assessment systems are not type specific in terms of WFD typology and do not relate to reference conditions, but rather to fixed concentrations of the criteria divided into five status classes.

83. At the present state the existing assessment systems of Norway, Sweden, Finland, Austria, Italy and Hungary have been compiled (Annex 3 Table 1a). For the most commonly used assessment criteria: Chlorophyll, Total phosphorus and secchi depth, the different systems except Hungarian show relatively good agreement between countries for the best class in the assessment systems: For chlorophyll a (summer mean values) the best class varies from < 2 µg/L in Norway and Sweden to < 4 µg/L in Finland and Austria. For total phosphorus (summer mean values) the best class varies from < 7 µg/L in Norway to < 13 µg/L in several other countries. For secchi depth the best class varies from > 6m to > 3m between countries. For all these three basic eutrophication assessment criteria used in existing classification systems, the between country variation for the best class is roughly a factor of 2. For the other classes the variation between countries are larger, probably due to both different class definitions, as well as to real regional differences. For further details please see Annex 3 Table 1a.

The Hungarian system has considerably higher boundaries between the classes for total phosphorus and chlorophyll, which is probably related to completely different lake types in Hungary (very shallow, calcareous) compared to the Northern and Alpine countries (deeper, more siliceous geology). The Hungarian class I has values comparable to class III (moderate) in the other countries compiled, whereas the Hungarian class II compares to class IV or V (poor or bad) in the others.

For the indirect effect criterium oxygen saturation, the two systems compiled (Hungary and Finland) shows relatively good agreement, with class I having 80-110% O_2 saturation, whereas class V has < 20% or < 40% O_2 saturation for the Hungarian and Finnish systems respectively.

The two countries, Sweden and Austria that have developed classification systems for phytoplankton biomass (mg/L) show remarkably good agreement: Class 2 is <1 mg/L and class 5 is > 5 mg/L.

For other assessment criteria the data provided is not sufficient to enable comparisons between countries.

5.2.2. Assessment methodologies and criteria used for UWWT and Nitrate Directive designations

84. This section refers only to the information received from Member States during the development of this guidance document and hence do not take into account other information that could have been submitted in the context of other duties or reporting obligations. Very few member states have reported their criteria for assessment of eutrophication under UWWT and Nitrates Directives. Further details on the criteria used are provided in Annex 3 Table 2a).

5.2.3. Impact and pressure criteria used in WFD Article 5 risk assessment

85. In completing the WFD Article 5 risk assessments for eutrophication related pressures, some Member States have derived pressure and impact criteria to determine whether a lake water body was at risk of not achieving its environmental objective in 2015. Where used, the pressure criteria have been based on the presence of point sources of nutrients and/or a proportion of a particular land use (most commonly agricultural and urban land uses) in the catchment of the lake. One country (Spain) assesses a water body to be probably at risk if the application of fertilizer is > 25 kg N /ha year or if major point sources are present, such as urban waste water > 2000 PE, unless no impact is documented.

86. For the most part, the impact criteria were based on nutrient concentrations (phosphorus and nitrogen) with occasional examples of the use of direct effects (chlorophyll a) criteria to supplement them. For the latter the existing classification systems are used in a way in which lakes in the high or good classes are assessed as being not at risk, whereas lakes in the poor or bad classes are assessed as being at risk of failing the WFD objective. One member state (UK) use the EQR < 0.5 for current phosphorus concentrations relative to type or site-specific reference conditions to assess water bodies at risk, whereas other (NL) use, among others, the existing management target value to assess water bodies at risk. The actual cut-off for total phosphorus between at risk and not at risk varies from < 10 µg/L to > 100 µg/L between different countries, probably related to type differences. For chlorophyll the only two member states who have reported cut-off values (Norway and Spain) both use 8 µg/L to say that a water body is clearly at risk (Norway) or probably at risk (Spain). Other impact criteria are too scarcely used to allow comparisons between countries. Many member states also evaluate future trends in nutrient pressures from the catchment as part of their risk assessment. Further details on the criteria used are provided in Annex 3 Table 3a.

5.2.4. Examples of development of new WFD-compliant assessment systems

87. Many Members States are currently engaged in the development of new, or refinement of existing, assessment methods for the eutrophication related biological quality elements required for the assessment of ecological status under the WFD. The ongoing work under the Intercalibration process is currently focussed on phytoplankton and macrophyte responses for eutrophication assessment of lakes. Intercalibration metrics used for lakes are: chlorophyll a phytoplankton taxonomic composition (% bluegreens, % chrysophytes, %

diatoms etc), macrophyte composition (% isoetids, % characeans), reduction in depth distribution of macrophytes.

88. The development of these methods will necessarily result in the definition of type specific reference conditions and class boundary criteria for the classification of ecological status with respect to these biological quality elements. The development of these methods for the biological quality elements will also result, in some cases, in the development of criteria for the eutrophication related supporting physico-chemical determinands such as secchi depth and nutrients, primarily total phosphorus concentrations.

89. The intercalibration process will not provide information on the indirect effects of eutrophication, such as oxygen depletion in bottom waters and fish kills.

90. Work is also underway in the REBECCA project under Work Package 3 (WP3 Lakes) to determine the relationships between nutrient concentrations and response variables relating to phytoplankton, macrophytes, macroinvertebrates and fish. A review of the literature on these relationships in European lakes has been completed (Heiskanen *et al.* 2005), as well as a report on Reference conditions of European Lakes (Lyche-Solheim *et al.* 2005).

91. The completion of ongoing work within Member States and at the EU level in research projects such as REBECCA and as part of the intercalibration process should provide assessment systems and criteria for eutrophication related biological quality and supporting physico-chemical elements required under the WFD in time for the implementation of the monitoring programmes in late 2006.

92. Annex 3 Table 4a shows the present state-of-the-art for the development of new WFD-compliant criteria for eutrophication assessment.

5.3. Rivers

93. The information in the following sections is based on the information compiled in Annex 3.

5.3.1. Existing assessment methodologies and criteria used for water quality status classification

94. Many Member States have existing water quality assessment systems that include assessment methods and criteria for eutrophication related parameters. Information collated in previous syntheses (i.e. Cardoso *et al.*, 2001) and as part of this activity (see Annex 3 Table 1b) indicates that the assessment of the degree of eutrophication in rivers to date has been primarily determined through the application of nutrient (phosphorus and nitrogen) concentration criteria with the occasional supplementary use of direct effect (chlorophyll a and responses in phytobenthos and macrophyte communities) and indirect effect (dissolved oxygen concentrations and responses in benthic invertebrate communities) criteria. The most commonly used parameter for rivers is total phosphorus and the criteria for excellent water quality are broadly comparable (0.01 to 0.07 mg/l TP; though these include summer mean, annual mean and 90 and 75%ile values). Orthophosphorus criteria are used in one Member States. Criteria for total nitrogen and nitrate are used in 2

Member States and also show good agreement. In all cases existing classification schemes are currently applied to all types of river.

5.3.2. Assessment methodologies and criteria used for UWWT and Nitrate Directive designations

95. This section refers only to the information received from Member States during the development of this guidance document and hence do not take into account other information that could have been submitted in the context of other duties or reporting obligations. Very few member states have reported their criteria for assessment of eutrophication under UWWT and Nitrates Directives. The most commonly used criterion for designation of NVZs is the 50 mg/l NO_3 value. However, for UWWT Sensitive Area designation, phosphorus criteria are used along with further information from direct effect measures (chlorophyll a concentration and metrics of phytobenthos and macrophytes community response) and from indirect effect measures (changes to the dissolved oxygen regime) in a weight of evidence approach to determine the case for designation. Further details on the criteria used are provided in Annex 3 Table 2b.

5.3.3. Impact and pressure criteria used in WFD Article 5 risk assessment

96. In completing the WFD Article 5 risk assessments for eutrophication related pressures, some Member States have derived pressure and impact criteria to determine whether a river water body was at risk of not achieving its environmental objective in 2015. Where used, the pressure criteria have been based on the presence of point sources of nutrients and/or a proportion of a particular land use (most commonly agriculture, forestry and unsewered human populations) in the upstream catchment of the river water body. For the most part, the impact criteria were based on nutrient concentrations (phosphorus and nitrogen). The most commonly used impact criteria were for total phosphorus and orthophosphate. Values for the estimated good/ moderate class boundary used in the Article 5 risk assessments were comparable for similar river types (i.e. lowland rivers) (0.15 mg/l TP and 0.1mg/l orthophosphate-P). Criteria for total N and for nitrate were used in some Member States supplemented with criteria for indirect effects measures (dissolved oxygen concentrations, benthic invertebrate and phytobenthos based measures). Further details on the criteria used are provided in Annex 3 Table 3b.

5.3.4. Examples of development of new WFD-compliant assessment systems

97. Many Member States are currently engaged in the development of new, or refinement of existing, assessment methods for the eutrophication related biological quality elements required for the assessment of ecological status under the WFD. For rivers, the eutrophication related biological quality elements are principally phytobenthos, macrophytes and, where appropriate, phytoplankton because these metrics are based on the response of the aquatic flora to changes in nutrient concentrations. The development of these methods will necessarily result in the definition of type specific reference conditions and class boundary criteria for the classification of ecological status with respect to these biological quality elements. The development of these methods for the biological quality elements will also result, in some cases, in the

development of criteria for the eutrophication related supporting physico-chemical determinands such nutrients and dissolved oxygen concentrations. Information collated under this activity on the development of new methods (Annex 3 Table 4b) indicates that preliminary criteria for nutrients (total phosphorus, orthophosphate, total nitrogen and nitrate) have been proposed for reference conditions and the good/moderate boundary in a number of Member States. Additional criteria for chlorophyll a, dissolved oxygen and benthic invertebrate measures have also been suggested.

98. Work is also underway in the REBECCA project under Work Package 4 (WP4) to determine the relationships between nutrient concentrations and response variables relating to phytoplankton, phytobenthos and macrophytes. A review of the literature on these relationships in European rivers has been completed (Andersen *et al.* 2004).

99. The ongoing work under the Intercalibration process is currently focussed on benthic invertebrates for rivers. Benthic invertebrates are widely used as an indicator of water quality in rivers throughout the EU and for the purposes of the intercalibration process are considered to be a response variable for a 'general' pressure comprising contributions from both physico-chemical and hydromorphological sources. The intercalibration of phytobenthos metrics is planned in some Geographical Intercalibration Groups (GIGs) but has yet to receive much attention.

100. The completion of ongoing work within Member States and at the EU level in research projects such as REBECCA and as part of the intercalibration process should provide assessment systems and criteria for eutrophication related biological quality and supporting physico-chemical elements required under the WFD in time for the implementation of the monitoring programmes in late 2006.

5.4. Transitional, coastal and marine waters

5.4.1. Existing assessment methodologies and criteria used for water quality status classification

101. Regarding marine waters, several Member States use water quality assessment methodologies and criteria related to eutrophication that have been established in the frame of the Marine Conventions. The existing information on eutrophication assessment (Conventions and national methodologies) shows that, as in the case of rivers and lakes, eutrophication is determined according to criteria including nutrient concentration together with direct effects (chlorophyll and other biological parameters) and indirect effects (dissolved oxygen, organic matter, algal toxins, etc). Further details on the criteria used are provided in Annex 3 Table 5.

5.4.2. Assessment methodologies and criteria used for UWWT and Nitrate Directive designations

102. There is limited information available from Member States regarding the criteria used for the UWWT and Nitrate Directive designations. The information available regarding designating Sensitive Areas under

the UWWTD shows that the designation was based principally on nutrient (DIN and orthophosphate) concentrations and chlorophyll concentrations.

5.4.3. Impact and pressure criteria used in WFD Article 5 risk assessment

103. The available information for Article 5 related criteria indicates that whenever pressure criteria were reported these were based mainly on the presence of surface point sources (sewage) of nutrients loads and surface water run-off. The impact criteria were based mainly on nutrient concentrations and chlorophyll a (direct effect) and occasionally on dissolved oxygen, macrovegetation, etc (indirect effects).

5.4.4. Examples of development of new WFD-compliant assessment systems

104. Eutrophication related assessment methodologies and criteria are subject to intercalibration for marine waters. The eutrophication related biological metrics that are subject to intercalibration in at least some marine water GIGs are: chlorophyll a, phytoplankton, macroalgae, angiosperms and benthic invertebrates. There is also related work on eutrophication related supporting physico-chemical determinands including nutrient concentrations, transparency and dissolved oxygen concentrations.

105. At present there is limited information available on progress with these developments.

6. TOWARDS HARMONISATION OF CLASSIFICATION CRITERIA

106. Chapter 5 compiles assessment information for eutrophication serving different purposes under various policies. This information has been submitted by Member States for the development of this guidance document. Although there is a great deal of information, the current compilation is far from complete. The most important reason is that several on-going processes will have a strong impact in the eutrophication assessment systems used in Member States, the intercalibration being the most relevant of those from an European perspective.

107. The intercalibration process is a legal obligation stemming from Section 1.4.1 of Annex V of the WFD and its objective is to achieve a EU-wide common understanding of good ecological status consistent with WFD normative definitions. The process is organised in Geographical Intercalibration Groups (GIG) that are groups of Member States sharing certain types of rivers, lakes, transitional or coastal waters. For some of this GIGs, nutrients are one of the main pressures to be assessed. It should be noted that the intercalibration is foreseen for biological quality elements only. However, as an important secondary outcome of the exercise, information on classification criteria for other quality elements may be expected.

108. Very strongly linked with the intercalibration exercise, the FP6 research project REBECCA is already providing new insights on the relationship between physico-chemical quality elements and the ecological quality elements, which will be very useful in developing WFD compliant assessment methods, also in the context of eutrophication. The project will finish by the end of 2006.

109. In parallel to the development of the intercalibration exercise, Member States are currently designing their WFD compliant monitoring networks, due to be operational in December 2006. These classification systems will address how to combine assessment information from different quality elements into a final assessment of ecological status. Guidance for the development of this systems has been produced by the Ecostat (see section 1.1.6 in Annex 1 for a summary of the Guidance Document on classification of ecological status).

110. Within OSPAR, further experience with the application of the 'Common Procedure' will be obtained from its second application, the results of which will be finalised by the meeting of the OSPAR Commission in 2008. In the intervening period, further work will be undertaken, amongst others, to obtain further indications out how some of the assessment parameters mentioned by the procedure — such as total nitrogen, total phosphorus, total diatoms, total (dino)flagellates, zoobenthos, transboundary nutrients input, atmospheric input — can be used in the Common Procedure in addition to the existing parameter set; and indications of the robustness of the parameters as basis for conclusions on whether the parameter is useful for harmonised application. OSPAR is also investigating the use of models for understanding the system dynamics associated with eutrophication and possibly as a predictive tool for assessing the eutrophication status following implementation of agreed measures.

111. Within HELCOM, the results from EUTRO project (Development of tools for assessment of eutrophication in the Baltic Sea) carried out during 2005 will provide information on testing of an eutrophication assessment method adopted from OSPAR and modified to the Baltic Sea conditions.

112. It is considered that any attempt to harmonise eutrophication classification criteria should be informed by these on-going projects, in order to avoid any duplication of efforts, and therefore it is proposed to hold the development of this part of the guidance until the outcome of this work is available.

113. Chapter 3 (section 3.6) proposes a conceptual approach to read across the assessment results of various Directives and policies. Further work is needed to test and validate this conceptual understanding, to prove it is workable from a practical perspective, and provide guidance on its implementation. The results of the on-going activities mentioned in the preceding paragraphs and the case studies that are outlined in Chapter 8 will contribute to develop guidance on these topics.

114. Linked with the design of monitoring systems and the Classification Guidance, further work can provide useful guidance on how to combine the results for different parameters and quality elements in relation WFD ecological status classification in terms of eutrophication.

7. MONITORING – GUIDANCE AND INTEGRATION OF REQUIREMENTS STEMMING FROM VARIOUS OBLIGATIONS

7.1. Introduction

115. The aim of this chapter is to:

- Specify further which aspects in the existing Guidance on Monitoring are relevant for eutrophication assessment;
- How to harmonise the monitoring in a way to satisfy the requirements in the different directives and regional conventions dealing with eutrophication.

116. As Section 1.1 of this document indicates, this guidance on monitoring has to be firmly based on the methodological concept of the Water Framework Directive and to explore thereafter to what extent this methodology can be used in the context of other directives and policies. For the Water Framework Directive monitoring networks have to be designed "so as to provide a coherent and comprehensive overview of ecological and chemical status within each river basin and shall permit classification of water bodies into five classes consistent with the normative definitions in section 1.2"[16]. Table 2 (section 3.2) gives a general overview of the requirements of EC Directives and regional conventions regarding the assessment and monitoring of eutrophication.

117. Assessing eutrophication in specific water body types may change specific monitoring requirements. The implementation activities of the Water Framework Directive have already addressed monitoring needs to a certain degree (e.g. Monitoring guidance document); however the spatial and temporal monitoring requirements may differ for critical variables when eutrophication issues are specifically focused on, and the requirements of specific water types (e.g. to capture the necessary seasonality and flow dependency in nutrients and of nutrient loads, chlorophyll and oxygen) are considered.

118. Member States are in the process of designing their monitoring networks for the Water Framework Directive: these have to be operational by 22 December 2006. Member States will wish, where possible, to have integrated monitoring programmes that provide the data and information which will meet the needs of all the relevant policies, in this case, all those that deal with eutrophication. For example, where possible, the same monitoring stations, quality elements and sampling frequencies would be used for Water Framework Directive assessments and also for any assessment required for other policies e.g. OSPAR.

7.2. Guidance documents

119. Monitoring guidance documents or guidelines have been developed for most of the policy drivers dealing with eutrophication. These have been used in this document and include:

- Common Implementation Strategy Guidance document No. 7: Monitoring under the Water Framework Directive, 2003[17].
- Common Implementation Strategy Guidance document No. 13: Overall approach to the classification of ecological status and ecological potential, 2003[17].
- Urban waste Water Treatment Directive (91/271/EEC). There is no EU guidance on how the monitoring of water status/quality[18] should be undertaken. There may be national examples available.
- European Commission. Draft guidelines for the monitoring required under the Nitrates Directive (91/676/EEC), March 2003[19].
- HELCOM. Monitoring and Assessment Strategy (http://www.helcom.fi/groups/monas/en_GB/monitoring_strategy/) and Manual for Marine Monitoring in the COMBINE Programme of HELCOM (http://sea.helcom.fi/Monas/CombineManual2/CombineHome.htm)
- OSPAR (2005). Eutrophication Monitoring Programme, OSPAR Agreement 2005-04..
- UNEP-MAP (2003) Eutrophication monitoring strategy of MEDPOL. UNEP(DEC)/MED WG.231/14, 30 April 2003.

120. It should also be noted that the European Marine Monitoring and Assessment (EMMA) group formed under the European Commission's "*Thematic Strategy for the Protection and Conservation of the European Marine Environment*" is also considering ways of harmonising monitoring and assessments of marine waters including for eutrophication. The recommendations arising from EMMA would have to be taken into account in this guidance document and in any subsequent harmonisation of monitoring programmes.

121. Also the revision of HELCOM monitoring programmes is underway (MONPRO project). The aim of the revision is to have a monitoring and assessment framework, which is in line with obligations stemming from various regulations (e.g. WFD, UWTD, Nitrates Directive) and which foresees the demands from the Thematic Strategy for the Protection and Conservation of the European Marine Environment

122. A detailed analysis and comparison of the monitoring requirements/guidelines is given in a background paper.

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16 Article 8

17 Informal consensus position on best practice agreed by all CIS partners

18 The Directive gives guidance on the monitoring of the effluents before discharge from the treatment works (Annex 1D of Directive 91/271/EEC)

19 Non statutory guidelines, informally discussed by Member States in the Nitrates Directive Committee, however the text has never been submitted to a formal vote

7.3. Water categories and geographic coverage

123. The Water Framework Directive covers all waters, including inland waters (surface water and groundwater) and transitional and coastal waters up to one sea mile (in terms of monitoring ecological status and hence eutrophication - and for the chemical status also territorial waters which may extend up to 12 sea miles) from the territorial baseline of a Member State, independent of the size and the characteristics[20.] These waters (water bodies) will need to be included in surveillance, operational or investigative monitoring programmes. Monitoring of surface freshwaters, estuarine, coastal and marine waters is also required for the Nitrates Directives where marine waters are referred to as those in "exclusive economic zones". The geographic extent of marine waters included in the requirements of the Urban Waste Water Treatment Directive is not clear: Annex II, (criteria for the identification of sensitive and less sensitive areas) includes estuaries and coastal waters in terms of sensitive areas, whereas marine water bodies are included in the criteria for less sensitive areas. Coastal waters are defined as "waters outside the low-water line or the outer limit of an estuary"[21.]

124. The monitoring required for Marine Conventions is generally for assessing the state[22] of transitional, coastal and open marine waters.

125. Operational monitoring for the Water Framework Directive will be carried out for all those water bodies identified as being at risk of failing their environmental objectives (for example, achievement of good ecological status or good ecological potential, or no deterioration of status). Where this risk is due to nutrient enrichment and water bodies have been assessed as eutrophic under other policies, these water bodies will be, or be part of, a sensitive area/water body, or a polluted water or a problem area, respectively, under the Urban Waste Water Treatment Directive, Nitrates Directive and OSPAR Strategy to Combat Eutrophication (in waters of overlapping jurisdiction) (see section 3.6). For these water bodies, operational monitoring will potentially help assess the effectiveness of the measures introduced under those other polices, and help to decide what further measures may be needed. In waters/water bodies not previously identified as eutrophic under the other policies but have been identified by the Annex II risk assessments as being at risk from nutrient enrichment, operational monitoring could be the basis for deciding a water body is "eutrophic", as part of its status assessment. Where there is a risk of future deterioration of status (due to increasing nutrient pressures), operational monitoring could also contribute to the assessments needed as to whether waters "may become eutrophic" under the other policies. In short, it is anticipated that, depending on the commonalities between other aspects of monitoring e.g. geographic jurisdiction, quality elements and

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20 Articles 2 (1), (2) and (3)

21 Article 2.13

22 Some Marine Conventions also require the monitoring of rivers for the estimation of loads entering the marine environment

frequency, integrated monitoring programmes could be established that will provide the data and information required for all of the relevant policies dealing with eutrophication.

