Common Implementation Strategy for the Water Framework Directive (2000/60/EC)

Wetlands Horizontal Guidance

Horizontal Guidance Document on the Role of Wetlands in the Water Framework Directive

Final Draft

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FOREWORD

The EU Member States, Norway and the European Commission have jointly developed a common strategy for supporting the implementation of the Directive 2000/60/EC establishing a framework for Community action in the field of water policy, hereafter referred to as Common Implementation Strategy (CIS) for the Water Framework Directive (WFD). The main aim of this strategy is to allow a coherent and harmonious implementation of this Directive. Focus is on methodological questions related to a common understanding of the technical and scientific implications of the WFD.

One of the main short-term objectives of the strategy is the development of non-legally binding and practical guidance documents on various technical issues of the Directive. These guidance documents are targeted to experts and stakeholders involved in the implementation of the WFD in river basins. The structure, presentation and terminology is therefore adapted to the needs of these experts and formal, legalistic language is avoided wherever possible.

Why this Document?

The 1995 Commission Communication to the Council and the European Parliament on the Wise Use and Conservation of Wetlands recognises the very critical situation of Europe's wetlands and the very urgent need for action. It underlines the widespread loss and degradation of wetlands that has resulted in a significant reduction of the beneficial functions they perform in renewing natural resources. By promoting the wise use and conservation initiative the Commission stresses the EU's involvement in wetland protection and enhancement and its commitment in setting up strategic policies for sector integration.

The Water Framework Directive (2000/60/EC) clearly identifies the protection, restoration and enhancement of the water needs of wetlands as part of its purpose at Article $1_{(a)}$:

> *The purpose of this Directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater which:*
>
> > *(a) prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems.*

However, it does not provide any specific definition of what a wetland is, nor does it clearly state the extent to which wetlands should be used for the achievement of environmental objectives.
Member States and stakeholders felt that it would be helpful to explore and clarify the role of wetlands in implementing the Water Framework Directive.

The Water Directors Meeting in November 2002 provided common text (cited in 1.1) to be inserted in Common Implementation Strategy guidance documents, in which the Directors acknowledge pressures on wetlands, highlight their potential important role in river basin management and in helping to achieve WFD environmental objectives, and recommend the preparation of a horizontal guidance on wetlands to implement these principles.

Support for the present document can be found in the *Horizontal Guidance on the Identification of Water Bodies* (HGIWB, compiled in order to provide additional guidance on the definition and protection of "water bodies" as intended by the Directive), in the *Guidance on Typology, Reference Conditions and Classification Systems for Transitional and Coastal Waters* (COAST) and in the *Guidance for the analysis of Pressures and Impacts in accordance with the WFD* (IMPRESS). These documents have undergone a negotiated participatory drafting process, therefore the present Guidance document will build upon definitions and recommendations proposed in them. In addition, this document will provide a description of how wetlands are relevant to WFD implementation, and will describe and provide guidance on the role of wetlands in the achievement of the environmental objectives of the WFD.

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1. INTRODUCTION

1.1 Background to the Document

Scope for the initiative has been acquired through the endorsement of the *Common text on wetlands* agreed upon at the Water Directors Meeting in Copenhagen, November 2002.

> *Common text to be inserted in the guidance documents:*
>
> *Wetland ecosystems are ecologically and functionally significant elements of the water environment, with potentially an important role to play in helping to achieve sustainable river basin management. The Water Framework Directive does not set environmental objectives for wetlands. However, wetlands that are dependent on groundwater bodies, form part of a surface water body, or are Protected Areas, will benefit from WFD obligations to protect and restore the status of water. Relevant definitions are developed in CIS horizontal guidance documents on water bodies and are further considered in a guidance on wetlands.*
>
> *Pressures on wetlands (for example physical modification or pollution) can result in impacts on the ecological status of water bodies. Measures to manage such pressures may therefore need to be considered as part of river basin management plans, where they are necessary to meet the environmental objectives of the Directive.*
> *Wetland creation and enhancement can in appropriate circumstances offer sustainable, cost-effective and socially acceptable mechanisms for helping to achieve the environmental objectives of the Directive. In particular, wetlands can help to: abate pollution impacts, contribute to mitigating the effects of droughts and floods, help to achieve sustainable coastal management and to promote groundwater re-charge. The relevance of wetlands within programmes of measures is examined in the horizontal guidance paper on wetlands.*

Following an initiative from some NGOs involved in the Common Implementation Strategy for the Water Framework Directive, a drafting group composed of the delegates of several Member States (see above) developed this horizontal guidance on wetlands to fulfil the mandate set by the Water Directors.

1.2 Purpose of Guidance

The purpose of the WFD in relation to wetlands as stated in Article 1 is unambiguous. Article 1(a) states that the Directive will

> '*establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater, which:*
>
> '*prevent further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and* ***wetlands*** *directly depending on the aquatic ecosystems.'*

The protection and enhancement of surface waters and groundwater will be achieved through the application of the Directive's environmental objectives, and where appropriate through the use of wetland protection and restoration to help fulfil these objectives in a cost effective and sustainable manner. These aspects of implementation are outlined in the main body of the paper.

As wetlands are a crosscutting issue, the purpose of this guidance is to elaborate a common understanding of the WFD requirements regarding wetlands and identify their role in its implementation.
In some cases, where additional effort could lead to considerably enhanced results, the Guidance goes one step further and illustrates best practices beyond the legal requirements of the WFD.