126. Surveillance monitoring for the Water Framework Directive must be carried out of sufficient surface water bodies to provide an assessment of the overall surface water status within each catchment or subcatchments within the river basin district [23]. This implies that water bodies across a range of statuses will be included and in particular those identified as not being at risk of failing their environmental objectives (good and high status water bodies, no risk of deterioration of status). Where Member States have identified sensitive and less sensitive areas for the Urban Waste Water Treatment Directive, and designated vulnerable zones for the Nitrates Directive, there is a requirement for Member States to review the identification of sensitive areas[24] and less sensitive areas, and the eutrophic state[25] of their surface waters (Nitrates Directive) every four years. Assuming that this would involve some monitoring[26] then it is likely that this would include those water bodies not previously identified as being sensitive (i.e. normal or less sensitive) or polluted. Where relevant, in terms of overlapping geographic jurisdiction of the different policies , it would be expected that the results from surveillance monitoring (which will include parameters indicative of the quality elements relevant to eutrophication) could contribute to the review and assessment of non – eutrophic, non polluted waters and non-problem areas (the latter as identified in the OSPAR Common Procedure) (see Table 5, section 3.6). Results from surveillance monitoring might also contribute to the establishment of the extent of nitrate pollution from agricultural sources in those countries that have established and applied action programmes throughout their national territory for the Nitrates Directive[27].

7.4. Selection of monitoring points

127. Guidance is given for the selection of monitoring points for inclusion in surveillance and operational monitoring for the Water Framework Directive. There is no EU guidance on the number of monitoring stations that might be appropriate for monitoring the quality of receiving waters under the Urban Waste

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23 Annex V.1.3.1

24 Member States do not have to identify sensitive areas if they have applied Article 5.8 of Directive 91/271/EEC.

25 For the Nitrates Directive monitoring requirements depend on whether Member States establish and apply action programmes throughout their national territory (Article 3.5) or identify and designate specific vulnerable zones (Article 3.1 and 3.2). Monitoring for the purpose of designating and revising the designation of vulnerable zones (Article 6) does not apply to Member States who establish and apply action programmes throughout their national territory. In the latter case, Member States must monitor their surface waters and groundwaters at selected monitoring points to establish the extent of nitrate pollution in their waters from agricultural sources (Article 5.6 first sentence). Those Member States who have designated vulnerable zones must monitor to assess the effectiveness of action programmes (Article 5.6 first sentence), and monitor the nitrate concentration in freshwaters over a period of a year (every 4 years or, under defined circumstances, every 8 years) and to review (every 4 years) the eutrophic state of their fresh surface waters, estuarial and coastal waters (Article 6).

26 Non statutory draft guidelines for the monitoring required under the Nitrates Directive (91/676/EEC), March 2003

27 Article 3.5

Water Treatment Directive. The informal guidance for monitoring under the Nitrates Directive suggests different station densities for rivers and standing waters, with an increased density inside and at the borders of polluted waters, and waters deemed to be at risk from eutrophication, and less in areas with low nutrient pressures.

128. For the OSPAR Eutrophication Monitoring Programme the spatial coverage of stations should be greatest in problem and potential problem areas, and least in non-problem areas. In all cases the optimum station locations are to be determined by each Contracting Party. The HELCOM Combine Manual (for monitoring) indicates that mapping stations and high-frequency stations are required. Mapping stations are used to map the winter pool of nutrients, oxygen/hydrogen sulphide in bottom waters and zoobenthos. High frequency stations are used for pelagic variables and for monitoring water exchange between the various basins in the Baltic Sea, and between the Baltic Sea and the North Sea. MEDPOL's eutrophication monitoring strategy[28] requires Contracting Parties to select representative water bodies in marine waters in order to detect changes over a selected period (e.g. 10 years), and in relation to off-shore fish farms and coastal lagoons.

7.5. Selection of quality elements/parameters to be measured

129. Annex V, Table 1.1 in the Water Framework Directive, explicitly defines the quality elements that must be used for the assessment of ecological status (e.g. composition and abundance of benthic invertebrate fauna). Quality elements include biological elements and elements supporting the biological elements. These supporting elements are in two categories: 'hydromorphological' and 'chemical and physicochemical'. Guidance is given as to which quality elements and parameters indicative of the quality elements should be selected for each type of monitoring[29]. In addition the key features of each element are described with an indication of which pressures the elements respond to e.g. nutrient enrichment[30]. Further guidance on the meaning of parameters, quality elements and groups of quality elements is given in the guidance on the "overall approach to the classification of ecological status and ecological potential"[31].

130. Guidance on the selection of quality elements/parameters to be measured for the purpose of the Nitrates Directive, OSPAR, HELCOM and MEDPOL is also given.

131. At the quality element level there are many similarities between the different policies, particularly for the biological and physicochemical quality elements that are considered to be indicative of eutrophication. However, there are some differences in terms of the recommended measured parameters indicative of the quality elements. More significantly surveillance and operational monitoring for the Water Framework

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[28] UNEP(DEC)/MED WG.231/14 30 April 2003

[29] Guidance document No. 7, pages 21 and 24

[30] Guidance document No. 7, pages 35 to 73

Directive requires the monitoring for hydromorphological quality elements: there is no such explicit requirement in the other relevant policy drivers even though some of these elements are included as supporting environmental factors in the conceptual framework for eutrophication (see Figure 2 in section 2.2).

7.6. Frequency of monitoring

132. Annex V of the Water Framework Directive provides tabulated guidelines in terms of the minimum monitoring frequencies for all the quality elements. The suggested minimum frequencies are applicable to both surveillance and operational monitoring and are generally lower than currently applied in some countries. More frequent monitoring will most likely be necessary in many cases to achieve a reliable assessment of the status of the relevant quality element, but also less frequent monitoring is justified when based on technical knowledge and expert judgment[32]. Member States are also able to target their monitoring to particular times of year to take into account variability due to seasonal factors.

133. Monitoring is required over a year once every 4 years for the Nitrates Directive[33], and the sensitivity of waters in general needs to be reviewed every 4 years for the Urban Waste Water Treatment Directive. The review does not explicitly require monitoring though undoubtedly information from monitoring would be invaluable in the assessment. For the Nitrates Directive a minimum of monthly samples for nitrates is required[34]; this compares with once every 3 months (for nutrient status) for the Water Framework Directive.

134. The OSPAR eutrophication monitoring programme gives different sampling frequencies for problem, potential problem and non-problem areas. For HELCOM there are two main monitoring frequencies recommended: frequent and highly frequent. Frequent sampling ranges from once or twice per year to 6 to 12 times per year depending on purpose and parameter. Some high frequency stations are sampled up to 26 times/year or even more often. For the MEDPOL eutrophication monitoring strategy, the optimal sampling frequency should be chosen by each country according to the parameter variability in the affected area, and with the objective of detecting a change in concentration over a selected period (e.g. 10 years).

135. A common theme between policies is the acknowledgement that monitoring/sampling may need to be targeted to particular seasons (e.g. for seas and large lakes: nutrients in winter, algae in summer) and

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[31] Guidance document No. 13, Paragraph 3.3

[32] Guidance document No. 7 on monitoring, section 2.10.2

[33] For the purpose of designating and revising the designation of vulnerable zones.

[34] At stations laid down in the Surface Water for Drinking Directive (75/440/EEC) and/or other sampling stations representative of surface waters of Member States (Article 6.1.a.i). These stations are used to identify polluted waters based on exceedence or potential exceedence of 50 mg/l nitrate (Annex I.A.1). Annex 1.A.3 also gives “eutrophic” or “may become eutrophic” as other criteria for identifying polluted waters. Though not strictly relevant to the eutrophication criteria (phosphorus is often the limiting nutrient for algal growth in freshwaters), monthly sampling of nitrate at those stations described in Article 6.1.a.i would in practice be useful in the assessment of eutrophication.

particular water bodies/areas (e.g. problem areas, water bodies at risk) and higher sampling frequencies may be needed in more variable water bodies/areas or during periods of high variability than the minimum frequencies recommended[35].

7.7. Monitoring of Protected Areas

136. As already described in section 3.6 of this guidance both sensitive areas under the Urban Waste Water Treatment Directive and polluted waters with nitrate vulnerable zones under the Nitrates Directive become Protected Areas under Annex IV of the Water Framework Directive. This means that monitoring programmes established for the Water Framework Directive will have to take into account any monitoring requirements in the respective Directives such as the monitoring of nitrate in freshwaters over a period of a year at least every 4 years for the Nitrates Directive[36].

7.8. Harmonisation of monitoring programmes

137. Member States will wish, where possible, to have integrated and harmonised monitoring programmes that provide the data and information which will meet the needs of all the relevant policies, in this case, all those that deal with eutrophication. This section attempts to demonstrate where this should be possible based on the commonalities of policies in terms of, for example, geographic coverage of waters and the monitoring requirements as given in Directives/Conventions and any associated guidance/guidelines.

7.8.1. Rivers and lakes

138. For fresh surface water bodies there is potentially a good deal of synergy between policies in terms of the identification and inclusion of the same water bodies impacted by nutrients, and the quality elements indicative of eutrophication that are recommended to be monitored. There is also a joint need to review periodically the status of those water bodies identified as not being impacted by nutrients or at risk of becoming impacted by nutrients: these (or groups of these) may be included in surveillance monitoring for the Water Framework Directive and be part of the periodic review of waters for the Nitrates Directive and Urban Waste Water Treatment Directive. Eutrophication assessment is an integral part of the ecological status assessments under the Water Framework Directive. So the assessments and monitoring to be carried out for ecological status (and for the objective of preventing deterioration in status) should be a good step forward towards integration across these three policies with the Water Framework Directive monitoring (and assessment) schemes meeting the needs for future reviews of Sensitive Areas and Polluted Waters (Eutrophic).

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[35] See, for example, for further guidance section 2.10 in CIS Guidance document No. 7 on monitoring

[36] Article 6 (a)

139. Water bodies impacted by, or at risk from, nutrients will be included in operational monitoring for the Water Framework Directive (though not all will necessarily be monitored as the representative monitoring of groups of water bodies is allowed), and they will also be required to be monitored for the Urban Waste Water Treatment Directive (waters subject to discharges from urban waste water treatment works and direct discharges from some industries) and for the Nitrates Directive (diffuse sources, assessment of effectiveness of action programmes). Surveillance monitoring for the Water Framework Directive may include water bodies across the range of statuses from high to bad (where all statuses exist), and therefore some of the impacted or at risk water bodies (from nutrient enrichment) might also be included: the results from this monitoring might also contribute to the periodic reviews required for the Urban Waste Water Treatment and Nitrates Directives.

140. There are synergies between the monitoring required in all water categories for the different policies in terms of quality elements required for assessing eutrophication particularly in terms of biological quality and physicochemical quality elements but less so for the hydromorphological quality elements required for the Water Framework Directive. There are also some differences in terms of the recommended measured parameters indicative of the quality elements, e. g. HELCOM requires the monitoring of zooplankton in coastal and marine waters, an element not required by the Water Framework Directive or other policies.. However these difference may not be significant as long as some common disaggregated parameters such as composition and abundance of the biological element are measured (at an appropriate taxonomic level) then other related parameters could be easily derived.

141. There are potential differences in the frequency that monitoring might be undertaken in fresh surface waters. The reviews of sensitive/less sensitive areas and eutrophic state under the Urban Waste Water Treatment and Nitrates Directives, respectively, are required at intervals of no more than four years. For the purpose of designating and revising the designation of vulnerable zones under the Nitrates Directive, monitoring for nitrate is required over a year when a minimum of monthly samples is required. It is not yet clear how Member States will implement surveillance and operational monitoring programmes for the Water Framework Directive. A minimum of one year in six years (or one year in 18 years in exceptional circumstances) is given in the Directive for surveillance monitoring, with a minimum of one sample per 3 months for nutrient status[37] in the years that monitoring is undertaken for surveillance and operational monitoring. However, an additional requirement of monitoring for the Water Framework Directive is the choosing of frequencies that "achieve an acceptable level of confidence and precision"[38] in the monitoring results and subsequent assessments. Monthly sampling for nutrients is currently common practice in many Member States. Therefore, Member States might in practice wish to critically assess their sampling frequencies for surveillance and operational monitoring in terms of the confidence in the estimates of status

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[37] Minimum monitoring frequencies are also given for the other quality elements in all water categories

[38] Annex V.1.3.4, sentence 3.

they will provide[39], and in terms of the costs of monitoring. In conclusion, it is likely that an integrated monitoring programme based on the requirements of the Water Framework Directive would be at a frequency that meet the needs of the other policies dealing with eutrophication.

7.8.2. Transitional, coastal and marine waters

142. The monitoring undertaken for the assessment of eutrophication for Marine Conventions includes offshore marine waters not required for the Water Framework Directive. Marine waters in terms of the Nitrates Directive include those within a Member State's exclusive economic zone. Additional monitoring of coastal and marine waters to that required for the Water Framework Directive will, therefore, be required for use in assessing eutrophication for the other relevant policies. Some policies also require the designation of specific areas in relation to eutrophication (e.g. polluted water and problem areas). These areas may not always be the same geographically or in spatial extent and this will have to be borne in mind when developing a harmonised integrated monitoring programme for eutrophication.

143. HELCOM defines frequent and highly frequent monitoring stations that have recommended sampling frequencies higher than other geographically relevant policies (i.e. Water Framework Directive and Nitrates Directive). A common theme that could be incorporated into a harmonised monitoring programme for transitional, coastal and marine waters is the recognition that sampling should be targeted to specific times of year for some of the elements (e.g. nutrients and chlorophyll). There is also a common theme of ensuring that monitoring results are fit for purpose and this implies that different frequencies would be required for different elements, different water categories and different water bodies. As examples: Member States have to achieve acceptable levels of precision and confidence in the monitoring results and subsequent assessments (Water Framework Directive); Contracting Parties have to determine optimum sampling frequencies, for example, to confirm maximum winter nutrient concentrations have been determined (OSPAR) or to detect changes in concentrations over 10 years (MEDPOL).

8. CASE STUDIES

144. The first part of this guidance comprises a proposal for a Common Conceptual Framework for eutrophication that could be adapted to the specific water categories. This framework provides the means for developing water category-specific check-lists as a basis for the assessment and classification.

145. This chapter presents a number of selected case studies on eutrophication assessment for lakes, rivers, transitional and coastal waters. The case studies are intended to illustrate eutrophication effects in different environments and the respective assessments and criteria for eutrophication.

146. In the selection of the case studies the following criteria were considered:

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[39] CIS Guidance document No. 7 on monitoring, section 2.10.4

- Global Criteria
    - Should be adequately distributed across water categories
    - Should be Geographically comprehensive
    - Should be representative of different ecoregions and WFD typology
- Specific Criteria - Availability and nature of monitoring data
    - Existing monitoring program
    - Substantial (min. 5 years) monitoring dataset
    - Seasonally comprehensive dataset (min. 4 measurements per year)
    - Existing activities for Eutrophication assessment
    - Existing "local" opinion on Eutrophication status
    - There should be local representative eager to be involved in the process

147. The following case studies (Table 10) were identified taking into consideration the criteria above.

Case study
Coastal and transitional Waters
Ria Formosa
River Tagus Estuary
Andalusia coast
North West Aegean coast
Northern Adriatic coast and Po estuary
Black sea coast
German Bight coast
River Scheldt estuary
Lakes and rivers
Lake Vansjoe
Norfolk Broads
Lakes Como, Garda, Iseo and Maggiore
Lake Eemmeer
Lake Peipsi
Lake Balaton
Lake Mälaren
Lake Vortsjarv
Lakes Päijänne and Pyhäjärvi
Lake Tegel
River Ebro and delta
River Tiber
Rivers Elbe
River Danube
River Nete

Table 10. List of selected case studies

148. The template used to collect information reflected the holistic checklists derived in the first part of this guidance.

149. The information collected is to be analysed in view of the need for harmonisation and considering the requirements and consequences of various policy instruments in relation with eutrophication. The case studies will be developed as a separate document by the Joint Research Centre. This will be produced in early 2006 after a workshop foreseen in January 2006. The analysis of the case studies is intended to influence future reviews of the guidance document.

9. NEXT STEPS – LINKS OF EUTROPHICATION ASSESSMENT WITH PRESSURE AND IMPACT ANALYSIS AND PROGRAMME OF MEASURES

9.1. Introduction

150. The DPSIR framework (Figure 3 in Chapter 2) is seen as giving a structure in which the indicators are presented that are needed to enable feedback to policy makers on environmental quality and the resulting impact of the political choices made, or to be made in the future.

151. According to the DPSIR framework there is a chain of causal links starting with '*driving forces*' (economic sectors, human activities) through '*pressures*' (emissions, waste) to '*states*' (physical, chemical and biological) and '*impacts*' on ecosystems, human health and functions, eventually leading to political '*responses*' (prioritisation, target setting, indicators).

152. Within the DPSIR framework, eutrophication assessment as described in the previous chapters belongs to the part of "State" and "Impact". The outcome of the assessment might result in responses and measures. In order to be able to formulate the response, there is a need to understand the links between drivers/pressures, state/impact and the response.

153. The need for a response becomes evident if the result of eutrophication assessment is that a water body (or part of marine area) is eutrophic or may become eutrophic in the near future. In that case it has to be clear how the appropriate response/measures will be developed and decided upon to reduce/eliminate eutrophication in that water body. The objective of the measures should be to move to a situation where a water body (or part of marine area) is not eutrophic, in order to assist the achievement of the environmental objectives for a water body. The steps that are necessary to set objectives and to develop measures have been described in general in the WFD-CIS guidance document "Environmental objectives under the WFD" (20 June 2005). Below, more specific details are given for the steps to develop measures to combat eutrophication.

9.2. Steps in the development of measures for a water body (or part of marine area) that is eutrophic or may become eutrophic in the near future

Step 1

154. A first step in the development of measures to abate eutrophication in a water body is the assessment of all the sources that (may) contribute to the nutrient load to a water body. Such an assessment should not be limited to the sources near the water body itself, as sources upstream may contribute to eutrophication in downstream water bodies/marine areas (cf. paragraphs 51 and 52 in section 3.6). Also retention processes (denitrification and sedimentation), atmospheric deposition and re-suspension from sediments can be taken into account.

Step 2a

155. A further step is to consider the possible (combination of) reduction measures for these sources, including the effect of those reduction measures on the eutrophication status (= effectiveness of a measure) and the costs associated to the implementation of those measures (= selecting the most effective measure for the least costs = cost efficiency). An important question to be answered in this step is the scale at which measures need to be considered – in other words: what is the expected extent in a catchment of the impact/effect of the various measures at source.

156. The (further and/or improved) implementation of existing measures need to be considered as well in this context – relevant existing measures in EU context are the Nitrates Directive, the Urban Waste Water Treatment Directive, the IPPC Directive, the (new) Directive on Groundwater Quality Protection, the National Emission Ceilings Directive and the Thematic Strategy on Air Pollution.

Step 2b

157. Besides measures at source, also measures in (or nearby) the affected water body itself should be considered and assessed that can result in a reduction of eutrophication effects. Examples of such measures are interfering in ecosystems disturbed by eutrophication, physical changes to aquatic soils and banks, other changes to the infrastructure. Also for this type of measures, the extent of achievable reduction and related costs should be considered and assessed.

Step 3

158. Finally, it has to be decided which (combination of) measures at source and in the water body is most appropriate and cost effective to reduce and eliminate eutrophication in a water body or part of marine area. At this stage, a balanced division of costs between upstream and downstream areas and between the various sectors has to be decided upon, taken into account the principles of polluter pays and proportionality. The quality of the information gathered on the various measures will be crucial in acceptance of the justification of measures in upstream water bodies/countries where no eutrophication exists but where nutrient loads contribute to eutrophication in downstream water bodies/marine areas. The mechanism for the decision

making is laid down in the WFD by preparing river basin management plans and agreement on this at the (international) catchment area level.

9.3. Identification of gaps that need to be addressed

159. A lot of the tools, guidance and mechanisms that are necessary to carry out the steps outlined in the preceding section are already available or in development.

160. For *step 1*, the pressures and impact analysis according to article 5 of the WFD and the drawing up of a river basin management plan will ideally result in an overview and assessment of all the sources.

161. For *step 2a*, on the establishment of effectiveness and cost effectiveness of measures and the scale at which measures need to be considered is subject of the ongoing CIS Cost Effectiveness Activity. The WFD article 5 analysis already gives indications on the scale by identifying issues/risks that need to be considered at the international catchment level. Considerations to measures with regard to agricultural losses of nutrients will be produced by the CIS activity on "Links between WFD and agriculture".

162. Several tools and examples exist or are in development to establish in a quantitative way the link between measures at sources of nutrients and the expected reduction of eutrophication effects in the fresh water and marine environment. It concerns flow studies (e.g. in Rhine and Danube catchment, COST initiative on evaluation of mitigation options for reducing nutrient losses to surface water), retention models and models for quantification of losses from diffuse sources and discharges from point sources (e.g. OSPAR HARPNUT guidelines, EUROHARP, COST action 626 European aquatic modelling network), HARMONICA. The challenge is to embed these tools in a sustainable way and to have the budgets/means to maintain the systems in the future.

163. In the area of measures in the water body itself (*step 2b*), available information and experience should be shared at European level.– a list of examples of such measures might be helpful.

164. For *step 3*, the future results of the CIS Activity on cost effectiveness are expected to assist in the decision making.

9.4. Conclusion

165. In general, all the necessary tools, guidance and mechanisms are available or in development to develop and decide upon the measures aiming at elimination of eutrophication in water bodies/catchments/marine areas. The challenge will be to (be able to) apply all the tools etc. in practice. The future results of the CIS activity on cost effectiveness will be essential – it will be of help to have eutrophication abatement as a pilot case in the future development of the guidance on cost effectiveness.

10. REFERENCES

1. Andersen, J.M, Dunbar, M. and Friberg N. Eds. (2004). REBECCA WP4 Rivers, Deliverable D6: Report on existing methods and relationships linking pressures, chemistry and biology in rivers.
2. Cardoso, A.C., Duchemin, J., Magoarou, P. and Premazzi, G. (2001). Criteria for the identification of freshwaters subject to eutrophication. European Commission, Joint Research Centre.
3. Cloern, J.E., 2001. Our evolving conceptual model of the coastal eutrophication problem. Marine Ecology Progressive Series, vol. 210, pp. 223-253.
4. European Commission 2005. Thematic Strategy on the Protection and Conservation of the Marine Environment. COM(2005)504 final
5. European Commission 2002b. Workshop on eutrophication criteria – summary report. Brussels 28-30 May 2002.
6. European Environment Agency 1995. Europe’s Environment: The Dobris Assessment.
7. European Environment Agency 2001. Eutrophication in Europe’s coastal waters. Topic report 7/2001, 86 p.
8. European Environment Agency 2003. Europe's water: An indicator based assessment. Topic report N0 1/2003, 99 p.
9. Heiskanen, A.S., Solimini, A.G. and Cardoso, A.C. (2005). REBECCA WP2 Literature review, Deliverable D4: Linkages between chemical and biological quality of surface waters. Current knowledge on indicators and methods for Water Framework Directive Ecological Status Assessment. Chapter 1: Nutrients and eutrophication in lakes.
10. Lyche-Solheim *et al.* (2005). REBECCA WP3 Lakes Deliverable D7: Reference conditions in European Lakes.
11. OECD 1982. Eutrophication of Water, Monitoring, Assessment and Control. Paris, 150 p.
12. OSPAR 2005-4. Eutrophication Monitoring Programme
13. Vollenweider, R.A. (1976). Advances in defining critical loading levels for phosphorus in lake eutrophication. Mem. Ist. Ital. Idrobiol., 33:53-83.