The text of the Guidance document is aimed at making as clear as possible a distinction between legal obligations and best practice recommendations; best practice recommendations are given in the blue boxes presented within the Guidance, as well as within the text itself. It is recognised that Member States have the flexibility to establish stricter environmental protection according to their particular national concerns.

1.3 Structure of guidance

The following section on the status of wetlands within the WFD brings forward a functional description of wetlands coherent with WFD purposes (2.1) in agreement with the consideration of wetlands in other horizontal guidance documents with particular reference to the HGIWB. Further, an illustration of the main wetland attributes recognised under the WFD (2.2) introduces the analysis of relationships between wetlands and surface water bodies (2.3), terrestrial ecosystems (2.4) and other elements of surface water having an influence on water bodies and catchment management (2.5, 2.6).
The specific role of wetlands in achieving RB environmental objectives is illustrated in Chapter 3, specifying minimum WFD's requirements (3.1), the relationship between wetlands and WFD objectives for surface water (3.2), the relevance of wetlands for the achievement of environmental objectives for Groundwater (3.3) and for Transitional and Coastal waters (3.4).
Chapter 4 illustrates the relationship between wetlands systems and Heavily Modified and Artificial Water bodies. Chapter 5 addresses issues for Protected Areas. Chapter 6 clarifies impact and pressures issues relative to wetlands following the general issues highlighted by the IMPRESS Guidance document. Chapter 7 discusses wetlands in relation to basic and supplementary measures (7.1). This pays particular attention to the consideration of wetland restoration and recreation as measures to be assessed among other technical means to prevent catchment degradation and the loss of environmental quality, also taking into account the concept of cost effectiveness (7.2), in the programme of measures (7.3). Chapter 8 illustrates issues concerning wetland monitoring. Chapter 9 resumes some conclusions and outlines issues that may be developed further.

2. IDENTIFYING WETLANDS UNDER THE WATER FRAMEWORK DIRECTIVE

2.1 What is a wetland?

Wetlands are diverse, hydrologically complex ecosystems which tend to develop within a hydrological gradient going from terrestrial to mainly aquatic habitats.
There is a wide range of definitions and interpretations of the term ‘wetland’. These definitions tend to reflect different national traditions as well as differences in the characteristics of the environment across Europe. From an ecological perspective, wetlands are heterogeneous but distinctive ecosystems which develop naturally or are the product of human activities. Their biogeochemical functions depend notably on a constant or periodic shallow inundation by fresh, brackish or saline water, or saturation at or near the surface of the substrate. They are characterised by standing or slowly moving waters. Common features include hydric soils, micro-organisms, hydrophilous and hygrophilous vegetation and fauna, adapted to chemical and biological processes reflective of periodic or permanent flooding and/or water-logging.

Wetlands perform regularly and to a high capacity a range of processes that in combination result in the delivery of significant benefits for welfare, wildlife and for the maintenance of environmental quality. Some wetlands have been recognised for their international conservation values.

The particular temporal and spatial patterns of the hydrological regime as well as other special wetland characteristics, such as distinctive plant and animal communities, ecosystems actively accumulating biomass and the provision of seasonal spawning sites for fish, combine to explain the unique features which characterise wetlands and which bear the potential to generate benefits such as water quality improvement, hydrological regulation, food web support and preservation of important environmental and cultural values.

Wetlands are part of the hydrological continuum. They comprise parts of other surface water bodies and may significantly influence their status. When not immediately contiguous to surface waters, wetlands are often linked to these through hydrological pathways. Their common occurrence at the interface between surface waters and agro-ecosystems underlines the potential relevance of wetlands for the protection of surface waters.
Situations in which there has been artificial separation between water bodies and their adjacent wetlands, or the disruption of the wetland’s ecological health and/or hydrological regime, result in the degeneration of wetland functions.

Rather than attempting to establish a new international definition of wetlands for the purposes of the Water Framework Directive, this guidance explains their relevance to the achievement of the Directive’s environmental objectives.

2.2 Wetlands within the operational structure of the Water Framework Directive

One of the greatest contributions of the Directive in setting up a new framework for river basin management is in the attention given to key relationships among significant elements of the hydrological network. The role of wetlands in this respect could be useful.

The recognition of these interdependencies is a major strength of the WFD as a management tool, in contrast to previous water pollution control or nature conservation Directives (COAST Guidance 2.7.1). This recognition supports the real purpose of the Directive as stated in Article 1.
Although the Directive refers to wetlands (Recitals 8 and 23, Article $1_{(a)}$ and Annex $VI_{(vii)}$) it does not define them or provide a size range to indicate their dimension. Nor does the Directive set obligations or recommendations for wetlands or other terrestrial ecosystems *per se*. However, the environmental objectives of the WFD are to be applied to, and monitored through, ‘water bodies’, therefore it is important for Member States to have a clear understanding of the relationship between

water bodies (ground and surface) and wetlands, in order to understand how these systems might be encompassed within the cycle of river basin planning.
The Directive's environmental objectives of: (i) preventing deterioration in status; (ii) achieving good surface water status or, for artificial or heavily modified surface water bodies, good ecological potential and good surface water chemical status; (iii) good groundwater status; or (iv) any less stringent objective applicable under Article 4.5, apply exclusively to water bodies. The HGIWB provides guidance on the identification of surface water and groundwater bodies and forms the starting point for the discussion and diagrams which follow.
The Directive's focus on water bodies and their relationships helps to highlight the functional role of wetland systems within the hydrological cycle and the river basin. This is reflected in the Directive by means of a complex set of provisions which are illustrated in the following diagram and the text in this chapter.