ANNEX 1 – THE UNDERSTANDING OF EUTROPHICATION

1. EU LEGISLATION AND POLICIES

1.1. Water Framework Directive (2000/60/EC)

1.1.1. Overview of the Water Framework Directive

166. The Water Framework Directive (WFD) establishes an integrated and co-ordinated framework for the sustainable management of water. Its purposes include preventing deterioration of water bodies, promoting sustainable water use, and ensuring “enhanced protection and improvement of the aquatic environment". This last point requires that rivers, lakes, estuaries, coastal waters and groundwater achieve and /or maintain at least ‘good status’ by 2015. For surface waters this requires both Ecological Status and Chemical Status to be at least ‘good’. Good status will be achieved by implementing a programme of measures as reported in River Basin Management Plans (Articles 11 and 13), and based on the results of river basin characterisation. The WFD stipulates detailed procedures for its implementation including the classification and monitoring of water bodies (see WFD Annex V).

167. Ecological status is derived from Ecological Quality Ratios (EQRs), which reflect the deviation of observed values from type-specific reference conditions. ‘High’, ‘good’, ‘moderate’, ‘poor’ and ‘bad’ Ecological Status have normative definitions (see Annex V of the WFD) based on the deviation, as a result of human activity, of quality elements from corresponding type-specific reference conditions. At good ecological status, the values of biological quality elements (communities of phytoplankton, plants, fish, macro-invertebrates etc.) should ‘deviate only slightly from those normally associated with the surface water body type under undisturbed conditions’ (Annex V 1.2). The boundary between good and moderate ecological status is crucial because it determines when restoration measures need to be taken.

168. The values for the biological quality elements set by Member States for the ‘high’ – ‘good’ class boundary and the ‘good’ – ‘moderate’ class boundary will be compared as part of the intercalibration exercise, which is further described below.

169. Several directives will coexist with the WFD, including: the UWWT Directive (91/271/EEC), Nitrates Directive (91/676/EEC), Bathing Water Directive (76/160/EEC), Habitats Directive (Directives 92/43/EEC) and the Birds Directive (Directive 79/409/EEC). Areas designated under these directives will have the status of Protected Areas under the WFD (Annex IV), for the protection of their surface water, groundwater or for the conservation of habitats or species directly depending on water. Several of these directives address eutrophication, increasing the need for a common framework for eutrophication assessments.

170. Sections of the WFD particularly relevant to assessing eutrophication are: Article 1 a (purpose); Article 4.1.a.i and ii (Environmental objectives and programmes of measures for surface waters); Article 5 (Characterisation); Article 6 (Register of Protected areas); Article 7.3 (Drinking Water); Article 8 (Monitoring); Article 10 (The combined approach for point and diffuse sources); Article 11 (Programme of measures); Annex II (1) (Characterisation), Annex IV.1.iv, (Protected Areas, nutrient-sensitive areas); Annex V (1) (Assessment of Surface Water Status) and Annex VIII (indicative list of main pollutants).

1.1.2. Summary of the Water Framework Directive's requirements

171. The term eutrophication is not explicitly defined in the Water Framework Directive. It is defined in two of the Directives that are to be integrated into the river basin planning process[40], Directive 91/271/EEC and Directive 91/676/EEC.

172. According to Directive 91/271/EEC concerning urban waste water treatment (the UWWT Directive), eutrophication means "the enrichment of water by nutrients especially compounds of nitrogen 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 to the quality of the water concerned". Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources (the Nitrates Directive) has an identical description of the environmental effects of eutrophication. However, for the purposes of the Nitrates Directive, these effects must be caused by the enrichment of water by nitrogen compounds rather than by nutrients in general.

173. The Water Framework Directive requires Member States to classify the ecological status of surface water bodies[41] into one of five ecological status classes; high, good, moderate, poor or bad ecological status. The ecological status of a water body is an expression of the quality of the structure and functioning of its aquatic ecosystem.

174. The Directive provides general qualitative definitions for each ecological status class, and more detailed qualitative definitions for high, good and moderate ecological status for each surface water category.

175. Among other things, the definitions of each ecological status class describe the extent to which biological components of the aquatic ecosystem, called biological quality elements, may differ in that class compared to their reference, or high status, conditions as a result of the effects of human activity.

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40 See Article 10; Article 11.3.a; and Article 4.1.c and Annex IV of the Water Framework Directive

41 The status of heavily modified water bodies and artificial water bodies is defined by their ecological potential rather than their ecological status. When considering such bodies, references to ecological status should be read as meaning ecological potential.

176. The reference conditions relevant to a particular water body depend on the type of water body. They are type-specific. This enables the classification system to take account of the natural variety of aquatic ecosystems across the Community's different water types.

177. The Directive requires the Commission to facilitate an intercalibration exercise. This exercise is designed to ensure that the numeric class boundaries for good ecological status, which have to be set by each Member State to make the classification scheme operational, are consistent with the Directive's 'normative' definitions and comparable between Member States.

178. The environmental objectives of the Directive require Member States to prevent deterioration of the status of water bodies. They also require Member States to aim to restore all surface water bodies to good ecological status, except where doing so would be unfeasible or disproportionately expensive. The Directive's ecological status classification scheme is therefore central to water management across the Community.

179. Nutrient enrichment is one of the many different anthropogenic pressures on water bodies that may affect their ecological status. As such, management measures may be required to control nutrient enrichment in order to achieve the objectives of the Directive.

180. The sensitivity of water bodies to nutrient enrichment may vary depending on their physical characteristics and on the extent of other anthropogenic alterations to them. For example, modifications to hydrology or morphology may significantly influence whether or not a given concentration of nutrients causes accelerated growth of algae or higher forms of plant life to produce undesirable disturbances. Changes to hydromorphology (e.g. residence time of water in lakes) could enable accelerated growth of algae or higher forms of plant life and thus impact on the ecological status of a water body even in the absence of further anthropogenic inputs of nutrients.

181. Operational monitoring must be undertaken for water bodies, or groups of water bodies, that are at risk of failing to achieve the Directive's objectives. The monitoring data obtained through operational monitoring must be used to establish the status of those bodies and to assess changes to their status resulting from management measures.

182. Monitoring must be designed to ensure that an adequate level of confidence and precision in the classification of ecological status can be achieved. Guideline minimum monitoring frequencies are set out in the Directive. However, the actual frequencies selected must provide sufficient data for a reliable assessment of the status of the relevant quality elements.

183. For the purposes of monitoring water bodies at risk because of nutrient enrichment, Member States must monitor parameters indicative of the biological quality element, or elements, most sensitive to the

effects of nutrient enrichment as well as the nutrients that are being discharged into the water body in significant quantities[42].

184. Where appropriate, Member States may group water bodies and use representative monitoring to assess the status of the water bodies in the group[43].

1.1.3. Conceptual understanding of eutrophication in the WFD

185. The WFD classifies water bodies in relation to type-specific reference conditions. This enforces the view of eutrophication as a process, where nutrient enrichment through human activities causes adverse changes in the aquatic environment, rather than as a particular level of productivity or trophic state.

186. The assessment of eutrophication is strongly implied in the classification of surface water bodies. The definition of good ecological status for the quality elements 'Phytoplankton' and 'Macrophytes and Phytobenthos' uses very similar wording as the definition of eutrophication used in the UWWT and Nitrates Directives and by OSPAR. For example, good ecological status of lake macrophytes and phytobenthos requires that '…changes do not indicate any accelerated growth of phytobenthos or higher forms of plant life resulting in undesirable disturbances to the water balance of organisms present in the water or to the physico-chemical quality of the water.' (Annex V1.2.2.).[44] In other words good status includes an absence of eutrophication problems.

187. Nutrients, as part of the physicochemical quality element, must be at a level to ensure the functioning of the ecosystem and the values specified for biological quality elements (i.e. to ensure that the above definition is met). Specific mention of eutrophication is made in the requirement to estimate the magnitude of all significant point and non-point source pollution, including 'substances that contribute to eutrophication (in particular nitrates and phosphates)' (Annex II 1.4, Annex VIII).

1.1.4. Methods specified for assessing eutrophication

188. Under the WFD Ecological Status is assessed by using quality elements. Many of these quality elements are traditionally used for assessing eutrophication, in particular 'nutrient conditions' as well as the 'composition, abundance and biomass of phytoplankton and macrophytes'. At good Ecological Status biological quality elements should have only slight deviation from type-specific reference conditions. Corresponding values for nutrients necessary to support the achievement of good ecological status may be

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42 See Annex V 1.3.2. The term 'discharge' in this context is clearly intended to include the direct or indirect introduction into water as a result of human activity of nutrients from point or diffuse sources

43 Guidance on grouping water bodies is provided in the CIS IMPRESS Guidance and the CIS Monitoring Guidance

44 Compared to the UWWT Directive definition:*' The 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 water balance of organisms present in the water and to the quality of the water concerned'.*

estimated from response curves based on knowledge of the relationships between nutrient concentrations and the biological quality elements.

189. High nutrient concentrations without any corresponding biological impacts may not necessarily result in down grading Ecological Status. Thus assessments of eutrophication consistent with the WFD should primarily focus on the biological effects resulting from elevated nutrient levels, taking also into account possible effect of transboundary transport of nutrients. Measures to reduce nutrient loading may still be needed (see section 1.1.6 on CIS Classification Guidance for more details) to reduce the impact of the discharge of nutrients in the area of discharge or elsewhere.

190. The main challenge for Member States is to find quantitative expressions (criteria or metrics) for the response in abundance and taxonomic composition for the different biological quality elements along the nutrient gradient, to quantify the impact of increased algal/plant biomass on other organisms and water quality and to quantify slight, moderate and large deviations from reference conditions, corresponding to 'good', 'moderate' and 'poor' Ecological Status. One challenge will be to obtain monitoring data for the required parameters from a sufficient number of sites and with a sufficient measurement frequency to ensure that assessments have sufficient accuracy and precision to differentiate between natural variation and human impact and to estimate the extent of anthropogenic pollution.

191. The CIS Monitoring Guidance recommends measurement frequencies for each parameter used in the assessments of Ecological Status. These frequencies are higher than the minimum frequencies specified in Annex V of the WFD, for many of the parameters relevant to eutrophication, such as phytoplankton and nutrient parameters (monthly or bi-weekly during growth season in the guidance as opposed to once every 3-6 months in Annex V).

192. The WFD furthermore focuses on managing whole river basins on a European scale, thus a down-stream water body failing the WFD objective of good status e.g. being eutrophic, may require measures to be taken, in the entire upstream catchment or even in other river basins including coastal water bodies or exporting coastal water bodies, even if upstream water bodies meet the objectives (transboundary transport of nutrients).

193. Further elaboration on the interpretation of ecological status and how to understand the different status classes is given in Chapter 3.

1.1.5. WFD Guidance documents

194. The following guidance documents for the implementation of the WFD with reference to eutrophication assessment have been prepared within WFD Common Implementation Strategy (CIS) working group:

- COAST: WFD CIS Guidance Document No. 5, 2003;
- INTERCALIBRATION: WFD CIS Guidance Document No. 6, 2003;

- Monitoring: WFD CIS Guidance Document No. 7, 2003;
- REFCOND: WFD CIS Guidance Document No.10, 2003;
- CLASSIFICATION WFD CIS Guidance Document No. 13, 2003;

195. These guidance documents contain helpful information assisting guidance on eutrophication assessment. Key issues mentioned in these documents for ecological classification of eutrophication are presented in the following section.

1.1.6. Common understanding of Ecological Classification from CIS guidance documents

Introduction

196. The WFD requires the establishment of classification schemes to reflect the Ecological Status or potential of surface water bodies as measured by the condition of specific biological, hydromorphological and physico-chemical quality elements. The relevant elements, and the specific conditions required for these elements in each of the classes of the classification schemes, depend on the surface water category and type to which the water body belongs, the pressures acting on the water body, and on whether the body is artificial or heavily modified. In addition the WFD requires Member States to achieve adequate confidence and precision in classification, and to give estimates of the level of confidence and precision achieved in the River Basin Management Plans.

197. The purpose of the overall ecological classification guidance is to provide general guidance on the assessment of Ecological Status and Potential leading to the overall ecological classification of water bodies for the purposes of the EC-Water Framework Directive. The document also provides specific guidance on the role of the general physico-chemical quality elements in ecological classification. The guidance document draws on the existing guidance documents REFCOND; COAST; MONITORING and HMWB&AWB.

Relationship between biological, hydromorphological and physico-chemical Quality Elements

198. As a basic step the values of the biological quality elements must be taken into account when assigning water bodies to any of the Ecological Status and Ecological Potential classes. In order to ensure comparability the results of the biological monitoring systems shall be expressed as ecological quality ratios for the purposes of ecological classification. The ratio shall be expressed as a numerical value between zero (worse class) and one (best class).

199. The values of the hydromorphological quality elements must be taken into account when assigning water bodies to the high Ecological Status class and the maximum Ecological Potential class (i.e. when downgrading from high Ecological Status or maximum Ecological Potential to good Ecological Status/Potential). For the other status/potential classes, the hydromorphological elements are required to have "conditions consistent with the achievement of the values specified for the biological quality elements."

Therefore, the assignment of water bodies to the good, moderate, poor or bad Ecological Status/Ecological Potential classes may be made on the basis of the monitoring results for the biological quality elements and also, in the case of the good Ecological Status/Potential the physico-chemical quality elements. This is because if the biological Quality Element values relevant to good, moderate, poor or bad status/potential are achieved, then by definition the condition of the hydromorphological quality elements must be consistent with that achievement and would not affect the classification of Ecological Status/Potential.

200. The values of the physico-chemical quality elements must be taken into account when assigning water bodies to the high and good Ecological Status classes and to the maximum and good Ecological Potential classes (i.e. when downgrading from high status/maximum Ecological Potential to good Ecological Status/Potential as well as from good to moderate Ecological Status/Potential). For the other status/potential classes the physico-chemical elements are required to have "conditions consistent with the achievement of the values specified for the biological quality elements." Therefore, the assignment of water bodies to moderate, poor or bad Ecological Status/Ecological Potential may be made on the basis of the monitoring results for the biological quality elements. This is because if the biological Quality Element values relevant to moderate, poor or bad status/potential are achieved, then by definition the condition of the physico-chemical quality elements must be consistent with that achievement and would not affect the classification of Ecological Status/Potential. The "physico-chemical quality elements" mean the physico-chemical elements supporting the biological elements listed in Section 1.1 of Annex V for each surface water category, except those for which an EQS has been set at EU-level.

201. The relationships between the biological, hydromorphological and physico-chemical quality elements in status classification are presented in Figure 6 for all natural water categories and types. The classification of heavily modified and artificial water bodies (HMWB&AWB) is done in a comparable way to identify high, good, moderate, poor and bad Ecological Potential.

202. The Directive requires that Member States achieve an adequate level of confidence that water bodies are assigned to their true status classes. The level of confidence achieved must be reported in the river basin management plans. Further guidance is given in the technical Annex I to the ecological classification guidance document and may also be found in REFCOND Guidance and specifically in the Monitoring Guidance.

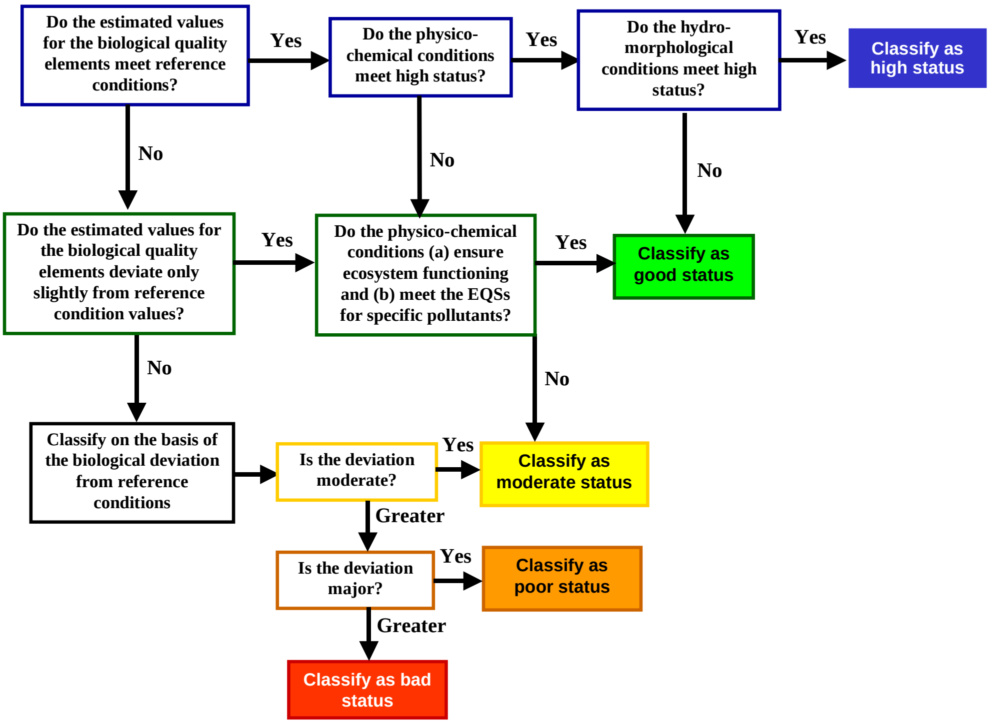

Figure 6. The relative roles of biological, hydromorphological and physico-chemical quality elements in classifying Ecological Status (Annex V 1.2). (Source: REFCOND & COAST guidance documents).

<u>Parameters indicative of the biological Quality Elements and most sensitive Quality Elements</u>

203. Member States must monitor parameters indicative of the condition of biological quality elements as part of their monitoring programmes. The Directive requires the assessment of the Ecological Status /Potential class of a water body to be based on the estimate of the condition of the Quality Element provided by these monitored parameters. In some circumstances, achieving a reliable assessment of the condition of a particular biological Quality Element may require consideration of the monitoring results for several parameters indicative of that Quality Element.

204. Figure 7 illustrates the relationship between biological quality elements and indicator parameters and their use in classification decisions. The example in the upper part of the figure illustrates the results for individual parameters of a biological Quality Element like phytobenthos with general sensitivity to a broad range of pressures (e.g. pressures resulting in morphological and hydrological changes as well as in changes to nutrient conditions). Parameters may be combined by, for example, averaging or weighting to estimate the status of the Quality Element.

205. The second example in Figure 7 illustrates the procedure of combining parameters, if pressure-related, multi-metric approaches are used. Under this approach, individual parameters indicative of the effects of a particular type of pressure on a biological Quality Element are identified. Where several parameters responsive to the same pressure are identified, these may be grouped and the results for individual

parameters in the group combined in order to increase confidence in the assessment of the impact of that pressure on the Quality Element. If several groups of parameters are identified, each indicating the effects of a different pressure on the Quality Element, the status of the Quality Element will be indicated by the results for the group that indicates the greatest impact on the element. However, if the parameters in a group are actually responding to the effects of a range of pressures on the Quality Element or there is low confidence in the results for a group of parameters, such pressure-related, multi-metric approaches may not be possible. In such cases, where the groups of parameters are not clearly signalling how the Quality Element has been affected by different pressures, the approach outlined above and the upper part of Figure 7 may be more appropriate.

The role of the general physico-chemical Quality Elements in the ecological classification

206. The Directive's normative definitions for Ecological Status describe the conditions required for the general physico-chemical quality elements and the specific pollutants at good status/potential. The general physico-chemical quality elements should not reach levels outside the range or exceed the levels established to ensure ecosystem functioning and the achievement of the values specified for the biological quality elements (see point (a) in the middle box in Figure 7). The concentrations of specific pollutants should not exceed environmental quality standards (EQSs) set in accordance with Annex V, Section 1.2.6 of the Directive (Figure 8).

207. The ranges and levels established for the general physico-chemical quality elements must support the achievement of the values required for the biological quality elements at good status or good potential, as relevant. Since the values for the biological quality elements at good status will be type-specific, it is reasonable to assume that the ranges and levels established for the general physico-chemical quality elements should also be type-specific. Several types may share the same ranges or levels for some or all of the general physico-chemical quality elements.

208. The Ecological Status/Potential of the water body is represented by the lowest value from the biological quality elements and physico-chemical quality elements as indicated in Figure 6. Thus good Ecological Status will only be attained if the monitoring results for both the biological quality elements and physico-chemical quality elements meet the conditions required for good Ecological Status/Potential (see WFD Annex V, 1.4.2.i, ii).

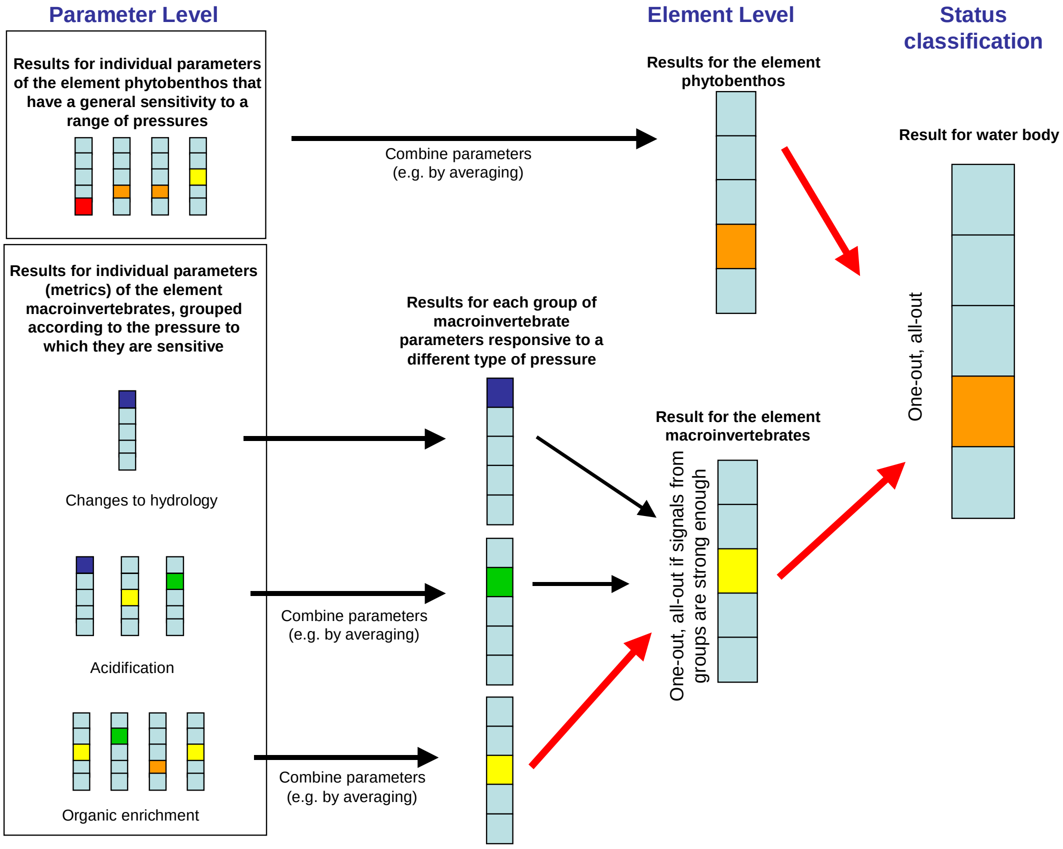

Figure 7. Examples of how indicative parameters may be combined to estimate the condition of biological quality elements. The one-out all-out principle is used at the Quality Element level.