Figure 1 (bubble chart) represents the different ecosystems that may be comprised in a river basin district and which may be relevant, in different ways to the achievement of the Directive's objectives. The relative sizes and overlaps of the bubbles depend on the sorts of ecosystems present within each river basin district. The central bubble represents the 'universe' of wetlands. The following sections of the guidance describe the role of these different ecosystems in the river basin management planning process.

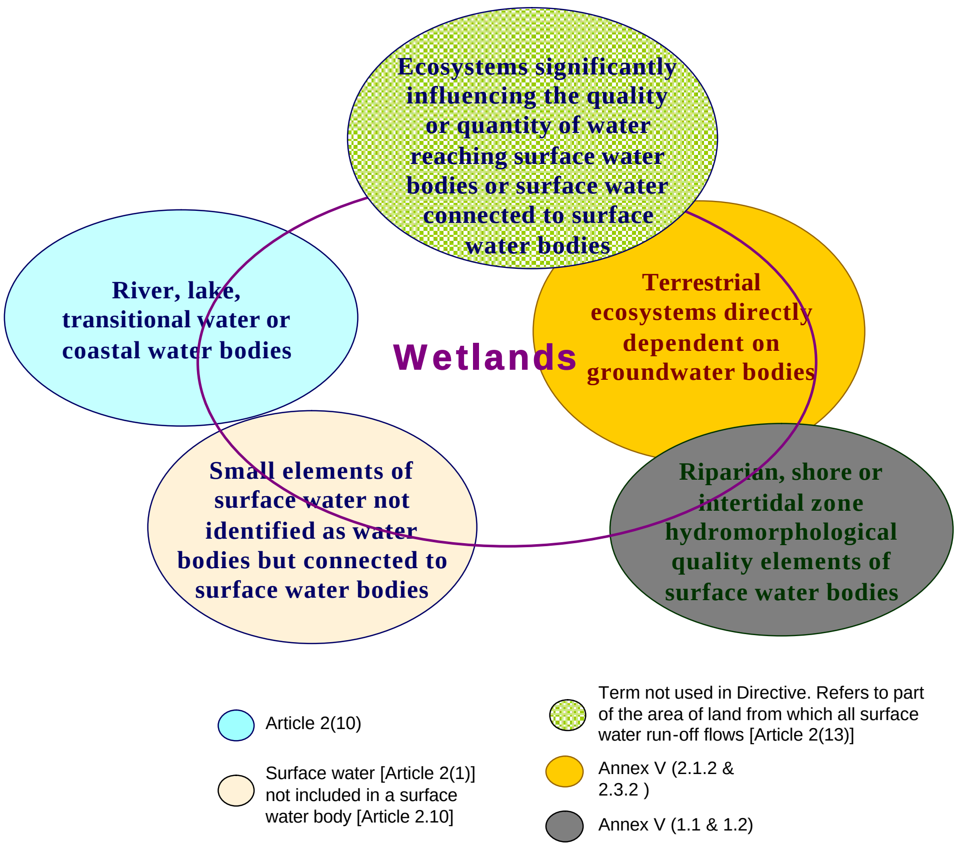


Figure 1: Ecosystems relevant to the achievement of the Directive's objectives (bubble chart)

Case Study. 1. Biebrza: a floodplain at reference condition

In Europe, many formerly dynamic rivers have become highly managed, single thread channels, isolated from their floodplains. However, in an undisturbed condition, channels in lowland floodplain systems may be part of an interconnecting series of biotopes that constitute the riverine ecosystem. The river in its natural state tends to migrate**s** across the floodplain, producing a range of lotic and lentic aquatic environments such as side channels, dead arms connected at one end, abandoned braids, ox bow lakes and ponds. This can result**s** in a mosaic of habitat patches, ecotones and successional stages, characterised by different communities and enhanced by natural forms of disturbance.

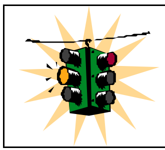
The physical modification of rivers generally prevents the formation of such complex floodplain ecosystems. For example, on the Isar floodplain in Germany, relatively unmodified areas have an abundance of short-lived ponds close to the stream system, whilst in sections more strongly influenced by water engineering, the abundance and diversity of ponds has declined due to embankments restricting the river to a single channel. New ponds cannot be created and existing ponds are isolated from the river (Homes *et al.* 1999).

A lowland floodplain river water body in a totally undisturbed condition should be unchannelised, intact and connected, and include the full complement of seral stages. Parts of the Biebrza River in Poland illustrate these concepts. The river meanders 164 km through a large floodplain of peat fens and marshes. Although its major tributaries have been channelised for agriculture, the River Biebrza itself remains unregulated. Large meanders are divided by mineral islands and the floodplain contains a complex network of waters including oxbow lakes, backwaters and abandoned channels. In Spring, natural flooding swells the river to form a vast shallow lake up to 1 km wide. This heterogeneous wetland complex allows great species diversity – 186 species of breeding bird have been recorded including 21 threatened species and there are over 60 plant communities present including nearly all the water, marsh and peatland plant communities found in Poland. The delineation of the river water body and the understanding of the extent of the riparian zone hydromorphological quality element should reflect the dynamic nature of the river and the ecological diversity this generates.