209. In individual water bodies, there will be cases where the monitoring results for the biology are good but the results for the general physico-chemical quality elements appear, at face value, to be less than good. Such a situation could occur if one or more of the specific pollutants exceeds the EQS-values established, or if there is a time lag between the change of the general physico-chemical quality elements and the response in the biological quality elements. Furthermore this situation could be common even though the physico-chemical ranges are thought to be valid, due to statistical errors in sampling and analysis. In these cases, Member States may decide to classify the body as less than good only when they have checked that the statistical confidence is adequate to say that the general physico-chemical quality elements are really less than good. Where it is not, Member States may take steps to improve confidence, for example, by doing more monitoring.

210. There may also be other cases where the levels or ranges proposed for a general physico-chemical Quality Element in a type are being exceeded as a result of anthropogenic effects, but no biological impacts are being detected. In such cases, it is recommended that a checking procedure should be undertaken. This procedure should be used to assess whether the established type-specific levels or ranges for the elements are more stringent than is necessary to ensure the functioning of the ecosystem and the achievement of the values specified for the biological quality elements at good status/potential.

211. The mismatch between the biological monitoring results and the general physico-chemical monitoring results may also be because the biological methods being used in monitoring are not sensitive to the effects of anthropogenic changes in the condition of the physico-chemical Quality Element. In such cases, improvements to the biological methods should be made on an on-going basis with the aim of developing methods that are sufficiently sensitive. This improvement work should not stop after the first classification decisions are made.

212. Water bodies in which an established level or range for a general physico-chemical Quality Element is exceeded should be classified as moderate status/potential or worse unless the established level or range for the type is revised as a result of the checking procedures.

213. To support the proposed practical approach, the relevant box in the general Figure 6 on ecological classification should be expanded for clarification as illustrated in Figure 8.

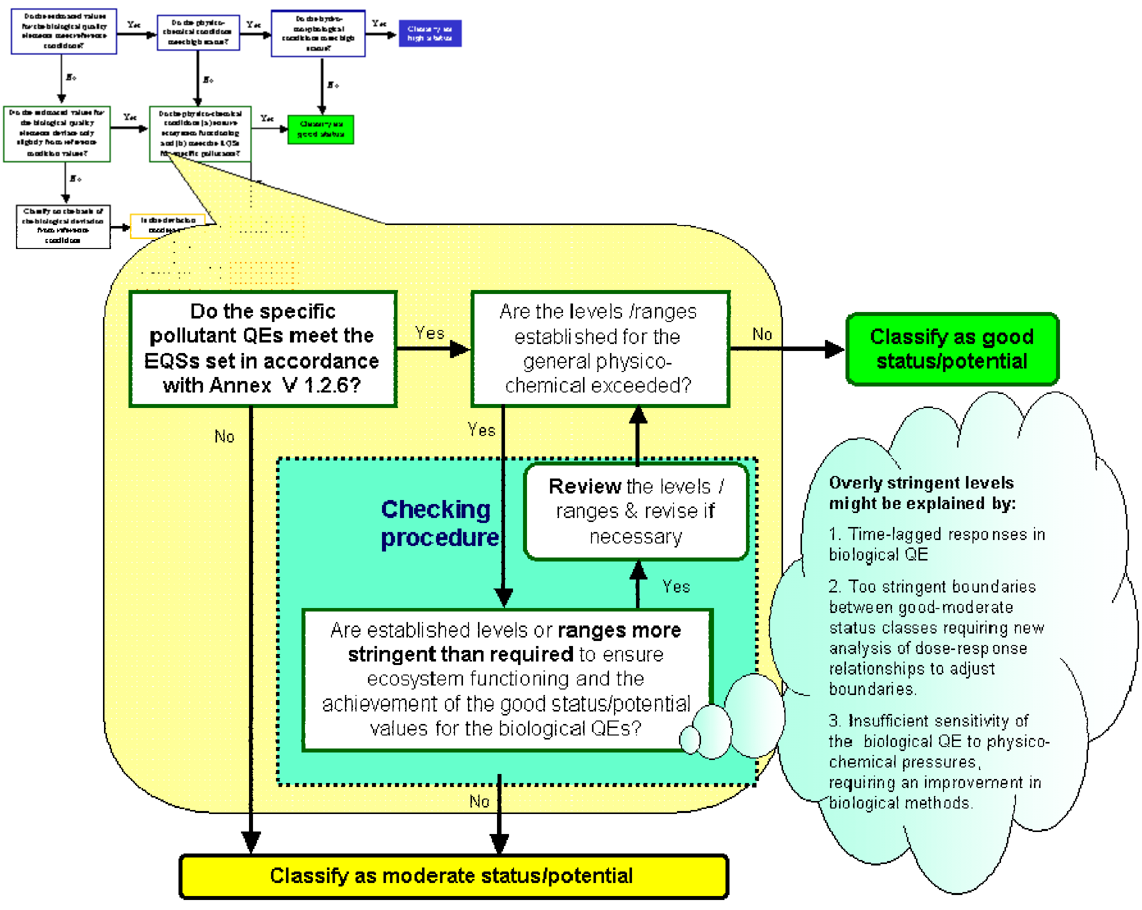

Figure 8. Elaboration of second box in the good Ecological Status line of the ecological classification diagrams (see Figure 6)

__Conclusion__

214. The analysis set out in the Sections above concludes that the Directive requires the establishment of, and compliance with, specific values for the physico-chemical quality elements for the high and good Ecological Status classes as well as for the maximum and good Ecological Potential. For the lower

Ecological Status/Potential classes (i.e. moderate, poor and bad status/potential) it only appears to require the establishment of, and compliance with, values for the biological quality elements. Where monitoring results indicate that the condition of the physico-chemical quality elements is worse than good, the status/potential class assigned to the water body must also be less than good, and should be determined with reference to the type specific condition of the biological quality elements.

1.2. Urban Waste Water Treatment Directive (91/271/EEC)

1.2.1. Overview of UWWT Directive

215. The Urban Waste Water Treatment Directive (UWWT Directive) aims to protect the environment from adverse effects of urban waste water discharges and direct discharges from certain (food processing) industries. It sets treatment levels on the basis of the agglomeration size and the sensitivity of waters receiving the discharges.

216. Surface waters must be designated as Sensitive Areas (SA) if, inter alia, they are eutrophic or if they may become eutrophic in the near future if protective action is not taken (Annex II A(a)). Discharges from agglomerations of >=10,000 population equivalent to Sensitive Areas require more stringent treatment for nitrogen and/or phosphorus. However, Member States do not have to identify Sensitive Areas if more stringent treatment is implemented over the whole of its territory (Article 5 (8)). The designation of Sensitive Areas needs to be reviewed at least every four years (Article 5 (6)), and for newly designated Sensitive Areas more stringent treatment, with nitrogen and/or phosphorus removal, must be in place within 7 years of their designation.

217. Sections of the UWWT Directive that particularly refer to eutrophication and surface water monitoring are: Article 2 (11) which defines eutrophication; Article 5 on the identification of Sensitive Areas and treatment requirements; and Annex II, which specifies criteria for identification of Sensitive Areas.

1.2.2. Conceptual understanding of eutrophication

218. Article 2.(11) of the UWWT Directive defines eutrophication as: "the 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 to the quality of the water concerned".

219.. This definition implicitly defines eutrophication by the confluence of four criteria[45]:

- Enrichment of water by nutrients;
- Accelerated growth of algae and higher forms of plant life;

[45] See also §§ 18 of the ECJ judgement for the case C-280/02

- An undesirable disturbance to the balance of organisms present in the water
- Deterioration of the quality of the water concerned.

220. It focuses more on changes in the aquatic environment rather than a particular state of productivity. It can apply to waters of any natural trophic state if their ecology or water quality has been adversely affected or is at risk due to nutrients from urban waste water discharges. The term "anthropogenic" eutrophication can been used to make this distinction clear.

1.2.3. Methods specified for assessing eutrophication

221. The UWWT Directive does not specify any methods or guideline values for assessing eutrophication[46], which results in Member States developing their own assessment systems and criteria, and may consequently lead to different levels of protection of their water bodies.

222. Several Member States[47] have developed criteria based on the three elements in the definition: nutrient enrichment, algae or plant life growth and other undesirable effects (e.g. oxygen depletion).

223. When designating Sensitive Areas, consideration should be given to which nutrient should be reduced by further treatment.

- "*Discharges to lakes and streams reaching lakes/reservoirs/closed bays with poor water exchange. Whereby accumulation may take place, should have removal of phosphorus unless it can be demonstrated that the removal will have no effect on the level of eutrophication. Where the discharges from large agglomerations are made, the removal of nitrogen may be also considered*" (Annex II A (a, i)).
- *"Discharges to estuaries, bays and coastal waters with poor water exchange or receiving large quantities of nutrients should have removal of phosphorus and /or nitrogen unless it can be demonstrated that the removal will have no effect on the level of eutrophication"* (Annex II A (a, ii)).

1.2.4. Relevant Case Law

224. The European Court of Justice (ECJ) is dealing with cases brought by the European Commission against several Member States, which address the designation of Sensitive Areas. The Court has recently ruled on a case brought against France (decision number C-280/02, ECJ judgement on 23/09/2004)[48].

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46 Surface freshwaters intended for the abstraction of drinking water must have nitrate levels less than 50 mg NO_3/l, but this is well above concentrations likely to cause eutrophication.

47 E.g. UK, Ireland, Portugal.

48 http://curia.eu.int/jurisp/cgi-bin/form.pl?lang=en

225. It is related to the breach of the Directive requirements in relation to non-designation of sensitive areas and lack of infrastructure for 130 agglomerations discharging into sensitive areas. The ECJ ruling addresses the following points:

a. Broader interpretation of purposes of Directive 91/271/EEC (which is based on the legal base of the Directive, i.e. Article 130s (now Article 175 EC) in order to achieve the objectives of Article 130r (now Article 174 EC)). It was stated that:

- The objective pursued by Directive 91/271 goes beyond the mere protection of aquatic ecosystems and attempts to conserve man, fauna, flora, soil, water, air and landscapes from any significant harmful effects of the accelerated growth of algae and higher forms of plant life resulting from discharges of urban waste water.
- *"undesirability must also be considered to be established where there are significant harmful effects not only on fauna and flora but also on man, the soil, water, air or landscape*" (§§22).
- undesirable disturbances of the balance of organism present in the water are: "*species changes involving loss of ecosystem biodiversity, nuisances due to proliferation of opportunistic macro algae and sever outbreaks of toxic or harmful phytoplankton"* (§§23).

b. Important guidance on component parts of definition of "eutrophication" by

- clearly defining that eutrophication is characterised by the confluence of four main criteria and extensively explaining the meaning of those criteria.
- stating that "*for there to be eutrophication, there must be a cause and effect relationship between enrichment by nutrients and the accelerated growth of algae and higher forms of plant life on the one hand and, on the other hand, between the accelerated growth and an undesirable disturbance of the balance of organisms present in the water and to the quality of the water concerned"* (§§19).
- highlighting that criterion "deterioration of water quality" means not only deterioration of the quality of the water which produces harmful effects for ecosystems but also "*deterioration of the colour, the appearance, taste or odour of the water or any change which prevents or limits water use such as tourism, fishing, fish farming, clamming and shellfish farming, abstraction of drinking water or cooling of industrial installations*." (§§24)

c. Need to decouple duty to designate sensitive areas from whether or not agglomerations with more than 10 000 population equivalents exist in catchment (§§69), but also considering that (according to §§40, 52, 69, 77, 87)

- it is not important to define what percentage of pollution goes from urban waste water discharges or from agricultural pollution since both of them may contribute to eutrophication of water body as 91/271/EEC and 91/676/EEC are complimentary. When urban wastewater discharges involve in combination to nitrate flows of agricultural origin, Member States have to designate water body in question as being as a sensitive area in accordance with the directive 91/271/EEC
- the significance of a nutrient loading to a water body should be not only importance of the percentage of that nutrient input but also of the absolute amount of nutrient in tonnes . The decision of its importance in the overall nutrient budget has to be taken on case-by-case basis.

226. It is evident that the interpretation of the European Court of Justice must be used as minimum requirement for the level of protection in environmental laws of the European Communities. The interpretation of terms and criteria in this and related judgements must be used as benchmarks for any assessment method applied under any EC Directive applicable to eutrophication. In particular, the outcome of the intercalibration exercise and the guidance provided by this document in relation to the WFD classification must meet, at least, the obligations that can be derived from this judgement.

1.3. Nitrates Directive (91/676/EEC)

1.3.1. Overview of the Nitrates Directive

227. The Nitrates Directive (91/676/EC) aims to reduce water pollution by nitrate from agricultural sources and to prevent such pollution occurring in the future. The Directive requires Member States to identify polluted waters and apply Action Programme measures (Annex III of the directive) within designated Nitrate Vulnerable Zones (NVZs) or throughout their whole territory. The measures of the Code of Good Agricultural Practice (in Annex II), which are not included in the action programme, must also be implemented in NVZs, or across the whole territory if the Member State choose the whole territory approach according to article 3 (5) of the Directive and, therefore, did not designate specific NVZs.

228. Nitrate Vulnerable Zones cover all land draining to “polluted waters”, including natural freshwater lakes, or other freshwater bodies, estuaries, coastal waters and marine waters which are eutrophic or may become so in the near future if protective action is not taken (Annex 1 of the directive).

229. In order to designate and revise NVZs, the eutrophic state of surface freshwaters, estuaries and coastal waters needs to be reviewed and reported every four years (Article 6).

230. Sections of the Nitrates Directive that refer to eutrophication and surface water monitoring are: Article 2(i), which defines eutrophication; Article 3, on the identification of polluted waters and designation of Vulnerable Zones; Article 5(6) on the monitoring programmes for the purpose of assessing the effectiveness

of action programmes; Article 6, on water monitoring for the purpose of the first designation and revision of NVZs; and Annex 1, which specifies criteria for identifying polluted waters.

1.3.2. Conceptual understanding of eutrophication

231. The Nitrates directive has the same definition of eutrophication as the UWWT Directive except that it only relates to nitrogen compounds.

1.3.3. Methods specified for assessing eutrophication

232. The Nitrates Directive does not specify any methods or guideline values for assessing eutrophication, which has resulted in Member States developing their own assessment criteria, and may result in different levels of protection of their water bodies. However the European Commission has developed a monitoring guidance that includes some preliminary elements for setting eutrophication criteria.

1.3.4. Relevant Case Law

233. Two ruling of the European Court of Justice address specifically the issue of eutrophication and designation of Nitrates Vulnerable Zones (NVZs) under the Nitrates directive, the Judgement of 27 June 2002 in case C 258/00 *Commission v France* and the Judgement 11 March 2004 in case C 396/01 *Commission v Ireland.*

234. In both cases the Commission considered that the designation of NVZs made by the Member State concerned did not adequately take account of the criterion of eutrophication in identification of polluted waters and designation of NVZs, as required by Annex I.A of the Directive. In both cases it was argued by the Member State concerned that the obligation to identify waters and designate NVZs in the context of the nitrates directive did not arise as phosphorus was the main factor causing eutrophication. The European Court of Justice rejected this line of argument. For instance, paragraph 45 of ruling in the case concerning France, stated that *"restricting the scope of the Directive to exclude certain categories of waters owing to the supposedly fundamental role of phosphorus in the pollution of those waters is incompatible with both the logic and the objective of the Directive"*. This Case Law indicated that it is contrary to the Directive to take a restrictive approach in relation to the criterion concerning eutrophication.

1.4. Habitats Directive (92/43/EEC)

235. The Habitats Directive (92/43/EEC) requires Member States to designate Special Areas of Conservation (SACs) (Article 4.4) and Special Protection Areas (SPAs) (Articles 12 and 13) for habitats of plants and animals listed in Annexes I-IV of the directive. For the habitats and species of selected sites, measures must be implemented to maintain or restore to 'a favourable condition' (i.e. Favourable Conservation Status). The Conservation Status must be monitored for all habitats and species of Community interest, and this is not restricted to Natura 2000 sites. The monitoring of habitats can focus on 'typical species'.

236. The Conservation Status of a species means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations (Article 1 (i)). Although not explicitly mentioned in the Directive, the impact of point and diffuse pollution by nutrients on water quality is an important part of conservation status in aquatic habitats.

237. The Habitats Directive does not specify any methods for assessing eutrophication. However eutrophication is relevant to the Habitats Directive to the extent that it might affect protected species and habitats. Nutrient enrichment leading to eutrophication can have significant detrimental effects on specific aquatic species and habitats. For example, excessive growth of benthic algae from elevated phosphorus can threaten the habitat for the pearl mussel. More generally, changes in water quality can also help explain trends in biodiversity.

1.5. Shellfish Waters Directive (79/923/EEC)

238. The Shellfish Waters Directive seeks to protect and improve shellfish waters in order to support shellfish life and growth and thus to improve the high quality of shellfish products for consumption. The Directive sets physical, chemical and microbiological water quality requirements that designated shellfish waters must either comply with or endeavour to meet. The Shellfish Water Directive will be repealed by the WFD by 2013.

239. The Shellfish Water Directive does not require an assessment of eutrophication per se, however Article 6 does require a number of parameters to be monitored to check the quality required for shellfish waters. Some of these parameters are relevant to assessments of eutrophication – in particular dissolved oxygen and saxitoxins (produced by dinoflagellates).

240. The Annex of the Shellfish Water Directive requires that dissolved oxygen saturation is monitored monthly, with a minimum of one sample representative of low oxygen conditions on the day of sampling. However where major daily variations are suspected, a minimum of two samples should be taken in a day; 95-percent of the samples should be greater than 70 percent saturation. There are standards and monitoring frequencies specified for saxitoxin.

241. These standards are set to protect shellfish beds and human health. They are absolute and apply regardless of whether the values reflect human induced impacts or naturally poor but undisturbed conditions.

1.6. Freshwater Fish Directive (78/659/EEC)

242. The purpose of the Freshwater Fish Directive (78/659/EEC) is to protect or improve the quality of running or standing freshwaters capable of sustaining fish populations. It sets physical and chemical water quality objectives for salmonid waters and cyprinid waters. Member States must designate salmonid waters and cyprinid waters and ensure they meet the quality objectives. The Freshwater Fish Directive will be repealed by the WFD by 2013.

243. There is no direct requirement for an assessment of eutrophication in the Directive. However, standards are set to safeguard fish populations from the harmful consequences resulting from the discharge of pollutant substances into waters (including the reduction of the number of fish belonging to a certain species). To enable the designated waters to comply with the Directive, Article 6 does require that designated waters are sampled at a minimum frequency and that the waters comply with the quality objectives set by the Member States (Article 3). Many of the parameters specified in Annex 1 of the directive are relevant to eutrophication, for example mandatory minimum values are set for ammonia and dissolved oxygen, and guideline values are specified for total phosphorus. The values set for phosphorus are explicitly to reduce the effects of eutrophication.

1.7. Bathing Water Directive (76/160/EEC)

244. The Bathing Waters Directive (76/160/EEC) seeks to protect the environment and public health, by reducing the pollution of bathing waters and protecting such waters from further deterioration. Bathing waters are classified as all surface freshwater and seawater, where bathing is authorised by competent authorities of Member Sates and is not prohibited[49].

245. Physical, chemical and microbiological parameters applicable to bathing waters are set by the Directive and all necessary measures taken to ensure that the quality of the bathing water conforms to the limit values (see Article 3 and Annex). Some concept of type-specific reference conditions is included in Article 8 of the Directive through the ability to derogate the Directive requirements where deviation from the prescribed value is caused by natural enrichment of certain substances.

246. The Bathing Water Directive does not require a direct assessment of eutrophication. However, there is a requirement to monitor several parameters relevant to the assessment of eutrophication, i.e. transparency (fortnightly), dissolved oxygen, nitrates and phosphate when the quality of the water has deteriorated. Furthermore samples must be collected for ammonia and nitrogen (Kjeldahl) when there is a tendency towards eutrophication of the water. Of these parameters the Annex provides guideline values for transparency (2 meters), and dissolved oxygen (80 to 120 percent saturation). These parameters will not be included in the future amended version of this Directive.

1.8. Abstraction of Drinking Water Directive (75/440/EEC)

247. The Abstraction of Drinking Water Directive (75/440/EEC) sets water quality requirements, which must be met for surface freshwater which is used, or intended for use, in the abstraction of drinking water. The Directive does not cover groundwater, brackish water or water intended to replenish water-bearing beds. The Directive distinguishes three different categories of surface waters (A1, A2 and A3) requiring three

[49] Excluding swimming pools or water intended for use in therapeutic purpose.

different level of treatment to transform them into drinking water. This Directive will be repealed by the WFD in 2007.

248. The Abstraction of Drinking Water Directive does not refer directly to any methods for assessing eutrophication. However, there is a requirement to monitor many parameters relevant to eutrophication (i.e. conductivity, nitrates, phosphates, and dissolved oxygen). Guidelines for phosphate are specifically included to satisfy the ecological requirement of certain types of environment, i.e. 90 percent of samples should be less than 0.4 mg/l P_2O_5 in A1 waters.

249. Some concept of type-specific reference conditions is included in Article 8 of the Directive through the ability to derogate the Directive requirements where the surface water undergoes natural enrichment of certain substances, or in the case of shallow lakes.

1.9. National Emission Ceilings for Atmospheric Pollutants Directive (2001/81/EC)

250. The Emission Ceilings Directive (2001/81/EC) aims to limit atmospheric emissions of acidifying and eutrophying pollutants and ozone precursors in order to improve the protection of the environment and human health. The protection will be against the adverse effects of acidification, eutrophication and ground level ozone. The long-term objectives of the Directive are to establish national emission ceilings aiming at avoiding exceedances of critical loads and levels[50] and to protect all people against recognised health risks from air emissions.

251. The Emissions Ceilings Directive covers atmospheric emissions from Member States which arise as a result of human activity. It is expected that Member States will lower their annual national emissions of acidifying and eutrophying substances (i.e. sulphur dioxide, nitrogen oxides and ammonia) to levels not greater than those laid down in Annex I by 2010 (Article 4 and 5). Meeting these objectives is expected to result in a reduction of water and soil eutrophication by deposition of nitrogen.