River Biebrza, Poland (Photograph: Zbigniew Mroczkowski)

The following paragraphs describe the nature of the role of each single category of wetland typology identified in the previous bubble chart; obligations related to each wetland type are indicated using the symbol 

2.3 Surface water bodies (river, lake, transitional and coastal waters)

	**Look Out! for protected areas which may be included under these water bodies, please refer to chapter 5**.

a) Wetland ecosystems identified as water bodies

Many wetland ecosystems are composed of mosaics of surface water, permanently and temporarily inundated or waterlogged land, such as lowland mire systems, or floodplain wetlands. WFD provisions in relation to surface waters will *in themselves,* help to protect and enhance wetland ecosystems, by defining parts of them as water bodies, and setting objectives for them, where they fall within the WFD categories of rivers, lakes, transitional or coastal waters.

In para 3.5 and Figure 8 of the HGIWB, a step-wise approach is suggested to guide in the identification of small elements of surface water and their potential designation as significant and discrete water bodies. The Guidance discusses in detail the issue of 'size limits' following Annex II.1.2, introducing systems A and B for defining surface water typology. It proposes that the identification of water bodies should reflect the ecological significance of surface waters within a river basin district. It states (3.3):

> *Member States may identify "surface water bodies" using additional criteria designated to take account of local circumstances and therefore assist in the river basin management planning process.*

Case Study 2. The UK Biodiversity Action Plan: a resource to assist with implementation of the WFD

The UK has identified a range of species and habitats which are priorities for conservation action, and developed an 'Action Plan' to support them, as part of its contribution to the Convention on Biological Diversity.

This plan includes provisions for the identification, protection and enhancement of wetland habitats such as floodplain grasslands, and habitats supporting important wetland species such as the natterjack toad, water vole and charophyte beds. Information about the whereabouts and features of interest of such habitats is held by a variety of Government and Non-Government organisations, who together make up the 'biodiversity partnership'. Plans to bring this information together by means of a web-based 'National Biodiversity Network' are underway, and much data is already available through local and national site registers. This important resource could be used during WFD implementation, to assist in the selection of water bodies and to help identify features of interest in groundwater receptor sites.

Among such criteria there is consideration of geographical, hydromorphological and nature protection features (e.g. Natura 2000 sites) as well as of human use and of other elements consistent with the context of the Directive's purposes and objectives.

Member States may thus use existing information about the presence and value of wetland features of interest, including biodiversity and cultural significance, to help to select water bodies. We recommend that the multiple role of wetlands within river basin management be given due consideration in the definition of "water body" status.

☞ Obligations to achieve the objectives for surface water bodies specified under Article 4 and Annex 5

b) Riparian, shore, and intertidal zone quality elements of surface water bodies

The hydromorphological quality elements of surface water bodies include the structure and condition of the riparian zone of rivers, the shore zone of lakes and the intertidal zones of transitional and coastal waters (See Annex V Sections 1.1–1.4). The HGIWB makes it clear that these zones may include ecosystems regarded as wetlands, where the structure and condition of such wetlands is relevant to the achievement of the objectives for a surface water body. Reference conditions should be set in accordance with Annex 2.

As stated in the HGIWB (3.6)

In concrete terms this means that, e.g., a river water body comprises:

(a) the hydromorphological quality elements, which include the water flow, the bed of the channel, that part of the land adjacent to the channel that's structure and condition is directly relevant to the achievement of the values for the biological quality elements (i.e. the riparian zone), and

(b) the relevant biological elements.
In relation to wetlands, this means that those wetlands must be associated with a "water body", which are directly influencing the status of the related "water body". The boundaries of such wetlands must be identified in a pragmatic way in order to meet the requirement of a "discrete and significant" element.

☞ Obligation to ensure that the hydromorphological quality elements at reference condition are subject to no more than minor alterations.

☞ Obligation to ensure that the hydromorphological elements are in the condition needed to achieve the objectives of Article 4

Where rivers are found within naturally functioning floodplains, wetlands in the riparian zone may have important implications for the development of an appropriate reference condition.
Case Study 1 below illustrates a river water body representing a relatively undisturbed hydromorphology.

2.4 Terrestrial ecosystems directly depending on groundwater bodies

The Directive's objectives of achieving good groundwater quantitative status (Annex V.2.1.2) and good groundwater chemical status (Annex V.2.3.2) require that, among other things, the groundwater needs of terrestrial ecosystems that depend directly on bodies of groundwater be protected, and where necessary restored to the extent needed to avoid or remedy significant damage to such ecosystems.

Terrestrial ecosystems that depend directly on a body of groundwater will include types of terrestrial ecosystems that occur in areas where the water table is at or near the surface of the ground.

☞ Obligation to achieve good groundwater status to manage quality and quantity of groundwater to avoid significant damage to terrestrial ecosystems directly dependent on groundwater bodies, in accordance with Article 4, Annex 5.