252. There is no direct requirement for an assessment of eutrophication in the Directive. However, the Directive does refer to the quantitative relationship between the emission levels of pollutants and levels of eutrophication. This is based on the exceedance of critical loads at which level the pollutants have a significant adverse effect on the environment. In this instance causing eutrophication, acidification and the formation of ground level ozone.

253. Following the adoption of the Thematic Strategy on air pollution in September 2005, new objectives for eutrophication, acidification, ozone and health have been defined to be met in 2020. The NEC Directive will be reviewed accordingly in 2006. The objective for what concerns eutrophication is a reduction of 43% of the ecosystems in which the critical loads are exceeded as to compare to 2000 situation.

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50 The concept of critical load and level is defined in the Working Group on Effects under the LRTAP Convention, see: http://www.unece.org/env/wge/definitions.htm

1.10. European Marine Strategy

254. The European Marine Strategy is being developed under the 6th Environment Action Programme (6th EAP) with the overall aim to 'promote sustainable use of the seas and conserve marine ecosystems' (European Commission 2002a). The strategy will be very broad and should provide a framework to embrace a wide range of issues.

255. In some aspects it will be analogous to the WFD in a way that it will be based on an ecosystem-approach that will support a regional approach considering that problems are different in different seas or parts thereof. Although many of them originated from activities on land, it only deals with issues pertinent to the marine environment. Eutrophication will be addressed within the strategy as one of several priority issues. A common approach toward marine monitoring and assessment will be developed under the Strategy.

256. On the basis of the proposals made by the European Commission (European Commission 2002a) a consultation process has been established to develop the strategy. This process ended at a broad Stakeholder Conference in November 2004. Following that, the European Commission will publish its proposals later in 2005.

2. OVERVIEW OF EUTROPHICATION IN OTHER INTERNATIONAL POLICIES

257. The control of eutrophication is addressed by a number of international and regional conventions, agreements and policies. These include OSPAR, HELCOM, BARCOM, Black Sea Convention, UNECE-LRTAP and the Rhine and Danube Conventions. These are briefly described in Table 11. The rest of this section focuses on the approach taken by OSPAR and HELCOM.

Table 11. Summary of international and regional conventions addressing eutrophication

Name	General objective	Waters covered	Website
OSPAR Convention	To take steps to prevent and eliminate pollution and the necessary measures to protect the maritime area against the adverse effects of human activities so as to safeguard human health and to conserve the marine ecosystem and, when practicable, restore marine area which have been adversely affected.	North East Atlantic Sea	www.OSPAR.org
Helsinki Convention (HELCOM)	To take measures to prevent and eliminate pollution in order to promote the ecological restoration of the Baltic Sea Area and the preservation of its ecological balance.	Baltic Sea	www.HELCOM.fi
Barcelona Convention (UNEP/MAP)	To take concerted actions to prevent and eliminate marine pollution and sustainable management of the Mediterranean.	Mediterranean Sea	www.unepmap.org
Bucharest Convention	To take all necessary measures… to prevent, reduce and control pollution in order to protect and preserve the marine environment of the Black Sea.	Black Sea	www.blacksea-environment.org

Name	General objective	Waters covered	Website
UNECE Convention on Long-range Transboundary Air Pollution (LRTAP)	An international legally binding instrument to deal with problems of air pollution on a broad regional basis. Signed by 34 governments and the EC. Includes a protocol to abate acidification and eutrophication. The Working Group on Effects under the Convention is in charge of monitoring the impact of air pollution on health and environment (notably eutrophication and acidification).	Air Pollution (Europe)	www.unece.org/env/lrtap/welcome.html http://www.unece.org/env/wge/welcome.html
Convention for the protection of the Rhine	Aims to strengthen cooperation between the Community and the Rhine riparian States in order to preserve and improve the ecosystem of the river. Council Decision 2000/706/EC	Rhine River Basin	http://europa.eu.int/scadplus/leg/en/lvb/l28115.htm
Danube River Protection Convention	Aims to achieved sustainable and equitable water management in the Danube Basin. Agreement to reduce pollution loads to the Black Sea. International Commission for the Protection of the Danube River (ICPDR) acts as the permanent secretariat. Supported by a communication from Commission -COM (2001) 615 - on Environmental Co-operation in the Danube.	Danube River Basin	http://www.icpdr.org/pls/danubis/danubis_db.dyn_navigator.show http://europa.eu.int/scadplus/leg/en/lvb/l28016.htm

2.1. OSPAR Comprehensive Procedure

2.1.1. Overview of OSPAR COMPP

258. One key goal of OSPAR is the implementation of the OSPAR Eutrophication Strategy to achieve ‘a healthy marine environment where eutrophication does not occur’ by 2010. PARCOM recommendation 88/2 deals with the reduction of nutrient inputs by 50 percent from 1985 to 1995 in regions where these inputs are likely, directly or indirectly to cause pollution. PARCOM recommendation 89/4 deals with the set up of national action plans to reach the aims set out in PARCOM Recommendations 88/2. OSPAR defines "eutrophication” as the enrichment of water by nutrients 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, and therefore refers to the undesirable effects resulting from anthropogenic enrichment by nutrients as described in the OSPAR Common Procedure.

259. OSPAR has developed a harmonised assessment of eutrophication through the Common Procedure to identify the regions of the OSPAR Marine Area in which these recommendations apply. This consists of an Initial Screening Procedure (a "one-off broad-brush approach") to identify obvious Non-Problem Areas, followed by the application of the Comprehensive Procedure to identify whether other waters should be classified as (Potential) Problem Areas or Non-Problem Areas with respect to eutrophication. The

Comprehensive procedure is applied as an iterative process, with periodic reassessments and feedback from its application being used to refine the procedure. The screening procedure has been finalised in 2004.

260. The Comprehensive Procedure (COMPP) consists of a set of assessment criteria that are linked to form a holistic assessment of eutrophication status (OSPAR Commission 2005-3). It is based on a conceptual framework of the eutrophication process and a checklist of qualitative parameters for a holistic assessment.

261. The conceptual framework and these categories take into account interactions and cause and effect relationships. The conceptual framework is further discussed in section 2.2 along side a modified version of the COMPP holistic checklist.

262. Harmonised quantitative criteria linking assessment parameters have been developed for a sub-group of the checklist, as shown in Table 12. The results of this assessment are combined using a matrix to distinguish Problem Areas from Non-Problem Areas, as shown in Table 13.

263. OSPAR is also piloting a set of Ecological Quality Objectives for eutrophication (EcoQOs-Eutro) for the Greater North Sea. This set of five EcoQOs-Eutro is derived directly from the Harmonised Assessment Criteria and their respective assessment levels, and is used as an integrated set. They provide the framework for evaluating the OSPAR 50% nutrient (N and P) reduction target (see also PARCOM recommendations 88/2 and 89/4) and particularly for measuring the achievement of OSPAR general goal to "achieve by the year 2010 a healthy marine environment where eutrophication does not occur". The assessment of ecosystem health based on EcoQOs (expressed as the desired levels of Ecological Quality) is similar to the use of biological, physico-chemical and hydromorphological quality elements to assess Ecological Status in the WFD (OSPAR Commission 2004).

264. The first application of the OSPAR Comprehensive Procedure by Contracting Parties has therefore produced an assessment and area classification of the eutrophication status of the OSPAR maritime waters which is reasonably transparent but not totally harmonised. Transparency is greatest in respect of the data sets providing the raw material for the assessment and the initial classification. The degree of harmonisation was diminished in respect of the final area classification. In the meantime OSPAR has therefore revised and updated the Comprehensive Procedure during the preparatory work for the second application.

Table 12. Harmonised assessment parameters and related elevated levels (OSPAR 2005-3)

Note: Parameters found at levels above the assessment level are considered as "elevated levels" and entail scoring of the relevant parameter category as (+) (cf. 'score' table at Annex 5 of the Common Procedure). For concentrations, the "assessment level" is defined as a justified area-specific % deviation from background levels not exceeding 50%.

Assessment parameters		
Category I	**Degree of nutrient enrichment**	
	1	**Riverine inputs and direct discharges[51] (area-specific)** Elevated inputs and/or increased trends of total N and total P (compared with previous years)
	2	**Nutrient concentrations (area-specific)** Elevated level(s) of winter DIN and/or DIP
	3	**N/P ratio (area-specific)** Elevated winter N/P ratio (Redfield N/P = 16)
Category II	**Direct effects of nutrient enrichment (during growing season)**	
	1	**Chlorophyll *a* concentration (area-specific)** Elevated maximum and mean level
	2	**Phytoplankton indicator species (area-specific)** Elevated levels of nuisance/toxic phytoplankton indicator species (and increased duration of blooms)
	3	**Macrophytes including macroalgae (area-specific)** Shift from long-lived to short-lived nuisance species (e.g. *Ulva*). Elevated levels (biomass or area covered) especially of opportunistic green macroalgae).
Category III	**Indirect effects of nutrient enrichment (during growing season)**	
	1	**Oxygen deficiency** Decreased levels (< 2 mg/l: acute toxicity; 2 - 6 mg/l: deficiency) and lowered % oxygen saturation
	2	**Zoobenthos and fish** Kills (in relation to oxygen deficiency and/or toxic algae) Long-term area-specific changes in zoobenthos biomass and species composition
	3	**Organic carbon/organic matter (area-specific)** Elevated levels (in relation to III.1) (relevant in sedimentation areas)
Category IV	**Other possible effects of nutrient enrichment (during growing season)**	
	1	**Algal toxins** Incidence of DSP/PSP mussel infection events (related to II.2)

51 Principles of the Comprehensive Study on Riverine Inputs and Direct Discharges (RID) (reference number: 1998-5, as amended).

Table 13 Examples of the integration of categorised assessment parameters (see Table 1) for an initial classification. (OSPAR 2005-3)

	Category I Degree of nutrient enrichment Nutrient inputs Winter DIN and DIP Winter N/P ratio	Category II Direct effects Chlorophyll *a* Phytoplankton indicator species Macrophytes	Categories III and IV Indirect effects/other possible effects Oxygen deficiency Changes/kills in zoobenthos, fish kills Organic carbon/matter Algal toxins	Initial Classification
a	+	+	+	problem area
	+	+	-	problem area
	+	-	+	problem area
b	-	+	+	problem area[52]
	-	+	-	problem area
	-	-	+	problem area
c	+	-	-	non-problem area [53]
	+	?	?	Potential problem area
	+	?	-	Potential problem area
	+	-	?	Potential problem area
d	-	-	-	non-problem area

(+) = Increased trends, elevated levels, shifts or changes in the respective assessment parameters in Table 12

(-) = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters in Table 12

? = Not enough data to perform an assessment or the data available is not fit for the purpose

Note: Categories I, II and/or III/IV are scored '+' in cases where one or more of its respective assessment parameters is showing an increased trend, elevated level, shift or change.

2.1.2. Procedures for assessing eutrophication in OSPAR and WFD

265. Procedures for assessing eutrophication are stipulated in the WFD and have been developed by OSPAR. A comparison of the criteria used to assess Good Ecological Status under the WFD, and Non-Problem Areas under the OSPAR Comprehensive Procedure and the related OSPAR Ecological Quality Objectives is made in Table 14. The table shows considerable similarities between the quality elements used for WFD classifications and the parameters used by OSPAR. The classification of Ecological Status incorporates most factors involved in eutrophication (i.e. causative factors, direct effects, and indirect effects) with the exception of algal toxins. A further comparison between WFD quality elements and OSPAR criteria is made below:

[52] For example, caused by transboundary transport of (toxic) algae and/or organic matter arising from adjacent/remote areas.

Phytoplankton – the WFD requires 'composition, abundance and biomass of phytoplankton' for all water body categories with exception of rivers. OSPAR has identified area-specific phytoplankton indicator species as an important element of composition, has set abundance thresholds for these species, and has also set area-specific thresholds for chlorophyll a, as an operational indicator of phytoplankton biomass.

Aquatic flora – the WFD requires the assessment of the 'composition and abundance of other aquatic flora' for all water body categories. OSPAR has agreed that shifts in species composition and aerial coverage of macrophytes/macroalgae should be assessed at an area-specific level (e.g. for the Wadden Sea area). Assessments seek to distinguish long-lived from short-lived nuisance species.

Benthic invertebrate fauna – the WFD requires the assessment of the 'composition and abundance of benthic invertebrate fauna' for all water body categories. OSPAR has not developed this criterion in depth for the time being, and simply seeks to distinguish long-term changes in zoobenthos species composition. However, these changes can also be caused by other factors like bottom trawling which may have an overriding effect compared with eutrophication effects. Kills of benthic fauna due to anoxia events and toxic phytoplankton (if caused by eutrophication) are used as more qualitative (descriptive) assessment criteria for assessing (non)occurrence of these events without any quantitative consideration.

Fish – the WFD requires the assessment of the 'composition, abundance and age structure of fish fauna' for all water body categories with exception of coastal waters. OSPAR is considering the criterion of fish kills due to anoxia events and toxic phytoplankton caused by eutrophication. It is used as a more qualitative (descriptive) criterion for assessing (non)occurrence of these events without any quantitative consideration.

Other elements – the WFD requires also the assessment of hydromorphological and physico-chemical quality elements supporting the biological quality elements. OSPAR has developed thresholds for winter DIN and DIP concentrations, for winter N:P ratios, and for oxygen. OSPAR also takes into account possible trends in riverine and direct nutrient inputs in the assessment. OSPAR recognises a set of supporting environmental elements but these are not used in the same way as in the WFD.

266. Assessments under the WFD cover all pressures whereas the OSPAR COMPP is focused on the impact of nutrient enrichment. A further difference between OSPAR COMPP and the WFD is the methods by which the various elements are integrated in the final assessment. The WFD compares deviation of from type-specific reference conditions to calculate an EQR, and base the Ecological Status on the Quality Element with the worst status. The COMPP uses area-specific/ historical reference levels for each criterion and has an additive process across the four categories (causative factors, direct effects, indirect effects and

[53] The increased degree of nutrient enrichment in these areas may contribute to eutrophication problems elsewhere.

other possible effects) to integrate the results of the parameters considered. The result is – like for WFD – driven by the worst result within each category (nutrient enrichment, direct effects, indirect effects). The initial outcome might be reviewed, taking into account the influence of environmental factors.

2.1.3. Water body typology

267. Both the OSPAR and WFD methods are based on recognition of differences between different types of waters. Typology forms the basis for classifications under the WFD since reference conditions for the biological elements are type specific. Two systems for typing are prescribed and Member States must apply one of them. OSPAR has developed a procedure to derive a Characterisation of the OSPAR Convention area:

268. In order to enable area-specific reference conditions to be established, there might be a need for Contracting Parties to carry out an analysis of the relevant characteristics ("typology") for their parts of the OSPAR maritime area. Relating thereto, further relevant information can be found in the Quality Status Reports for the North Sea and the whole OSPAR maritime area (QSR 1993 and QSR 2000).

269. For transitional (e.g. estuarine) and coastal waters falling under the regime of the Water Framework Directive, the respective typology could be used also for the application of the Comprehensive Procedure. When carrying out the characterisation, Contracting Parties should focus on the overall purpose of the Comprehensive Procedure to identify the eutrophication status of various parts of the OSPAR maritime area.

270. If Contracting Parties see a need to (further) divide their waters outside the area of jurisdiction of the Water Framework Directive, the factors like

a. salinity gradients and regimes;
b. depth;
c. mixing characteristics (such as fronts, stratification);
d. transboundary fluxes;
e. upwelling;
f. sedimentation;
g. residence time/retention time;
h. mean water temperature (water temperature range);
i. turbidity (expressed in terms of suspended matter);
j. mean substrate composition (in terms of sediment types);
k. typology of offshore waters,

could assist in the characterisation.

271. The background levels and elevated assessment levels determined for some elements of the OSPAR harmonised assessment criteria could be used to influence the development of the WFD classification boundaries, e.g. background level potentially could correspond to the high/ good boundary, and the elevated assessment level could correspond to the good/ moderate boundary (OSPAR 2005).

Table 14. Comparison of OSPAR Ecological Quality Objectives and the normative definition of good Ecological Status for WFD quality elements (coastal waters) (Annex V 1.1)

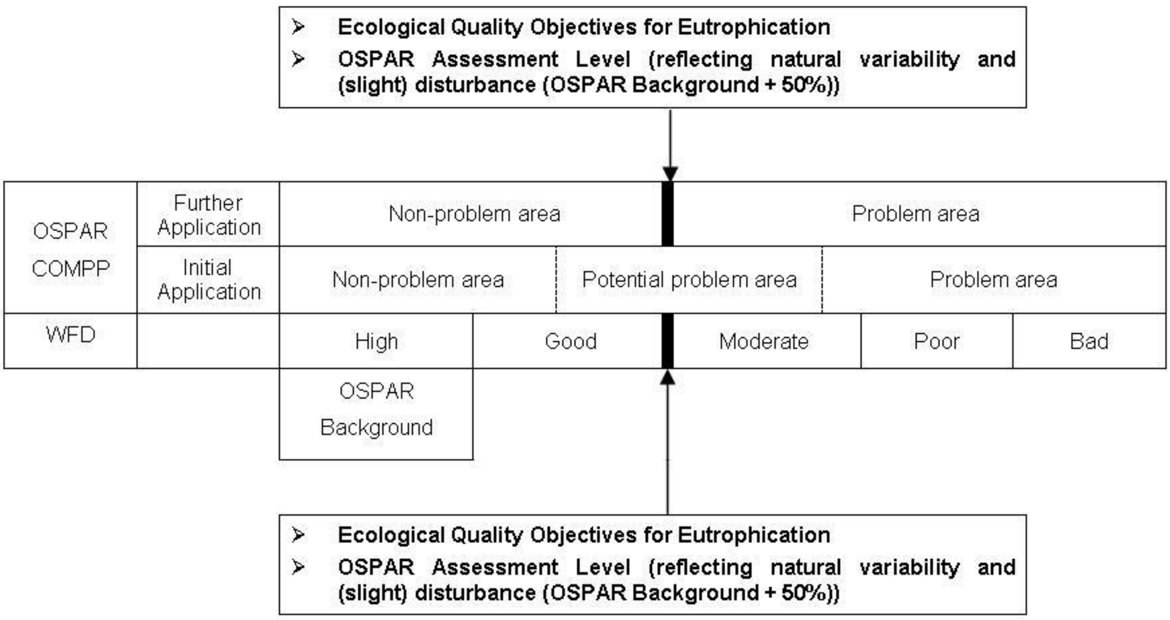
Quality Element	WFD	OSPAR COMMP	OSPAR EcoQ Objectives
Biological			
Composition, abundance and biomass of phytoplankton	The composition and abundance of phytoplanktonic taxa show slight signs of disturbance. There are slight changes in biomass compared to type-specific conditions. Such changes do not indicate any accelerated growth of algae resulting in undesirable disturbance to the balance of organisms present in the water body or to the quality of the water. A slight increase in the frequency and intensity of the type-specific planktonic blooms may occur.	No elevated levels (and increased duration) of region-specific phytoplankton indicator species. Maximum and mean chlorophyll a concentrations in during the growing season should remain below elevated levels. (Elevated if concentration > 50% above background concentrations).	Region/area-specific phytoplankton eutrophication indicator species should remain below respective nuisance and/or toxic elevated levels (and increased duration). Maximum and mean chlorophyll a concentrations during the growing season should remain below elevated levels, defined as concentrations>50% above the spatial (offshore) and/or historical background concentrations.
Composition and abundance of aquatic flora (macroalgae and angiosperms)	Most disturbance-sensitive macroalgal and angiosperm taxa associated with undisturbed conditions are present. The level of macroalgal cover and angiosperm abundance show slight signs of disturbance.	Macrophytes including macroalgae: no shifts from long-lived to short-lived nuisance species (e.g. Ulva, Enteromorpha). No reduced depth distribution.	-
Composition and abundance of benthic invertebrate fauna,	The level of diversity and abundance of invertebrate taxa is slightly outside the range associated with the type-specific conditions. Most of the sensitive taxa of the type-specific communities are present.	No kills in zoobenthos due to oxygen deficiency and/or toxic algae) No long term changes in zoobenthos species composition.	There should be no kills in benthic animal species as a result of oxygen deficiency and/or toxic phytoplankton species.

Quality Element	WFD	OSPAR COMMP	OSPAR EcoQ Objectives
Composition, abundance and age structure of fish (T)	The abundance of the disturbance-sensitive species shows slight signs of distortion from type-specific conditions attributable to anthropogenic impacts on physicochemical or hydromorphological quality elements.	No kills in fish due to oxygen deficiency and/or toxic algae).	There should be no kills in benthic animal species as a result of oxygen deficiency and/or toxic phytoplankton species.
Chemical and Physicochemical			
General Physicochemical quality elements • Transparency • Thermal conditions • Oxygenation conditions • Salinity • Nutrients conditions	Temperature, oxygenation conditions and transparency do not reach levels outside the ranges established so as to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements. Nutrient concentrations do not exceed the levels established so as to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements.	Oxygen levels should remain above region-specific oxygen deficiency levels (< 2 mg/l = acute toxicity; 2 - 6 mg/l = deficiency). Winter DIN- and/or DIP concentrations should remain below elevated levels (defined as concentration >50% above salinity related and/or region specific background concentration). Winter N/P-ratios should remain below elevated levels (defined as ratio >50% above Redfield ratio (N/P=16 molar ratio))	Any decrease in oxygen concentration as an indirect effect of nutrient enrichment should remain above region specific oxygen deficiency levels. Winter DIN and/or DIP should remain below elevated levels defined as concentrations >50% above salinity related and/or region-specific background natural background concentrations.
Specific Pollutants		-	-
Hydromorphological			
Tidal regime	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Supporting environmental factors such as physical and hydrodynamic aspects or climate (e.g. flushing, wind, temperature, light availability).	-
Morphological conditions	Conditions consistent with the achievement of the values specified above for the biological quality elements.	-	-

2.1.4. Comparison of OSPAR and WFD class boundaries

272. A more detailed comparison of ecological classification under the WFD and classification under OSPAR COMPP was made by OSPAR (2005) and is shown in Figure 9.

273. The assessment of good Ecological Status under the WFD is similar to the assessment of Non-Problem Areas in the OSPAR Comprehensive Procedure. A water body will fail to achieve good Ecological Status if any single Quality Element fails good status, similarly the OSPAR Comprehensive Procedure requires that none of the categories I, II, III & IV (causative factors, direct effects and indirect effects) show increased trends, elevated levels or adverse changes. However, there is not always a direct match in how different parameters are combined. Category II, for example, requires two objectives related to phytoplankton to be met ('chlorophyll-a' and 'indicator species'), which correspond to a single Quality Element ('composition, abundance and biomass of phytoplankton').



Note: Assessment levels are based on a justified area-specific % deviation from background levels not exceeding 50%. OSPAR COMPP = the Comprehensive Procedure; WFD = the Water Framework Directive.

Figure 9. Relationship between the classification under the OSPAR Comprehensive Procedure, the integrated set of OSPAR EcoQOs for eutrophication and the Water Framework Directive. (OSPAR 2005)

2.2. HELCOM

2.2.1. Overview of HELCOM[54]

274. The Helsinki Commission, or HELCOM, aims to protect the marine environment of the Baltic Sea from all sources of pollution, and to restore and safeguard its ecological balance. It operates through intergovernmental co-operation and is the governing body of the "Convention on the Protection of the Marine Environment of the Baltic Sea Area" (known as the Helsinki Convention).

275. The control of eutrophication is a major priority of HELCOM. It is widely acknowledged that excessive amounts of nutrients are entering the semi-enclosed Baltic Sea and disturbing the ecological balance of the fragile sea. Under certain hydrological and environmental conditions this leads to algal blooms, oxygen depletion and occasionally fish kills (e.g. 2002 in the Belt Sea and 2003 in the Gulf of Gdansk). In many coastal regions the perennial algal belts have reduced and partly replaced by short-lived filamentous algal species.

276. Since mid 1980, HELCOM has adopted several HELCOM Recommendations to reduce the load of nutrients and oxygen consuming substances from point and non-point sources in the Baltic Sea catchment. In addition the 1988 HELCOM Ministerial Declaration sets goals for all coastal states to decrease their anthropogenic nutrient loading by 50% from 1987 by 1995. Furthermore, in 1992, the Baltic Sea Joint Comprehensive Environmental Action Programme (JCP) was established to facilitate and monitor the elimination of the 132 most polluting sources within the Baltic Sea catchment area - known as "hot-spots".

277. At present, HELCOM has established monitoring programmes, including detailed Guidelines, to quantify inputs of airborne and waterborne nutrients and their sources. Currently, airborne inputs and their sources are assessed annually.

278. Pollution Load Compilations are periodically carried out in order to compile:

a. Total loads of nutrients on an annual basis (from rivers and coastal areas as well as point sources and diffuse sources discharging directly to the Baltic Sea); and

b. Waterborne discharges from point sources and losses from non-point pollution sources as well as natural background losses into inland surface waters within the catchment area of the Baltic Sea located within the borders of the Contracting Parties.

279. These are reported every six year starting in 1987 (PLC-1). The latest report (PLC-4, HELCOM 2004) covers the period 1994-2000 for riverine loads and both point and non-point sources in the Baltic Sea catchment area for the year 2000. In addition, indicator fact sheets are being produced annually.

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54 For further information see: http://www.helcom.fi/groups/monas/en_GB/monas_main/

280. This information is required to assess the effectiveness of measures taken to reduce pollution in the Baltic Sea catchment area as well as to interpret and evaluate the environmental status and related changes in the open sea and coastal waters.

281. Since the late 1970's , the joint holistic environmental monitoring has been carried out in the Baltic Sea under the co-ordination by HELCOM. It has included quantification of spatial distribution and long-term trends in nutrients, oxygen, phytoplankton, zooplankton, and benthic macrofauna. Cycles of hydrographic parameters, water exchange and fluxes of nutrients between the Baltic Sea and the North Sea and between the Baltic Sea basins, sediment, littoral phytobenthic communities and coastal fish are also included in the HELCOM monitoring programme. The aim of this COMBINE monitoring programme is to identify and quantify the effects of anthropogenic discharges/activities in the Baltic Sea, in the context of the natural variations in the system, and to identify and quantify the changes in the environment as a result of regulatory actions. The programme covers both coastal and open sea waters. The COMBINE program is carried out every year; it focuses on eutrophication and contaminant monitoring and assessment in coastal waters and the open marine environment.

282. The results are published every five years as comprehensive periodic assessments which include most of the DPSIR chain as well as structure and functioning of the pelagic system. Background concentrations of nutrients in the open marine environment are used as one of the criteria for assessments. Ecological Quality Objectives (EcoQOs) for eutrophication are also under development.

283. HELCOM MONAS launched in 2004 the project "Development of tools for a thematic eutrophication assessment (HELCOM EUTRO)" which aims at a Baltic Sea wide harmonisation of eutrophication assessment criteria and procedures including the establishment of reference conditions for different parts of the Baltic Sea. The project will be a test of the preliminary Pan-European guidance on assessment of eutrophication in European waters adapted to Baltic Sea specific features. The activities are based on monitoring data produced within the COMBINE programme and other national monitoring and research data, and they cover both the coastal areas and the open sea.

3. REFERENCES

1. European Communities, 1975. Council Directive 75/440/EEC of 16 June 1975 concerning the quality required of surface water intended for the abstraction of drinking water in the Member States. OJ L194, 25/07/1975.
2. European Communities, 1976. Council Directive 76/160/EEC of 8 December 1975 concerning the quality of bathing water. OJ No. L31/1. 5/2/76.
3. European Communities, 1978. Council Directive 78/659/EEC of 18 July 1978 on the quality of freshwaters needing protection or improvement in order to support fish life. OJ L 222, 14/08/1978.
4. European Communities, 1979a. Council Directive 79/923/EEC of 30 October 1979 on the quality required of shellfish waters. OJ L 281/47, 10/11/79.
5. European Communities, 1979b. Directive 79/409/EEC of the European Parliament and of the Council on the conservation of wild birds. OJ L 103/ 43.
6. European Communities, 1991a. Directive 91/271/EEC. Council Directive of 21 May 1991 concerning urban waste water treatment. O.J. L135/40 vol. 30/5/91.
7. European Communities, 1991b. Directive 91/676/EEC of the European Parliament and of the Council Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources. OJ L375/1.
8. European Communities, 1992. Directive 92/43/EEC of the European Parliament and of the Council of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. OJ L 206/ 7.
9. European Communities, 2000: Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. O.J. L327 vol.43.22/12/2000.
10. European Communities, 2001. Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants. O.J. L 309/22, 27/11/2001. .
11. European Communities, 2003a. WFD CIS Guidance Document No. 5. Transitional and coastal waters - typology, reference conditions, and classification systems. Produced by Working Group 2.4 COAST. http://forum.europa.eu.int/Public/irc/env/wfd/library
12. European Communities, 2003b. WFD CIS Guidance Document No. 6. Towards a guidance on establishment of the intercalibration network and the process on the intercalibration exercise. Produced by Working Group 2.5 – Intercalibration.

13. European Communities, 2003c. WFD CIS Guidance Document No. 7. Monitoring under the Water Framework Directive. Produced by Working Group 2.7 – Monitoring.

14. European Communities, 2003d. WFD CIS Guidance Document No. 10. Rivers and lakes – Typology, reference conditions and classification systems. Produced by Working Group 2.3 - REFCOND. http://forum.europa.eu.int/Public/irc/env/wfd/library

15. European Communities 2004. Common Implementation Strategy for the Water Framework Directive (2000/60/EC). Overall Approach to the Classification of Ecological Status and Ecological Potential.

16. European Communities 2005. WFD CIS Guidance Document No. 13. Overall Approach to the Classification of Ecological Status and Ecological Potential. Produced by Working Group 2A.

17. European Environment Agency 1995. Europe's Environment: The Dobris Assessment.

18. HELCOM, 2002. Environment of the Baltic Sea Area 1994 – 1998. Balt. Sea Environ. Proc. No. 82B, ISNN: 0357-2994

19. HELCOM, 2004. The fourth Baltic Sea Pollution Load compilation. Balt. Sea Environ. Proc. No. 93, ISSN: 0357-2994

20. OSPAR 2001. Harmonised assessment criteria and their respective assessment levels in the Comprehensive Procedure.

21. OSPAR Commission 2000. For the protection of the Marine Environment of the North-East Atlantic. Quality Status Report 2000. London.

22. OSPAR Commission 2003. Draft starting point for the further development of the Common Procedure for the identification of the eutrophication status of the OSPAR Maritime Area. Meeting of the Eutrophication Committee (EUC) London, 8-12 December 2003.

23. OSPAR 2003. OSPAR Integrated Report 2003 on the Eutrophication Status of the OSPAR Maritime Area Based upon the First Application of the Comprehensive Procedure, ISBN 1-904426-25-5.

24. OSPAR Commission 2004. Similarities and synergies between the OSPAR Comprehensive Procedure, OSPAR Ecological Quality Objectives related to eutrophication (EcoQO-Eutro) and the EC Water Framework Directive. Submission from the OSPAR Eutrophication Committee to the Water Framework Directive Intercalibration Workshop, 11 February 2004.

25. OSPAR 2005-3. Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area.

26. Quality Status Report 1993. Quality Status Report for the North Sea. London: HMSO.

ANNEX 2 – INDICATIVE CHECK-LISTS FOR CATEGORY SPECIFIC FEATURES OF THE IMPACT OF EUTROPHICATION

284. The following tables are the complete water category-specific check-lists developed during the Eutrophication Workshop in Ispra in September 2004.

RIVERS – Checklist for a holistic assessment
The qualitative assessment parameters are:
a. The causative factors:

The degree of nutrient enrichment:
- With regard to inorganic/organic nitrogen
- With regard to inorganic/organic phosphorus

Taking account of:
- Sources (differentiating between anthropogenic and natural sources)
- Increased/upward trends in concentration
- Elevated concentrations
- Change in N/P ratios
- Fluxes and nutrient cycles (including internal nutrient loading, direct and atmospheric inputs).
- Changes in hydromorphology.

b. The environmental factors:
- Light availability (irradiance, turbidity, suspended load, shading)
- Hydromorphology (e.g. water depth, velocity, flood frequency, substrate type and mobility, stratification, deposition)
- Climatic/weather conditions (rainfall, temperature)
- Chemical status (e.g. suppression of algae growth by pesticides).

c. The direct effects of nutrient enrichment/eutrophication:

i. Phytoplankton;
- Increased biomass (e.g. chlorophyll a, organic carbon and cell numbers or volume)
- Increased frequency and duration of blooms
- Increased annual primary production
- Shifts in species composition (e.g. from diatoms to green algae or cyanobacteria some of which are nuisance or toxic species)

ii. Macrophytes;
- Increased biomass
- Shifts in species composition (from long-lived species to short-lived species, some of which are nuisance species)
- Reduced depth distribution

iii. Phytobenthos
- Increased biomass
- Increased aerial cover on substrate
- Shifts in species composition (e.g. from diatoms to green algae or cyanobacteria)

d. The indirect effects of nutrient enrichment/eutrophication

i. organic carbon/organic matter;
- Increased dissolved/particulate organic carbon concentrations
- Occurrence of foam and/or slime
- increased concentration of organic carbon in sediments (due to increased sedimentation rate)

ii. oxygen;
- Decreased concentrations and saturation percentage
- Increased frequency of low oxygen concentrations
- More extreme diurnal variation
- Occurrence of anoxic zones at the sediment surface (“black spots”)

iii. Fish;
- Mortalities resulting from low oxygen concentrations
- Changes in species composition
- Changes in abundance
- Disruption of migration or movement

iv. benthic invertebrate community;
- Changes in abundance
- Changes in species composition
- Changes in biomass

v. Increased growth and biomass of benthic heterotrophic organisms, such as fungi and bacteria

e. Other possible effects of nutrient enrichment

i) Algal toxins (still under investigation - the recent increase in toxic events may be linked to eutrophication).

ii) Amenity values compromised e.g. clogging of pipes and filters, build up of iron deposits due to low DO, amenity value of the river.

LAKES – Checklist for a holistic assessment
The qualitative assessment parameters are:
a. The causative factors:

The degree of nutrient enrichment:
- With regard to total and inorganic/organic nitrogen
- With regard to total and inorganic/organic phosphorus
- With regard to silicon

Taking account of:
- Sources (differentiating between anthropogenic and natural sources)
- Increased/upward trends in concentration
- Elevated concentrations
- Changed N/P, N/Si, P/Si ratios-
- Fluxes and nutrient cycles (including *internal nutrient loading,* across boundary fluxes, recycling within environmental compartments and riverine, direct and atmospheric inputs)

b. Typology factors and other pressures:
- Typology factors (alkalinity, colour, depth, size etc.),
- Other pressures (hydromorphological impacts and anthropogenic toxic substances)
- Light availability (irradiance, mineral turbidity, suspended load)
- Hydrodynamic conditions (e.g. stratification, flushing, retention time,)
- Climatic/weather conditions (wind, temperature, wet and dry deposition)
- Zooplankton grazing (which may be influenced by other anthropogenic activities)

c. The direct effects of nutrient enrichment:

i. Phytoplankton;
- Increased biomass (e.g. chlorophyll a, organic carbon and cell numbers)
- Increased frequency and duration of blooms
- Increased annual primary production
- Shifts in species composition (e.g. from *chrysophytes and* diatoms to flagellates */cyanobacteria*, some of which are nuisance or toxic species)

ii. Other aquatic flora, including macroalgae *(such as Characeans)*;

a) Submerged macrophytes:
- Changes in biomass (can also be decreased in lakes due to light limitation)
- Changes in species composition (, some of which are nuisance species)
- Reduced depth distribution

b)phytobenthos;
- Increased biomass and primary production, and changes in taxonomic composition

d. The indirect effects of nutrient enrichment

i. organic carbon/organic matter;
- Increased dissolved/particulate organic carbon concentrations
- Occurrence of foam and/or slime
- increased concentration of organic carbon in sediments (due to increased sedimentation rate)

ii. oxygen;
- Decreased concentrations and saturation percentage in bottom water and under icecover
- Increased occurrence of low oxygen concentrations in bottom water and under icecover
- Increased consumption rate
- Occurrence of anoxic zones at the sediment surface ("black spots")
- Oversaturation of oxygen in surface water

iii pH increase in littoral zone and surface layers

iv. reduced top-down control of primary producers (reduced grazing by zooplankton and benthic fauna)

v Littoral and profundal macroinvertebrates;
- Changes in abundance and species composition

vi. Fish;
- Changes in abundance
- Changes in species composition (from salmonids and coregonids to perchids and cyprinids)
- Changes in age structure
- Fish kills

COASTAL/TRANSITIONAL WATERS – Checklist for a holistic assessment
The qualitative assessment parameters are:
a. The causative factors:

The degree of nutrient enrichment:
- With regard to inorganic/organic nitrogen
- With regard to inorganic/organic phosphorus
- With regard to silicon

Taking account of:
- Sources (differentiating between anthropogenic and natural sources)
- Increased/upward trends in concentration
- Elevated concentrations
- Changes in N/P, N/Si, P/Si ratios
- Fluxes and nutrient cycles (including across boundary fluxes, recycling within environmental compartments and riverine, direct and atmospheric inputs)

b. The supporting environmental factors:
- Light availability (irradiance, turbidity, suspended load)
- Hydrodynamic conditions (stratification, flushing, retention time, upwelling, salinity gradients, deposition)
- Climatic/weather conditions
- Zooplankton grazing (which may be influenced by other anthropogenic activities)
- Coastal morphology
- Typology factors for coastal waters

c. The direct effects of nutrient enrichment:

i. Phytoplankton;
- Increased biomass (e.g. chlorophyll a, organic carbon and cell numbers)
- Increased frequency and duration of blooms
- Increased annual primary production
- Shifts in species composition (e.g. from diatoms to flagellates, some of which are nuisance or toxic species)

ii. Macrophytes including macroalgae;
- Increased biomass
- Shifts in species composition (from long-lived species to short-lived species, some of which are nuisance species)
- Reduced depth distribution

iii. Mycrophytobenthos;
- Increased biomass and primary production

d. The indirect effects of nutrient enrichment

i. organic carbon/organic matter;
- Increased dissolved/particulate organic carbon concentrations
- Occurrence of foam and/or slime
- increased concentration of organic carbon in sediments (due to increased sedimentation rate)

ii. oxygen;
- Decreased concentrations and saturation percentage
- Increased frequency of low oxygen concentrations
- Increased consumption rate
- Occurrence of anoxic zones at the sediment surface (“black spots”)

iii. zoobenthos and fish;
- Mortalities resulting from low oxygen concentrations

iv. benthic community structure;
- Changes in abundance
- Changes in species composition
- Changes in biomass

v. Ecosystem structure;
- Structural changes

e. Other possible effects of nutrient enrichment

i) Algal toxins (still under investigation - the recent increase in toxic events may be linked to eutrophication)

ANNEX 3 – SUMMARY TABLES OF INFORMATION COLLATED DURING THE PREPARATION OF THIS GUIDANCE ON EXISTING EUTROPHICATION RELATED ASSESSMENT METHODOLOGIES AND CRITERIA USED FOR LAKES, RIVERS AND MARINE WATERS

CONTENT

Table 1a: Existing classification systems for assessment of eutrophication in LAKES							
No specific information given for the following countries							
UK							No WQ classification defined
DE							Assessment of trophic status (Index including summer means of chlorophyll-a, secchi depth, total phosphorous and spring total phosphorous) Objective: Current trophic status equal or one class lower than natural one (i.e. natural: mesotrophic; objective: mesotrophic or slight eutrophic)
BE (FL)							Preliminary classification used in characterisation in Flemish territory. Chlorophyll A, PO4-P and NO3-N mentioned, without parameter values
ES							Existing system non-compliant (no typology, no ref.cond.), TP, SD, chlf. included.
MT							No WQ classification defined
Information available from the following countries, not entered into tables below							
PL							Existing system non-compliant (no typology, no ref.cond.), four classes based on TP, Chlf.a, Secchi depth, Combining the values to a total assessment according to a scoring system. Susceptibility to degradation is also quantified, this may help to distinguish reference conditions
NL							Values for chlorophyll a (100 µg/l summer mean), total phosphorus (0.15 mgP/l) and total nitrogen (2.2 mgN/l summer mean) are used in the assessment of eutrophication in lakes.
IT							1999 system defines 5 WQ classes based on O2 saturation, TP, Secchi depth, and Chlorophyll. For O2 and TP, a scoring system is employed - these parameters are not entered in tables below

Table 1a: Existing classification systems for assessment of eutrophication in LAKES

Chlorophyll a (µg/L)

Country						Lake type	Comments
NO	**high**	**good**	**moderate**	**poor**	**bad**		
	<2	2-4	4-8	8-20	>20	all types	seasonal mean May -October
SE	**Very low**	**Low**	**Moderate**	**High**	**Very high**		
	≤2	2-5	5-12	12-25	>25	all types	seasonal mean May -October
	≤2.5	2,5-10	10-20	20-40	>40	all types	in August
FI	**excellent**	**good**	**satisfactory**	**passable**	**poor**		
	<4	4-10	10-20	20-50	>50	all types	seasonal mean
AT	**Oligo-trophic**	**Meso-trophic**	**Eutrophic**		**Hyper-trophic**		
	<3	3-8	7-30		>40	A1, A2, A3, K2, K3	annual mean
AT	**Oligo-trophic**	**Meso-trophic**	**Weakly Eutrophic**	**Strongly Eutrophic**	**Hyper-trophic**		
	<4	4-12	12-35	12-35	>35	B1, B2, C1, D1, D2, D3, E1, E2, K1	in summer epilimnion
IT	**Excellent**	**Good**	**Moderate**	**Poor**	**Bad**		
	<3	3-6	6-10	10-25	>25		
HU	I (Excellent)	II	III	IV	V (Heavily polluted)		National Quality standard MSZ 12749:93 (Five classes I. excellent to V. heavily polluted)
	10	25	75	250	>250		

Total Phosphorus (µg/L)

Country						Lake type	Comments
NO	**high**	**good**	**moderate**	**poor**	**bad**		
	<7	7-11	11-20	20-50	>50	all types	seasonal mean May -October
SE	**low**	**Moderate**	**High**	**Very high**	**Extremely high**		
	≤12.5	12.5 - 25	25 - 50	50 - 100	>100	all types	seasonal mean May -October

Table 1a: Existing classification systems for assessment of eutrophication in LAKES

FI	**excellent**	**good**	**satisfactory**	**passable**	**poor**		
	<12	12-30	30-50	50-100	>100	all types	
AT	**Oligo-trophic**	**Meso-trophic**	**Eutrophic**		**Hyper-trophic**		
	<13	13-40	40-100		>100	A1, A2, A3, K2, K3	annual mean
AT	**Oligo-trophic**	**Meso-trophic**	**Weakly Eutrophic**	**Strongly Eutrophic**	**Hyper-trophic**		
	<10	10-20	20-30	30-50	>50	B1, B2, C1, D1, D2, D3, E1, E2, K1	the same class limits are specified for the periods: during spring turnover, in summer epilimnion, during autumn
	<10	<20	20-40	40-60	>60		separate class limits for annual mean
HU	I (Excellent)	II	III	IV	V (Heavily polluted)		National Quality standard MSZ 12749:93 (Five classes I. excellent to V. heavily polluted)
	40	100	200	500	>500		
Secchi depth (m)							
Country						**Lake type**	**Comments**
NO	**high**	**good**	**moderate**	**poor**	**bad**		
	>6	4-6	2-4	1-2	<1	all types	seasonal mean May -October
SE							
FI	**excellent**	**good**	**satisfactory**	**passable**	**poor**		
	>2.5	1-2.5	<1	-	-	all types	
AT	**Oligo-trophic**	**Meso-trophic**	**Eutrophic**	**Hyper-trophic**			
	>6	2-5	0.5-1.5	<0.5		A1, A2, A3, K2, K3	mean during summer stagnation
IT	**Excellent**	**Good**	**Moderate**	**Poor**	**Bad**		
	>5	2-5	1.5-2	1-1.5	<1		

Table 1a: Existing classification systems for assessment of eutrophication in LAKES

Total N (µg/l)							
Country						**Lake type**	**Comments**
NO	**high**	**good**	**moderate**	**poor**	**bad**		
	<300	300-400	400-600	600-1200	>1200	all types	seasonal mean May -October
SE	**low**	**Moderate**	**High**	**Very high**	**Extremely high**		
	≤300	300-625	625-1250	1250-5000	>5000	all types	seasonal mean May -October
Nitrogen/Posphorus ratio							
Country						**Lake type**	**Comments**
SE	**N surplus**	**N:P balanced**	**Moderate N deficit**	**Large N deficit**	**Extreme N deficit**		
	≥30	15-30	10-15	5-10	<5	all types	
Areal TN loss (kg N/ha/year)							
Country						**Lake type**	**Comments**
SE	**Very low**	**Low**	**Moderate**	**High**	**Very high**		
	≤1.0	1.0-2.0	2.0-4.0	3.0-16.0	>16	all types	at least 12 measurements in runoff per year
Areal TP loss (kg P/ha/year)							
Country						**Lake type**	**Comments**
SE	**Very low**	**Low**	**Moderate**	**High**	**Very high**		
	≤0.04	0.04-0.08	0.08-0.16	0.16-0.32	>0.32	all types	at least 12 measurements in runoff per year
Nitrate-N (mg/L, 90%ile)							
Country							
HU	I (Excellent)	II	III	IV	V (Heavily polluted)		
	1	5	10	25	>25		National Quality standard MSZ 12749:93 (Five classes I. excellent to V. heavily polluted)