2.5 Small elements of surface water connected to water bodies but not identified as water bodies

As noted in the HGIWB, it will not be practical to identify every element of surface water in a river basin district as a water body or part of a water body. Member States will have to decide within the river basin management planning process which elements of surface water are not sufficiently discrete and significant to be identified as water bodies. Many of the elements of surface water that are not identified will nevertheless be connected to surface water bodies. In accordance with the HGIWB, such elements will need to be protected or, in some cases, enhanced and restored to the extent needed to ensure that any impacts of human activity on them do not compromise the achievement of the environmental objectives of the water bodies to which they are connected. In some cases, Member States may even choose to artificially create such surface waters where they determine that this is an appropriate or necessary means of achieving the objectives of the Directive for surface water bodies. For example, some Member States use artificially created detention ponds to help mitigate the impacts of urban run-off on river water bodies.

☞ Obligation to achieve objectives for connected surface water bodies

2.6 Ecosystems significantly influencing the quality and quantity of water reaching surface water bodies, or surface waters connected to surface water bodies

Ecosystems which are adjacent to water bodies and which may influence the status of those water bodies should be encompassed within the riparian, lakeshore or intertidal zones (see above), in order to ensure the most effective operation of WFD environmental objectives. However, there may be other wetland ecosystems in river basins which although they are not adjacent to water bodies and do not therefore form part of the riparian, shore or intertidal zones, may nevertheless significantly influence the quality and quantity of water reaching those bodies, or reaching small elements of surface waters connected to those bodies. Member States will need to ensure that the quality and quantity of water entering surface water bodies via these ecosystems is such as to ensure the achievement of the relevant objectives for the water bodies. In doing so, Member States may determine where appropriate or necessary to manage relevant activities on, protect, enhance, restore or even artificially create such ecosystems.

☞ Obligation to achieve objectives for surface water bodies influenced by such ecosystems

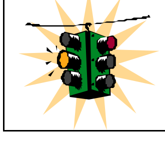
	**Look out! The Directive's objectives of protecting, enhancing or restoring surface water status apply to BODIES of surface water - lakes, rivers, transitional waters, and stretches of coastal water. Its groundwater status objectives apply to BODIES of groundwater**

Figure 2 (map chart) provides a schematic summary of the different types of ecosystem within a river basin that may be relevant to the achievement of the Directive's objectives, and which may include ecosystems regarded as wetlands.

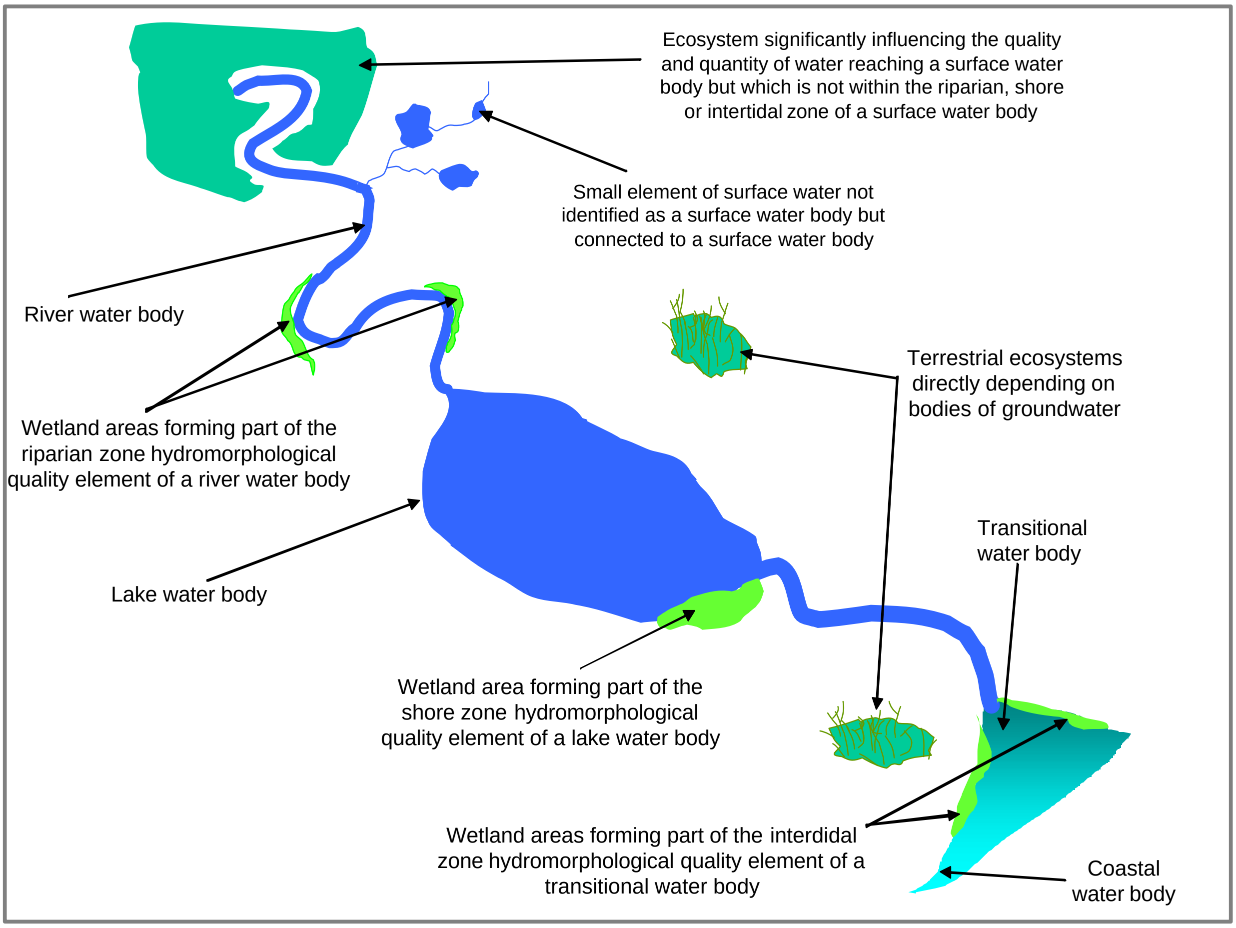


Figure 2: Ecosystems within a river basin that may be relevant to the achievement of the Directive's objectives (map chart)

3. WFD ENVIRONMENTAL OBJECTIVES AND WETLANDS

This Chapter addresses ways in which wetlands may be relevant to the achievement of surface and groundwater body objectives.

3.1 Summary of the main requirements

The WFD does not set independent ecological objectives for wetlands other than where those wetlands, or parts of them, are surface water bodies.
The WFD does however, (a) set groundwater objectives that include obligations towards these ecosystems, and (b) identify the use of wetland functions as a possible means of achieving the Directive's objectives.

The most important WFD provisions in relation to wetlands are:

- Obligations to surface waters, which will apply to those 'open water' wetlands which are identified as water bodies [Article 4.1(a)$_{(i)}$] (see Chapter 2) and belong therefore either to rivers, lakes, transitional waters or coastal waters.

- Obligations to prevent more than very minor anthropogenic disturbance to the hydro-morphological condition of surface water bodies at High Ecological Status. The hydro-morphological quality elements of a surface water body include the structure and condition of riparian, lakeshore or inter-tidal zone, and hence the condition of any wetlands encompassed by these zones. This protection is necessary to achieve the objective of preventing deterioration from high ecological status [Article 4.1(a)$_{(i)}$; Annex V 1.2], bearing in mind the exceptions identified at Article 4.6, 4.7 and the additional requirement in Article 4.8.

- Obligations to protect, enhance and restore wetlands identified as water bodies, where this is necessary to support the achievement of (a) good ecological status or good ecological potential, (b) good surface water chemical status, or (c) a less stringent objective [Article 4.1(a)$_{(i\ \&\ ii)}$; Article 4.5]. If damage to any such surface water body, wherever it occurs within a river basin district, is causing a failure to achieve one of the Directive's environmental objectives, then appropriate measures will be required.

- Obligations towards wetlands that are not individual water bodies, but part of the riparian zone. Member States are required under Article 11.3(i) to establish measures to control and mitigate modifications to the structure and the condition of these zones, including that of any wetland they contain, to the extent necessary to ensure that the hydromorphological conditions of the water bodies are consistent with the required ecological status or ecological potential.

- Obligations to achieve good groundwater status [Article 4.1(b)$_{(i\ \&\ ii)}$, as defined in Annex V 2.1.2 and 2.3.2.] and to reverse any significant and sustained upward trends in the concentration of any pollutant in groundwater in order to progressively reduce pollution of groundwater [Article 4.1(b)$_{(iii)}$]. Member States must, among other things, control and remedy anthropogenic alterations to groundwater quality and water levels to the extent needed to ensure that such alterations are not causing, and will not cause: (a) significant damage to terrestrial ecosystems that directly depend on bodies of groundwater; and (b) significant diminution in the chemical or ecological quality of bodies of surface water associated with bodies of groundwater. This also includes an obligation to ensure that dependent surface waters achieve their environmental objectives under Article 4, as far as these depend on groundwater quality and quantity. Bogs, fens and marshes, that are dependent on groundwater to maintain their characteristic structure and function, may fall within the category of dependent terrestrial ecosystems.

- ☞ Obligations, as requested specifically under the Habitats (Dir 92/43/EEC) and Wild Birds (Dir 79/409/EEC) Directives, to take protective or restorative action in the management of wetlands which are included in the register of protected areas following Annex IV(v).

Furthermore, wetlands could play a relevant role in facilitating the achievement of other WFD requirements concerning Protected Areas that do not target wetlands directly. The list below largely refers to objectives established under other Community legislation the achievement of some of which may conceivably be assisted by the management of wetlands. These are:

- ☞ Obligations to take protective or restorative action in the management of areas designated for the abstraction of drinking water and areas relevant for the protection of economically significant aquatic species (Annex $IV_{(i\ \&\ ii)}$).

- ☞ Obligations to take protective or restorative action in the management of recreational water bodies under the Bathing Directive (Dir 76/160/EEC) (Annex $IV_{(iii)}$).

- ☞ Obligations to take protective or restorative action in the management of sensitive areas and vulnerable zones designated under the Nitrate Directive (Dir 91/676/EEC) and the Urban Wastewater Directive (Dir 91/271/EEC) (Annex $IV_{(iv)}$).

Please refer to Chapter 5 for further details concerning obligations established under the Protected Areas Register.