Table 1a: Existing classification systems for assessment of eutrophication in LAKES							
Nitrite-N (mg/L, 90%ile)							
Country							
HU	I (Excellent)	II	III	IV	V (Heavily polluted)		
	0.01	0.03	0.1	0.3	>0.3		National Quality standard MSZ 12749:93 (Five classes I. excellent to V. heavily polluted)
Ammonium-N (mg/L, 90%ile)							
Country							
HU	I (Excellent)	II	III	IV	V (Heavily polluted)		
	0.2	0.5	1	2	>2		National Quality standard MSZ 12749:93 (Five classes I. excellent to V. heavily polluted)
Ortho-P (µg/L, 90%ile)							
Country							
HU	I (Excellent)	II	III	IV	V (Heavily polluted)		
	0.2	0.5	1	2	>2		National Quality standard MSZ 12749:93 (Five classes I. excellent to V. heavily polluted)
Oxygen in surface water (% saturation)							
Country						**Lake type**	**Comments**
HU	I (Excellent)	II	III	IV	V (Heavily polluted)		
	80-110	70-80; 100-120	50-70; 120-150	20-50; 150-200	<20, >200		National Quality standard MSZ 12749:93 (Five classes I. excellent to V. heavily polluted)
FI	**excellent**	**good**	**satisfactory**	**passable**	**poor**		
	80-110	80-110	70-120	40-150	serious problems		

Table 1a: Existing classification systems for assessment of eutrophication in LAKES

Oxygen annual minimum (mg/l)								
Country							**Lake type**	**Comments**
SE	**O2 rich**	**Moderate**	**Weak**	**O2 poor**	**O2 deficient**			
	≥7	5-7	3-5	1-3	<1	all types	Only if area below sampling depth represents > 10% of lake area. Special regard to H2S occurrence	
Oxygen depletion in hypolimnion (% or verbal description)								
Country							**Lake type**	**Comments**
FI	**excellent**	**good**	**satisfactory**	**passable**	**poor**			
	no	no	occasionally	frequently	common	all types		
AT	**Oligo-trophic**	**Meso-trophic**	**Weakly Eutrophic**	**Strongly Eutrophic**	**Hyper-trophic**			
	>20	20-0	0	0	0	B1, B2, C1, D1, D2, D3, E1, E2, K1	during summer stratification	
Phytoplankton biomass in summer epilimnion (g/m3 or mg/l)								
Country							**Lake type**	**Comments**
SE	**Very low**	**Low**	**Moderate**	**High**	**Very high**			
	≤0.5	0.5-1	1.5-2.5	2.5-5	>5		seasonal mean May-October	
	≤0.5	0.5-2	2-4	4-8	>8		in August	
							Sweden also has quantitative criteria for biomass of certain algal groups (diatoms, cyanobacteria, potentially toxin-producing cyanobacteria, *Gonyostomum semen)*	
AT	**Oligo-trophic**	**Meso-trophic**	**Weakly Eutrophic**	**Strongly Eutrophic**	**Hyper-trophic**			
	<0.2	0.2-1	-	>2	>5	B1, B2, C1, D1, D2, D3, E1, E2, K1		

Table 1a: Existing classification systems for assessment of eutrophication in LAKES

Nitrate reduction and ammonia enrichment in hypolimnion during peak summer stratification							
Country						**Lake type**	**Comments**
AT	**Oligo-trophic**	**Meso-trophic**	**Weakly Eutrophic**	**Strongly Eutrophic**	**Hyper-trophic**		
	None	Slight nitrate reduction and NH3 accumulation above bottom	Nitrate markedly depleted, NH3 accumulation	Nitrate depleted, NH3 accumulation	Nitrate depleted, NH3 accumulation	B1, B2, C1, D1, D2, D3, E1, E2, K1	during peak summer stratification
Sulfate reduction in hypolimnion during peak summer stratification							
Country						**Lake type**	**Comments**
AT	**Oligo-trophic**	**Meso-trophic**	**Weakly Eutrophic**	**Strongly Eutrophic**	**Hyper-trophic**		
	None	None	None	Slight H2S enrichment above bottom	H2S enrichment	B1, B2, C1, D1, D2, D3, E1, E2, K1	during peak summer stratification

Table 1b: Existing classification systems for assessment of eutrophication in RIVERS							
No specific information given for the following countries							
UK							No information on WQ classification provided
AT							No information on WQ classification provided
BG							No information on WQ classification provided
PT							No information on WQ classification provided
Information available from the following countries, not entered into tables below							
BE (FL)							A set of quality standards are used: 1 mg/l Total P (90%ile), 0.3 mg/l Ortho P (90%ile) for running waters and 0.05 mg/l Ortho P (90%ile) for standing waters, 16 mg /l Total N (90%ile), 10 mg/l Nitrate as N (90%ile) and 100 ug/l Chlorophyll a
IE							A biological classification based mainly on benthic invertebrates has been found to respond to P concentrations and Q values from Q1 (bad) to Q5 (high) are used to classify water quality
Chlorophyll a (μg/L)							
Country						**River type**	**Comments**
HU	I (Excellent)	II	III	IV	V (Heavily polluted)		
	10	25	75	250	>250	Two types of river: A: river flowing into lake, B: river not flowing into a lake	National Quality standard MSZ 12749:93 (Five classes I. excellent to V. heavily polluted)
FI	**excellent**	**good**	**satisfactory**	**passable**	**poor**		
	<4	4-10	10-20	20-50	>50	all types	seasonal mean
NL							Values on chlorophyll a, total phosphorus and total nitrogen for lakes presented in Table 1a are guidance for deriving values for rivers.

Table 1b: Existing classification systems for assessment of eutrophication in RIVERS

Total Phosphorus (mg/L)							
Country						**River type**	**Comments**
DE	**Reference**	**Objective**	**Worse classes**				
	<0.05	<0.15	<0.3	<0.6	<1.2	all types	90%ile
FI	**excellent**	**good**	**satisfactory**	**passable**	**poor**		
	<0.012	0.012-0.03	0.03-0.05	0.05-0.1	>0.1	all types	
IT	**Excellent**	**Good**	**Moderate**	**Poor**	**Bad**		
	<0.07	0.07 - 0.15	0.15 - 0.3	0.3 - 0.6	>0.6	all types	75%ile
NL							Values on chlorophyll a, total phosphorus and total nitrogen for lakes presented in Table 1a are guidance for deriving values for rivers.
HU	I (Excellent)	II	III	IV	V (Heavily polluted)		
	A: 0.04 B: 0.1	A: 0.1 B: 0.2	A: 0.2 B: 0.4	A: 0.5 B: 1	A: >0.5 B: >1	Two types of river: A: river flowing into lake, B: river not flowing into a lake	90%ile. National Quality standard MSZ 12749:93 (Five classes I. excellent to V. heavily polluted)

Available Phosphorus (mg/l)							
Country						**River type**	**Comments**
DE	**Reference**	**Objective**	**Worse classes**				
	<0.02	<0.10	<0.2	<0.4	<0.8	all types	Ortho-Phosphate-P
HU	I (Excellent)	II	III	IV	V (Heavily polluted)		
	A: 0.02 B: 0.5	A: 0.05 B: 0.1	A: 0.1 B: 0.2	A: 0.25 B: 0.5	A: >0.25 B: >0.5	Two types of river: A: river flowing into lake, B: river not flowing into a lake	90%ile. National Quality standard MSZ 12749:93 (Five classes I. excellent to V. heavily polluted)

Table 1b: Existing classification systems for assessment of eutrophication in RIVERS

Total N (mg/l)								
Country							**River type**	**Comments**
DE	**Reference**	**Objective**						
	<1	<3	<6	<12	<24	all types	90%ile	
NL								Values on chlorophyll a, total phosphorus and total nitrogen for lakes presented in Table 1a are guidance for deriving values for rivers.
Nitrate (mg N /l)								
Country							**River type**	**Comments**
IT	**Excellent**	**Good**	**Moderate**	**Poor**	**Bad**			
	<0.3	0.3 - 1.5	1.5 - 5	5 - 10	>10	all types	75%ile	
DE	**Reference**	**Guide**						
	1	2.5	5	10	>10	all types	90%ile	
HU	I (Excellent)	II	III	IV	V (Heavily polluted)			
	1	5	10	25	>25	Two types of river: A: river flowing into lake, B: river not flowing into a lake	Types A and B. 90%ile. National Quality standard MSZ 12749:93 (Five classes I. excellent to V. heavily polluted)	
Nitrite (mg N /l)								
HU	I (Excellent)	II	III	IV	V (Heavily polluted)			
	0.01	0.03	0.1	0.3	>0.3	Two types of river: A: river flowing into lake, B: river not flowing into a lake	Types A and B. 90%ile. National Quality standard MSZ 12749:93 (Five classes I. excellent to V. heavily polluted)	

Table 1b: Existing classification systems for assessment of eutrophication in RIVERS							
Ammonium (mg N /l)							
HU	I (Excellent)	II	III	IV	V (Heavily polluted)		
	0.02	0.05	1	2	>2	Two types of river: A: river flowing into lake, B: river not flowing into a lake	Types A and B. 90%ile. National Quality standard MSZ 12749:93 (Five classes I. excellent to V. heavily polluted)
Oxygen in surface water (% saturation)							
Country						**River type**	**Comments**
IT	**Excellent**	**Good**	**Moderate**	**Poor**	**Bad**		
	≤10	≤20	≤30	≤50	>50	all types	100-Ox(%sat), the value of 75°ile is referred to the value of the difference from 100
HU	I (Excellent)	II	III	IV	V (Heavily polluted)		
	100-80	70-80; 100-120	50-70: 120-150	50-20; 150-200	<20; >200	Two types of river: A: river flowing into lake, B: river not flowing into a lake	Types A and B. 90%ile. National Quality standard MSZ 12749:93 (Five classes I. excellent to V. heavily polluted)

Table 2a: Criteria used for designation of sensitive areas for the UWWT Directive and vulnerable zones for the Nitrate Directive in LAKES

Country	UWWT	NO3	Comments
NO	No info available	No info available	
SE	No info available	No info available	
FI	Whole territory approach. No info available	Whole territory approach. No info available	
UK	Waters exceeding upper OECD fixed values for oligo, meso- and eutrophic, asessed in the context of natural trophic state. UWWT: Tot-P (annual mean), Chlorophyll peak annual conc., Secchi depth (annual min)., Algal (partic. cyanobact.) blooms, Macrophyte changes		UK UWWTD designation criteria require assessment of the weight/balance of evidence across causative, direct and indirect effects. Adverse effects should be attributable to nutrient enrichment. In addition, the guidance proposes consideration of trends or other changes, and the influence of environmental conditions, which can determine whether waters may be at risk of becoming eutrophic. Current methods are not considered WFD compliant. WFD classification tools/methods are still under development. Criteria for Nitrate Directive are joint with UWWTD with the role of N requiring case specific consideration.
NL	No criteria used; apply more stringent measures for the whole territory	No criteria used; apply more stringent measures for the whole territory	
BE (FL)	No info available	No info available	
DE	Whole territory approach. No designation.	Whole territory approach. No designation.	
AT	No info available	No info available	
PL	No info available	No info available	
HU	No info available	No info available	

Table 2a: Criteria used for designation of sensitive areas for the UWWT Directive and vulnerable zones for the Nitrate Directive in LAKES

Country	UWWT	NO3	Comments
IT	The same criteria of the Dir. 91/271/EC and all the lakes located under 1000 m a.s.l. with an area ≥ 0,3 km2 are considered sensitive	Nitrates 50 mg/L and the trophic status assessed with the National WQ Scheme	
ES	No info available	No info available	
MT	No info available	No info available	

Table 2b: Criteria used for designation of sensitive areas for the UWWT Directive and vulnerable zones for the Nitrate Directive in RIVERS

Country	UWWT	Nitrate	Comments
DE	Whole territory approach. No designation.	Whole territory approach. No designation.	
AT	Whole territory approach. No info available	Whole territory approach. No info available	
IE	No information provided	No information provided	
BG	No information provided	No information provided	
PT	No information provided	No information provided	
BE (FL)	Whole territory approach under development. No information provided	50 mg/l Nitrate (95%ile) for Annex IA1 waters	
UK	3 river types have been for UWWTD dsignation purposes pending development of WFD methods: oligotrophic (hard upland), mesotrophic and eutrophic (lowland). Criteria used for designation are: Total Reactive Phosphate (TRP) 0.02 mg/l (oligo), 0.06 (meso) and 0.1 (eu); 25 µg/l chlorophylla annual mean; 100 µg/l chlorophyll a maximum; >150% dissolved oxyegn (% saturation) (and low night-time values); Use of methods to assess changes in abundance/cover and composition. Recommends use of Trophic Diatom Index method, plus Mean Trophic Rank method for macrophytes.	50 mg/1 NO_3 for Annex IA1 waters.	UK UWWTD designation criteria also require assessment of the weight/balance of evidence across causative, direct and indirect effects. In addition, the guidance proposes consideration of trends or other changes, and the influence of environmental conditions, which can determine whether waters may be at risk of becoming eutrophic. Current methods are not considered WFD compliant. WFD classification tools/methods are still under development
FI	Whole territory approach. No information provided.	Whole territory approach. No information provided	
HU	No information provided	No information provided	
IT	No information provided	50 mg/l Nitrate	For the designation of vulnerable zones, the following parameters are also considered: orthophosphate, oxygen dissolved, TP, NO2, NH3, TN, but there are limits only for nitrates.

Table 2b: Criteria used for designation of sensitive areas for the UWWT Directive and vulnerable zones for the Nitrate Directive in RIVERS			
Country	**UWWT**	**Nitrate**	**Comments**
NL	Whole territory approach. No information available	Whole territory approach. No information available	

Table 3a: Criteria used for risk assessment for WFD Article 5 reporting in LAKES

Country		Pressure Criteria					Impact criteria				Comments
		Agriculture	**Forestry**	**Population density**	**Point sources**	**Other**	**Total P**	**Chlorophyll**	**E.coli-bact.**	**Other**	
NO	at risk	>15% of area		>10 p.e./km2	major point sources present		>20	>8			In the Norwegian characterization work the criteria are set to identify waterbodies that are obviously at risk or obviously not at risk. This is to ensure that waterbodies that may be at risk will be given a closer assessment by the regional water authority. Since the EFTA countries are given later deadlines that EU, this work is still going on. For this reason waterbodies classified as being "not at risk" will be closer to the high/good boundary or better and waterbodies classified as "at risk" will generally be worse than moderate status
	not at risk	<5 % of area		<5 p.e./km2	none		<7	<2			
SE	not at risk	x	x	x	x	N deposition on lakes, below critical load					Criteria: Model based estimate of load (same model as used for HELCOM Pollution Load Control 4, PLC4)
FI											The Finnish Article 5 assessment is made as expert judgement. It is based on water quality classification and selected biological variables together with observed temporal changes in loading and state, as well as the expected development in the state of a water body. No strict threshold values were used. No pressure criteria were used
UK	at risk						See comment				Type-specific reference conditions for TP-concentration and current P loads calculated from export modelling, converted to lake P concs and used to calculate EQRs for the different types. EQRs for reference over modelled/ measured lake P. Moderate EQR = >.33 - <0.5 Poor or worse EQR =<0.33
	not at risk						Type-specific ref. cond.: 7 µg/L (low alk., deep) to 32 µg/L (High alk., very shallow), see comments			Diatom species turnover (chord distance < 0.48 (insignificant spp turnover at 5th %ile)	Reference total phosphorus concentration in totally 10 lake types, used for risk assessment (Article 5 reporting): peat, deep >3m: 8µg/L, peat, shallow < 3m: 15 µg/L, low alk, deep >3m: 7µg/L, low alk, shallow < 3m: 11µg/L, moderate alk, deep:11µg/L, mod alk, shallow < 3m: 19µg/L, high alk, deep: 29µg/L, high alk, shallow: 32 µg/L, marl deep: 11 µg/L, marl shallow: 19µg/L

Table 3a: Criteria used for risk assessment for WFD Article 5 reporting in LAKES

Country		Pressure Criteria					Impact criteria				Comments
		Agriculture	**Forestry**	**Population density**	**Point sources**	**Other**	**Total P**	**Chlorophyll**	**E.coli-bact.**	**Other**	
NL		x?									90 percentile, at risk: when >Management target value (MTR) for the type, whereas not at risk: <MTR taking into account expected developments in e.g. agriculture, only for national bigger rivers and lakes the preliminary references were used
BE											unclear whether reported TP values (poor >500 µg/l, bad >1000) apply to lakes, or only to rivers/trans. waters
DE	at risk	>40% arable land, >1-1.5 livestock units/ha, >10-20% root crop area, >2-5% vegetables, horticulture etc.		>10-15% urban land							Model based estimate of nutrient load: MONERIS (no forecast to 2015)
	at risk						spring and summer means	x		Secchi depth, >70% of shore with untypical morphology	Trophic status more than 1 class worse than natural one; Combined index with shore morphology (weighting factors: 70% trophic, 30% shore)
AT		x			x	Fisheries; diffuse sources	x	x		oxygen and other WQ parameters	Impact criteria: trophic level exceed reference conditions by more than half a class
PL		x		x	x	tourism, recreation					Detailed criteria given for rivers, but not lakes. Risk assessment li lakes was based on pressure analysis and WQ classification not compliant with WFD."Lake monitoring programme does not include the estimation of P and N loads coming to the lake from different sources"
HU	at risk						TP>125 µg/l annual mean	Table on Chl-a is given for five classes but it is not indicated which class gives at risk.			Estimation of in-lake P conc. Is based on TP loads from point and non-point sources.
IT											No information on Article 5 risk assessment

Table 3a: Criteria used for risk assessment for WFD Article 5 reporting in LAKES

Country		Pressure Criteria					Impact criteria				Comments
		Agriculture	**Forestry**	**Population density**	**Point sources**	**Other**	**Total P**	**Chlorophyll**	**E.coli-bact.**	**Other**	
ES	Not at risk						Lakes (mostly reservoirs): P-tot < 35 µg/l	Reservoirs (Heavily modified rivers): < 8 µg/L (most RBD) < 0,5-3,0 depending on type for Jucar RBD Lakes: < 8 µg/L (Jucar RBD)		secchi depth > 3m, NO3 < 25 mg/L	Most river basin districts (RBD)
	Probably at risk	Significant pressure if: Irrigated land: 10-21% of catchment with > 25 kg N / ha year dryland: > 30-55% of catchment with > 25kg N /ha year Meadows: 15-60% of catchment with > 25 kg N /ha year Stockbreeding: > no of animals (porks and cows) excreting 25 kg N/ha year			Significant pressure if: Urban waste water > 2000 PE, Biodegradable industrial waste water > 4000 PE, Dumps present in catchment	Significant pressure if: Fish farming using > 50 l/s	Lakes (mostly reservoirs): P-tot > 35 µg/l	Reservoirs (Heavily modified rivers): > 8 µg/L (most RBD) > 0,5-3,0 depending on type for Jucar RBD Lakes: > 8 µg/L (Jucar RBD)		secchi depth < 3m, NO3 > 25 mg/L	Most river basin districts (RBD)
MT		x			x		x?				Nutrient loadings from agriculture and sewage input. Sewerage network (precence/absence, state), For criteria, links are given to one report on coastal areas and one state of the environment report, but these were not available on Internet

Table 3b: Criteria used for risk assessment for WFD Article 5 reporting in RIVERS

Country		**Pressure criteria**					**Impact criteria**					**Comments**
		Agriculture	**Forestry**	**Population density**	**Point sources**	**Other**	**Total P**	**Ortho-P**	**Total N**	**Chloro-phyll**	**Other**	
FI												The Finnish Article 5 assessment is made as expert judgement. It is based on water quality classification and selected biological variables together with observed temporal changes in loading and state, as well as the expected development in the state of a water body. No strict threshold values were used. No pressure criteria were used
SE		x	x	x	x							Model based estimate of load to coastal and inland waters as used for HELCOM's pollution load control each year
UK	At risk	x			x	Sediment loading		>0.1 mg/l SRP (low sensitivity) for hard calcareous waters; >0.04 mg/l SRP (high sensitivity) for soft non calcareous waters			TDI = 60 (moderate/high productivity). TDI = 40 (low productivity organic/siliceous).Used in Scotland.	
	Not at risk	x			x	Sediment loading		<0.1 mg/l SRP (low sensitivity) for hard calcareous waters; <0.04 mg/l SRP (high sensitivity) for soft non calcareous waters				
NL												90 percentile, when > MTR at risk < MTR not at risk taking in account expected developments in e.g. agriculture, only for the Rijkswateren (national bigger rivers and lakes) the preliminary references were used)

Table 3b: Criteria used for risk assessment for WFD Article 5 reporting in RIVERS

Country		Pressure criteria					Impact criteria					Comments
		Agriculture	Forestry	Population density	Point sources	Other	Total P	Ortho-P	Total N	Chloro-phyll	Other	
ES	At risk	x		x	x			0.5 mg/l (Catalonia RBD)			Nitrate >25 mg/l (Guadiana RBD); BOD 7 mg/l; TOC 5 mg/l; Ammonia 0.5 mg/l; Nitrates 10 mg/l, Biological indices (Catalonia RBD).	Pressure criteria: Catalonia RBD
BE (FL)		x		x	x		1 mg/l (90%ile)	Ortho-P 0.3 mg/l (90%ile)	Minimum of N species critera (see other)		BOD 6 mg/l (90%ile), COD 30 mg/l (90%ile), KjN 3 mg/l (90%ile), NH4-N 2.5 mg/l (90%ile), NO3-N 4 mg/l (90%ile), NO2-N 0.1 mg/l, , SS 50 mg/l (90%ile), DO 6mg/l	Values quoted have been taken from those provided at the G/M boundary
DE	At risk	>40% arable land, >1-1.5 livestock units/ha, >10-20% root crop area, >2-5% vegetables, horticulture etc.		>10-15% urban land			>0.15 or >0.3 mg/l (90%ile or annual mean)	> 0,1 or >0,2 mg/l (90%ile or annual mean)	> 3 – 6 mg/l (Total N or Nitrate N) (90%ile or annual mean)			Model based estimate of nutrient load: MONERIS (no forecast to 2015)
	Not at risk						<0.15 or <0.3 mg/l (90%ile or annual mean); <0.09 mg/l for slow flowing rivers with lakes	<0,1 – 0,2 mg/l (90%ile or annual mean)	<3 – 6 mg/l (Total N or Nitrate N) (90%ile or annual mean)			

Table 3b: Criteria used for risk assessment for WFD Article 5 reporting in RIVERS

Country		**Pressure criteria**					**Impact criteria**					**Comments**
		Agriculture	**Forestry**	**Population density**	**Point sources**	**Other**	**Total P**	**Ortho-P**	**Total N**	**Chloro-phyll**	**Other**	
AT		Agricult. Landuse > 10%			Presence of sewage point source	Reduction of flow velocity by dams/reservoirs	Alpine rivers: >5.5 mg/ Total P (filtered) (80%ile) – at risk. Lowland rivers >0.15 mg/l (80%ile)		Alpine rivers: >5.5 mg/l Nitrate-N (80%ile) – at risk. Lowland rivers >0.07 mg/l Nitrate N (80%ile)	x	Saprobic water quality class: >II for alpine rivers and >II-III for lowland rivers. Trophic index phytobenthos: eutrophic levels	Pressure criteria used to select sites but risk assessment based on presence of an impact according to set criteria
PL		Emission from: Animal Production Total N >6 t/km^2/y; Total P >1.5t/km^2/y – Probably at risk. Use of mineral fertilisers Nitrogen .50kg/ha/yr; Phosphate >17kg/ha/yr – Probably at risk.		Emission from: Inhabitant not connected to sewer network – Total N >820 kg/km^2/yr; Total P >180 kg/km^2/y – Probably at risk	Municipal: discharged load of Total N .17t/y; Total P >2t/y – Probably at risk							
HU		x			x		>0.25 mg/l as an annual mean					Estimation P concentration in water bodies based on TP loads from point and diffuse sources.
MT		x			x							Nutrient loadings from agriculture and sewage input. Sewerage network (presence/absence, state).