3.2 Surface waters objectives and wetlands

The description of wetlands adopted for the purposes of this Guidance includes areas of surface water. The Directive's status objectives [Article $4.1a_{(i)}$, $_{(ii)}$ and $_{(iii)}$] apply to surface waters identified as a "water body". In the Directive (2.1) "surface water" is defined as:

> *Inland waters, except groundwater, transitional waters and coastal waters, except in respect of chemical status for which it shall also include territorial waters;*

and "body of surface water" (Article 2.10) is :

> *A discrete and significant element of surface water such as a lake, a reservoir, a stream, river or canal, part of a stream, river or canal, a transitional water or a stretch of coastal water.*

Chapter 2 discussed in detail the ways in which some wetland systems may be encompassed within the definition of surface water bodies, either as lakes, rivers, coastal or transitional waters in themselves, or as part of the riparian, lakeshore or inter-tidal zones of such water bodies. This section of the guidance will explore in more detail the implications of achieving the relevant environmental objectives for such water bodies.

3.2.1 Biological Quality Elements for Surface Water Bodies

River Basin Districts typically include complex mosaics of surface waters, temporarily inundated and terrestrial habitats. The HGIWB document provides a pragmatic approach to determine the area of surface water which constitutes the water body *per se* and parts of 'wetland' ecosystems that may be identified as, or form parts of, water bodies.
The following paragraphs provide a guideline for identifying the area of adjacent land which is included when assessing water bodies' *biological quality elements* described in Annex V, and the relationship between these and water bodies' *hydro-morphological quality elements.*

Case Study 3. The Great Ouse: effects of river regulation on fish species composition in an English lowland river

Continued and extensive regulation of lowland rivers such as the Great Ouse has caused considerable changes in fish populations. The Great Ouse is strongly regulated by weirs, dredging, flood embankments and navigation locks, and is largely disconnected from its floodplain. Since there are no lowland rivers in the UK that can be considered to be at reference condition, the Great Ouse has been compared to the unregulated river Biebrza in Eastern Poland, which had similar characteristics to the Great Ouse prior to its regulation.

On the Ouse, generalist species (roach and minnow) dominated the system and often made up more than 70% of the fish population. Gudgeon, three spine stickleback, chub, bullhead and silver bream occasionally co-dominated. When compared to the relatively unmodified River Biebrza, the Great Ouse has a poor recruitment of specialist fish - both limnophilic (slow-flowing and standing water specialists) and rheophilic (characteristic of faster flowing water). In the River Biebrza limnophilic species such as silver bream, tench and rudd were found throughout the length of the river, principally in adjacent oxbows and abandoned side channels. The Ouse has few connected floodplain waters and therefore reproduction of limnophilic species is restricted to downstream sites. The absence of the rheophile burbot was notable, as it is a common species of unregulated lowland rivers and their floodplain waters, and historical records indicate that it was common in the Great Ouse prior to modification. The general absence of salmonids also suggests that modification has lead to the severe reduction of more sensitive rheophilic fish and a dominance of generalist species.

Copp G.H. (1990) Effect of regulation on fish recruitment in the Great Ouse, a lowland river. *Regulated Rivers: Research and Management* **5:**251-263.

Rivers

Depending on river morphology, riverine systems may be characterised at reference condition (and therefore at High Status) by complex and dynamic patterns of channels, oxbow lakes and temporary surface waters. In such cases, it may not be appropriate to assess biological quality elements from single parts of the river environment without consideration of the condition of other parts (for example by treating 'main channels' as separate from backwaters, side arms and oxbows).

Large channels vary in their course over time, and biological quality elements can depend on the presence of a range of habitats within the river and floodplain ecosystem to sustain their life-cycles and abundance. In these contexts, the river water body, and its biological reference condition, should reflect this dynamism and ecological integrity.

The following biological quality elements are required for the assessment of the ecological status of rivers (Table 1):

Table 1. Biological quality elements relevant in the assessment of the ecological status of rivers (Annex V)

Biota	Characteristics				
Phytoplankton	Taxonomic composition	Abundance			
Macrophytes and phytobenthos	Taxonomic composition	Abundance			
Macro-invertebrates	Taxonomic composition		Proportion of disturbance sensitive to insensitive taxa	Level of diversity	
Fish	Species composition	Abundance	Presence of disturbance sensitive taxa		Age structure of communities

The following case studies demonstrate the interaction between relevant biological quality elements and the condition and delineation of the floodplain river water body.

Case Study 4. The importance of flood disturbance for maintenance of macrophyte communities

A natural alluvial floodplain contains areas of water created as the channel moves across the floodplain which are variously disturbed by flooding. Flood disturbance has a positive role in the maintenance of Charophyte species diversity in cut-off channels. Charophytes are usually considered pioneer species occurring in disturbed habitats supplied with groundwater. They occur abundantly in large river floodplains influenced by floods. Data collected from 63 cut off channels on the Doubs, Saône, Ain and Rhône rivers showed that *Chara vulgaris* and *Nitella conferuacea* were more frequent in and even limited to channels with high flood disturbance. In contrast, *C. major* and *C. globularis* occurred in channels with little or no flood disturbance indicating that some species can survive under low disturbance conditions. In order to maintain optimal species diversity a range of ages of cut off channels are required, containing different successional stages of vegetation. If rivers are channelised and cut off from side channels the early successional stages and therefore pioneer species will be lost as all channels gradually reach climax vegetation.