Table 4a: Progress in the development of new WFD-compliant assessment systems for eutrophication in LAKES Preliminary criteria and values (September 2005)

Chlorophyll a (µg/L

GIG	Country	Lake type (GIG-type code and/or description)	High	Good	Moderate	Poor	Bad	Comments
Northern	**NO***	L-N1: Moderate alk., □learwater, shallow, lowland	2		<12			value for high represents reference value (mean), value for moderate represents the G/M boundary
		L-N2: Low alk., □learwater, shallow, lowland	1.5		<6			value for high represents reference value (mean), value for moderate represents the G/M boundary
		L-N3: Low alk., humic, shallow, lowland	2		<10			value for high represents reference value (mean), value for moderate represents the G/M boundary
		L-N8: Moderate alk., humic, shallow, lowland	3		<15			value for high represents reference value (mean), value for moderate represents the G/M boundary
	Common	L-N1: Moderate alk., □learwater, shallow, lowland	<5,5					REBECCA data: 75 percentile, N=21
		L-N2a: Low alk., □learwater, shallow, lowland	<4,1					REBECCA data: 75 percentile, N=57
		L-N2b: Low alk., □learwater, deep, lowland	<2,4					REBECCA data: 75 percentile, N=47
		L-N3: Low alk., humic, shallow, lowland	<7,3					REBECCA data: 75 percentile, N=51
		L-N5: Low alk., □learwater, shallow, boreal	<2,4					REBECCA data: 75 percentile, N-41
		L-N6: Low alk., humic, shallow, boreal	<3,8					REBECCA data: 75 percentile, N-9
		L-N8: Moderate alk., humic, shallow, lowland	<10					REBECCA data: 75 percentile, N=5
Central/Baltic		**LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)**						Summary of C-GIG March 2005
	BE (FL)	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<12	12-25				
	EE	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<10	10-20	20-40			
	DK	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<7	7-12				
	LT	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<5	5-10				
	LV	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<7	7-15	15-30			
	NL	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<8,3	8,3-14,5				
	PL	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<4	4-10	10-18			

Table 4a: Progress in the development of new WFD-compliant assessment systems for eutrophication in LAKES Preliminary criteria and values (September 2005)

	Common	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<5,4					REBECCA data: 75 percentile, N=44
		LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)						
	BE (FL)	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<23	23-46				
	EE	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<10	10-20	20-40			
	DK	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<11	11-21				
	LT	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<10	10-20				
	LV	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<7	7-20	20-40			
	NL	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<16,3	16,3-30				
	PL	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<10	10-20	20-50			
	UK	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<13	13-26				
	Common	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<14,3					REBECCA data: 75 percentile, N=21
		LCB3: soft water Lobelia lakes (alk: 0.2-1 meq/L?)						
	BE (FL)	LCB3: soft water Lobelia lakes (alk: 0.2-1 meq/L?)	<9	9-17				
	EE	LCB3: soft water Lobelia lakes (alk: 0.2-1 meq/L?)	<10	10-20				
	LV	LCB3: soft water Lobelia lakes (alk: 0.2-1 meq/L?)	<5	5-10				
	NL	LCB3: soft water Lobelia lakes (alk: 0.2-1 meq/L?)	<10,3	10,3-19				
	Common	LCB3: soft water Lobelia lakes (alk: 0.2-1 meq/L?)	<5,2					REBECCA data: 75 percentile, N=17
	BE (FL)	Bzl	15.5					No description of types available
		Ad	10.5					
		Ai	11.5					
		Ami	9.5					
		Aw	5.5					

Table 4a: Progress in the development of new WFD-compliant assessment systems for eutrophication in LAKES Preliminary criteria and values (September 2005)

		Cb	6.0					
		Cfe	5.0					
		Czb	4.5					
		Zm	1.5					
		Zs	1.0					
	NL	M5	9.4		>16,3			Value for moderate represents the G/M boundary Example for one lake type from large report available only in Dutch
Atlantic	**Common**	L-A2: Lowland, shallow, calcareous, large (non-stratified)	<5,4					REBECCA data: 75 percentile, N=6
Mediterranean	**ES**	17: Shallow lakes in Jucar River Basin District	<10					maximum ecological potential
		I – VI: Reservoirs (Heavily modified rivers) in Jucar River Basin District	2,3-5,7					
		different types in Catalonia River Basin District	0,5-3					Late summer concentration: < mean+SD for reference sites

Total Phosphorus (µg/L)

GIG	Country	**Lake type** (GIG-type code and/or description)	High	Good	Moderate	Poor	Bad	Comments
Northern	**NO***	L-N1: Moderate alk., □learwater, shallow, lowland	8		<30			Value for high represents reference value (mean), value for moderate represents the G/M boundary
		L-N2: Low alk., □learwater, shallow, lowland	4		<14			Value for high represents reference value (mean), value for moderate represents the G/M boundary
		L-N3: Low alk., humic, shallow, lowland	6		<25			Value for high represents reference value (mean), value for moderate represents the G/M boundary
		L-N8: Moderate alk., humic, shallow, lowland	10		<35			Value for high represents reference value (mean), value for moderate represents the G/M boundary
	Common	L-N1: Moderate alk., □learwater, shallow, lowland	<13,1					REBECCA data: 75 percentile, N=21
		L-N2a: Low alk., □learwater, shallow, lowland	<10,7					REBECCA data: 75 percentile, N=64
		L-N2b: Low alk., □learwater, deep, lowland	<7,5					REBECCA data: 75 percentile, N=47
		L-N3: Low alk., humic, shallow, lowland	<16,3					REBECCA data: 75 percentile, N=49
		L-N5: Low alk., □learwater, shallow, boreal	<8,1					REBECCA data: 75 percentile, N-49
		L-N6: Low alk., humic, shallow, boreal	<12,0					REBECCA data: 75 percentile, N-9
		L-N8: Moderate alk., humic, shallow, lowland	<23,6					REBECCA data: 75 percentile, N=5

Table 4a: Progress in the development of new WFD-compliant assessment systems for eutrophication in LAKES Preliminary criteria and values (September 2005)

Central/Baltic		**LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)**						Summary of C-GIG March 2005
	BE (FL)	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<45	45-93				
	EE	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<30	30-60	60-80			
	DK	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<25	25-50				
	DE1	Naturally oligotrophic lakes (4 of 11 often existing types)	<15	<20				Proposals, value for high represent reference
	DE2	Naturally mesotrophic lakes (4 of 11 often existing types)	15-45	<60				Proposals, value for high represent reference
	DE3	Naturallu eutrophic lakes (3 of 11 often existing types)	45-85	<100				Proposals, value for high represent reference
	LT	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<20	20-35				Lithuanian sub-type with 3-9 m mean depth
	LV	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<20	20-45	45-70			
	NL	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<30					
	PL	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<45	45-80				
	Common	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	<27,5					REBECCA data: 75 percentile, N=37
		LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)						
	BE (FL)	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<48	48-58				
	EE	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<30	30-60	60-80			
	DK	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<50	51-100				
	LT	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<40	40-65				
	LV	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<25	25-50	50-75			
	NL	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<100					

Table 4a: Progress in the development of new WFD-compliant assessment systems for eutrophication in LAKES
Preliminary criteria and values (September 2005)

	PL	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<70	70-150				
	UK	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<50	50-70				
	Common	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	<30,6					REBECCA data: 75 percentile, N=12
		LCB3: soft water Lobelia lakes (alk: 0.2-1 meq/L?)						
	BE (FL)	LCB3: soft water Lobelia lakes (alk: 0.2-1 meq/L?)	<34	34-70				
	EE	LCB3: soft water Lobelia lakes (alk: 0.2-1 meq/L?)	<10	10-20				
	LV	LCB3: soft water Lobelia lakes (alk: 0.2-1 meq/L?)	<15	15-35				
	NL	LCB3: soft water Lobelia lakes (alk: 0.2-1 meq/L?)	<25					
	Common	LCB3: soft water Lobelia lakes (alk: 0.2-1 meq/L?)	<21					REBECCA data: 75 percentile, N=16
	UK	peat, deep >3m	8*					* Total P reference values used only in risk assessment, not for WQ classification. These reference values were applied only when no local data were available to permit estimation of site-specific reference conditions. Reference conditions for classification purposes not yet fully developed.
		Peat, shallow <3m	15*					
		Low alk, deep >3m	7*					
		Low alk, shallow <3m	11*					
		Moderate alk deep >3m	11*					
		Mod alk shallow <3m	19*					
		High alk, deep >3m	29*					
		High alk, shallow <3m	32*					
		Marl deep >3m	11*					
		Marl shallow <3m	19*					
Atlantic	**Common**	L-A2:Lowland, shallow, calcareous, large (non-stratified)	<10,9					REBECCA data: 75 percentile, N=6
		L-A3: Lowland, shallow, peat, small (non-stratified?)	<17,5					REBECCA data: 75 percentile, N=4

Table 4a: Progress in the development of new WFD-compliant assessment systems for eutrophication in LAKES Preliminary criteria and values (September 2005)

Alpine	**Common**	L-AL3:Lowland or mid-altitude, deep, moderate to high alkalinity (alpine influence), large	<16					REBECCA data: 75 percentile, N=7
Mediterranean	**ES**	I – VI: Reservoirs (Heavily modified rivers): Catalonia River Basin District	130-1000					
Total nitrogen (µg/l)								
GIG	**Country**	**Lake type** (GIG-type code and/or description)	**High**	**Good**	**Moderate**	**Poor**	**Bad**	**Comments**
Mediterranean	**ES**	I – VI: Reservoirs (Heavily modified rivers): Catalonia River Basin District	130-1000					
Secchi depth (m)								
GIG	**Country**	**Lake type** (GIG-type code and/or description)	**High**	**Good**	**Moderate**	**Poor**	**Bad**	**Comments**
Central/Baltic								Summary of C-GIG March 2005
	EE	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	>3					
	DK	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	>3,9					
	LT	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	>6	4-6				
	LV	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	>4	2-4				
	NL	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	2.75					
	PL	LCB1: shallow (3-15 m mean depth), calcareous (alk.> 1 meq/L)	>3	2,3-3,0				
	EE	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	>3	2-3	1-2			
	DK	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	>2	1,5-2,0	1,0-1,5			
	LT	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	>3,4	2,0-3,4				
	LV	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	>3	1,5-3,0	1,0-1,5			
	NL	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	1					

Table 4a: Progress in the development of new WFD-compliant assessment systems for eutrophication in LAKES Preliminary criteria and values (September 2005)

	PL	LCB2: very shallow (< 3 m mean depth), calcareous (alk. > 1 meq/L)	>2	1,5-2,0				
	EE	LCB3: soft water Lobelia lakes (alk: 0.2-1 meq/L?)	>5	3-5				
	LV	LCB3: soft water Lobelia lakes (alk: 0.2-1 meq/L?)	> 4,5	2,5-4,5				
	NL	LCB3: soft water Lobelia lakes (alk: 0.2-1 meq/L?)	bottom					only very shallow lakes with mean depth < 3m
Mediterranean	**ES**	I – VI: Reservoirs (Heavily modified rivers): Jucar River Basin District	2,0-5,8					

Phytoplankton biomass (mg/L) (growth season mean)

GIG	Country	**Lake type** (GIG-type code and/or description)	High	Good	Moderate	Poor	Bad	Comments
Northern	**NO***	L-N1: Moderate alk., □learwater, shallow, lowland	0.2		<1,5			value for high represents reference value (mean), value for moderate represents the G/M boundary
		L-N2: Low alk., □learwater, shallow, lowland	0.1		<0,6			value for high represents reference value (mean), value for moderate represents the G/M boundary
		L-N3: Low alk., humic, shallow, lowland	0.1		<1,2			value for high represents reference value (mean), value for moderate represents the G/M boundary
		L-N8: Moderate alk., humic, shallow, lowland	0.3		<1,8			value for high represents reference value (mean), value for moderate represents the G/M boundary
	SE	Mountain lakes (M)	0.5		<1			existing system (type-specific and WFD-compliant, but different types than the IC types
		Forest lakes (F)	0.5		<1			existing system (type-specific and WFD-compliant, but different types than the IC types
		Deep (>3m) plain lakes (DP)	0.5		<1			existing system (type-specific and WFD-compliant, but different types than the IC types
		Shallow (<3m) plain lakes (SP)	1		<2			existing system (type-specific and WFD-compliant, but different types than the IC types

Phytoplankton biomass (mg/L) (August)

GIG	Country	**Lake type** (GIG-type code and/or description)	High	Good	Moderate	Poor	Bad	Comments
Northern								
	SE							
		Mountain lakes (M)	M: 0.5					
		Forest lakes (F)	F: 0.5					
		Deep (>3m) plain lakes (DP)	DP: 0.75					

Table 4a: Progress in the development of new WFD-compliant assessment systems for eutrophication in LAKES Preliminary criteria and values (September 2005)

		Shallow (<3m) plain lakes (SP)	SP: 1.5						
Spring diatom biomass (mg/L)									
GIG	**Country**	**Lake type** (GIG-type code and/or description)	**High**	**Good**	**Moderate**	**Poor**	**Bad**	**Comments**	
Northern									
	SE								
		Mountain lakes (M)	M: -						
		Forest lakes (F)	F: 0.5						
		Deep (>3m) plain lakes (DP)	DP: 1						
		Shallow (<3m) plain lakes (SP)	SP: 1						
Diatom species turnover (chord distance) combined with diatom inferred TP value									
GIG	**Country**	**Lake type** (GIG-type code and/or description)	**High**	**Good**	**Moderate**	**Poor**	**Bad**	**Comments**	
Central/Baltic	**UK**	All types	Chord distance <0.48 (insignificant species turnover at 5th percentile)						
Bloom-forming Cyanobacteria (mg/L, or proportion of total phytoplankton biomass)									
GIG	**Country**	**Lake type** (GIG-type code and/or description)	**High**	**Good**	**Moderate**	**Poor**	**Bad**	**Comments**	
Northern									
	NO*	L-N1: Moderate alk., □learwater, shallow, lowland	0.8		<10				
		L-N2: Low alk., □learwater, shallow, lowland	0.3		<10				
		L-N3: Low alk., humic, shallow, lowland	0.2		<10				
		L-N8: Moderate alk., humic, shallow, lowland	5		<10				
	SE								
		Mountain lakes (M)	M: -						
		Forest lakes (F)	F: 0.05						
		Deep (>3m) plain lakes (DP)	DP: 0.5						
		Shallow (<3m) plain lakes (SP)	SP: 0.5						

Table 4a: Progress in the development of new WFD-compliant assessment systems for eutrophication in LAKES Preliminary criteria and values (September 2005)

Gonyostomum biomass (mg/L) (harmful algae)								
GIG	**Country**	**Lake type** (GIG-type code and/or description)	**High**	**Good**	**Moderate**	**Poor**	**Bad**	**Comments**
Northern								
	SE							
		Mountain lakes (M)	M: -					
		Forest lakes (F)	F: 0.5					
		Deep (>3m) plain lakes (DP)	DP: 1					
		Shallow (<3m) plain lakes (SP)	SP: 1					
Chrysophytes (% of total phytoplankton biomass)								
GIG	**Country**	**Lake type** (GIG-type code and/or description)	**High**	**Good**	**Moderate**	**Poor**	**Bad**	**Comments**
Northern								
	NO*							
		L-N1: Moderate alk., □learwater, shallow, lowland	50		>33			Value for high represents reference value (mean), value for moderate represents the G/M boundary
		L-N2: Low alk., □learwater, shallow, lowland	62		>33			Value for high represents reference value (mean), value for moderate represents the G/M boundary
		L-N3: Low alk., humic, shallow, lowland	63		>33			Value for high represents reference value (mean), value for moderate represents the G/M boundary
		L-N8: Moderate alk., humic, shallow, lowland	37		>33			Value for high represents reference value (mean), value for moderate represents the G/M boundary

Table 4b: Progress in the development of new WFD-compliant assessment systems for eutrophication in RIVERS
Preliminary criteria and values (September 2005)

Total Phosphorus (mg/L)

Country	River type	High	Good	Moderate	Poor	Bad	Comments
DE	All	<0.05	<0.1				Proposal, 90%ile. Value for high represents reference value.
AT	37 river types defined	0.02 –0.1 (0.2)		0.05 – 0.25			Values for high represents reference value (95%ile) for TP Filtered, values for moderate represents the G/M boundary
BG		0.1		0.2			Value for high represents reference value (annual mean), value for moderate represents the G/M boundary
IT		0.1					Value for high represents reference value (annual mean)
NL	17 river types defined						
PT		0.4					Value for high represents reference value (annual mean)

Orthophosphate (mg/l)

Country	River type	High	Good	Moderate	Poor	Bad	Comments
DE	All	<0.02	<0.07				Proposal, 90%ile. Value for high represents reference value.
AT	37 river types defined	0.01 – 0.07 (0.1)		0.04-0.15 (0.2)			Values for high represents reference value (95%ile), values for moderate represents the G/M boundary
IE				0.03			Value for moderate represents the G/M boundary (annual mean)
BE (FL)	GbK	<0.05					Value for high represents reference value
BE (FL)	Gb	<0.05					Value for high represents reference value
BE (FL)	Kr	<0.1					Value for high represents reference value

Table 4b: Progress in the development of new WFD-compliant assessment systems for eutrophication in RIVERS Preliminary criteria and values (September 2005)

BE (FL)	Gr	<0.1					Value for high represents reference value
BE (FL)	ZGR	<0.1					Value for high represents reference value
Total N (mg/l)							
Country	**River type**	**High**	**Good**	**Moderate**	**Poor**	**Bad**	**Comments**
BE (FL)	GbK	<0.6					Value for high represents reference value
BE (FL)	Gb	<1					Value for high represents reference value
BE (FL)	Kr	<1					Value for high represents reference value
BE (FL)	Gr	<1.1					Value for high represents reference value
BE (FL)	ZGR	<0.8					Value for high represents reference value
IT		1.27					Value for high represents reference value
Nitrate (mg N/l)							
Country	**River type**	**High**	**Good**	**Moderate**	**Poor**	**Bad**	**Comments**
DE	All	<1	<2.5				Proposal, 90%ile.Value for high represents reference; protection of aquatic environments with natural occurrence of river pearl oysters.
AT	37 river types defined	0.5 – 3 (4)		1.5 – 4.5 (5.5)			Values for high represents reference value (95%ile), values for moderate represents the G/M boundary
BG		0.8		1			Value for high represents reference value (annual mean), value for moderate represents the G/M boundary
ES		<2					Catalonia RBD. Value for high represents reference value. Comparable value for TOC is <3 mg/l and for ammonium is <0.2 mg/l.

Table 4b: Progress in the development of new WFD-compliant assessment systems for eutrophication in RIVERS
Preliminary criteria and values (September 2005)

Chlorophyll a (µg/L

Country	River type	High	Good	Moderate	Poor	Bad	Comments
BE (FL)	ZGR	<20					Value for high represents reference value
BE (FL)	Water velocity <0.1 m/s	14.5					Value for high represents reference value (max.)

Oxygen saturation (%)

Country	River type	High	Good	Moderate	Poor	Bad	Comments
DE	Cyprinid waters	<120	<130				Proposal, Max..Value for high represents reference.
DE	Salmonid waters	<110	<120				Proposal, Max.. Value for high represents reference.

Biotic index (benthic macroinvertebrates)

Country	River type	High	Good	Moderate	Poor	Bad	Comments
IE	All	Q5		Q4			Value for high represents reference value, value for moderate represents the G/M boundary
BG	All	>=Q4		>Q3			Value for high represents reference value, value for moderate represents the G/M boundary
ES		IBMWP 39-123 (depending on WB type); IPS>17					Catalonia RBD. Value for high represents reference value.

Table 5: Marine Waters: Summary of information on eutrophication assessment methodologies and risk assessment criteria from the Marine Conventions.

ISSUES	OSPAR	HELCOM	MED POL (TRIX)	BLACK SEA
TYPOLOGY	(+)	(+)	-	
REFERENCE CONDITIONS	+	+	-	
BOUNDARY VALUES	+	+	+	
NUMBER OF CLASSES	2(3)	2	4	
BOUNDARIES FOR MEASURES TO BE TAKEN	NPA/PA+			
SUPPORTING ELEMENTS (N, P, DO)	+	+	+	
BIOLOGICAL QUALITY ELEMENTS:				
PHYTOPLANKTON				
Phytoplankton biomass	CHL	CHL	CHL	
Phytoplankton Composition/Abundance	A		C/A	
Primary Production				
Blooms (occurrence & frequency)	duration		optional	
MACROALGAE / ANGIOSPERMS				
Angiosperms abundance	(-)	+	Posidonia	
Macroalgal coverage	+	-		
Disturbance sensitive species	-			
ZOOBENTHOS			optional	
Diversity & abundance	+	-		
Disturbance sensitive species	+	-		
ADDITIONAL PARAMETERS as:				
Organic Carbon/Matter	+			
Occurence of foam/slime				
Algal Toxins	+		optional	
Fish Kills	+			
Anoxia/Hypoxia	+	+	+	
Macrozoobenthos kills	+			
Release of nutrients and sulphide from sediment				
COMBINATION OF CRITERIA	additive	additive		
ONE OUT - ALL OUT	+	+	+	

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