Bornette, G. and Arens, M. (2002) Charophyte communities in cut-off river channels – the role of connectivity. *Aquatic Botany* **73:**149-162.

Lowland floodplains historically suffered radical physical modification in many parts of Europe, as a result of land drainage and flood management activities, aimed at maximizing agricultural production and protecting people and property. In many cases, decisions about how practical or desirable it will be to restore the hydro-morphology (and the associated biology) of such river systems to the extent needed to achieve good ecological status, will be determined through the application of the tests for the Heavily Modified Water Body designation (see Chapter 4). However, the principle of the WFD in relation to the development of a type-specific reference condition for natural waters is clear. The reference condition for such systems should reflect no (or only very minor) anthropogenic impacts on the biological quality elements, whilst good status should represent

an acceptable, but slight deviation from this condition. The reference condition for heavily modified or artificial water bodies is maximum ecological potential.
For some floodplain river types, the reference condition values for the biological quality elements may be strongly dependent on the range of surface water and adjacent riparian zone habitats that would be present under totally or nearly totally undisturbed conditions. Such dependency should be taken into account when defining the good status values for the biological quality elements and identifying the hydromorphological conditions consistent with the achievement of those values.

In the uplands river channels are often clearly distinguishable even at reference condition; the identification of the water body, and its associated riparian zone, (the land adjacent to the channel whose condition directly influences its ecology), is less complex. However, the requirement to ensure that this riparian zone, including any relevant wetlands, are in a physical condition capable of supporting the biological elements found in the water body at good status, will remain. This is discussed in more detail in Section 3.2.3, which describes the role of hydro-morphological elements at reference condition, and as supporting elements for the biological quality elements at good status.

Lakes

Lakes with substantial, shallow littoral zones (which might in many cases be defined as ‘wetlands’), including areas of seasonal inundation, derive much of their ecological character from their characteristic littoral communities. This should be reflected in the development of an appropriate biological reference condition for the relevant biological quality elements.
The following biological quality elements are required for the assessment of the ecological status of lakes (Table 2):

Table 2. Biological quality elements relevant in the assessment of the ecological status of lakes (Annex V)

Biota	Characteristics			
Phytoplankton	Taxonomic composition	Biomass		
Macrophytes and phytobenthos	Taxonomic composition	Abundance		
Benthic invertebrate fauna	Taxonomic composition	Ratio of disturbance sensitive to insensitive species	Level of diversity	
Fish	Species composition	Abundance	Presence of type-specific sensitive species	Age structures

The case study below illustrates the relevance of seasonal inundation in water bodies with naturally fluctuating water levels, and demonstrates how in such contexts the biological quality elements will encompass taxa and communities associated with ‘wetland’ and semi-terrestrial habitats.

Case Study 5. Turloughs and Breckland Meres: Lakes with high levels of natural fluctuation in water level and associated biological diversity

Naturally fluctuating water levels in these lakes result in characteristic plant and animal communities that may appear almost or wholly terrestrial at certain times of the year. In the UK, a habitat action plan exists for these lakes which describes their typical fauna and flora.

As a result of the fluctuating water levels, aquatic vegetation is absent (or, in Northern Ireland, restricted to residual pools) at some periods in the cycle of these lakes and abundant at others. An element common to both turloughs and meres is the prevalence of aquatic and semi-aquatic mosses such as *Fontinalis antipyretica* and *Cinclidotus fontinaloides,* which are more resistant to desiccation than higher (vascular) aquatic plants. Rare plants of the inundation zone include the moss *Physcomitrium erystomum* in the meres and the rare fen violet *Viola persicifolia* in the turloughs of Northern Ireland. Although some permanent pools in the Northern Irish turloughs support white water lily *Nymphaea alba* and other water plants, in the Breckland meres, where deep flooding can occur for long periods, aquatic vegetation becomes better established and more diverse than in most turloughs. Water plants typical of the meres are shining pondweed *Potamogeton lucens* and various-leaved pondweed *Potamogeton gramineus*, sometimes accompanied by their hybrid, long-leaved pondweed *Potamogeton x zizii*, which is scarce nationally.

The aquatic fauna of these fluctuating water bodies is adapted to intermittent desiccation. Fish are generally absent, but a range of amphibians can be found, including the protected great crested newt *Triturus cristatus* in the Breckland. Invertebrates include many insect species such as dragonflies, water boatmen and diving beetles, which are highly mobile and are therefore able colonisers. Typically, there is also a rich assemblage of micro-crustaceans such as water fleas, which have resting stages that can remain viable in the soil during dry phases. Snails such as the marsh snail *Lymnaea palustris*, which breathe air and can persist during periods of drought under stones and in damp vegetation, are common in both turloughs and meres. Numerous rare invertebrates have been recorded, including the large mussel-shrimp (ostracod) *Cypris bispinosa*, the small diving beetle *Bidessus unistriatus* and the scarce emerald damselfly *Lestes dryas* from the Breckland meres. During their wet phase the meres support breeding coot *Fulica atra*, tufted duck *Aythya fuligula*, mallard *Anas platyrhynchos*, shelduck *Tadorna tadorna*, pochard *Aythya ferina* and gadwall *Anas strepera.*

UK Habitat Action Plan for Naturally Fluctuating Aquifer Fed Water Bodies, *UK Biodiversity Group Tranche 2 Action Plans - Volume II: Terrestrial and freshwater habitats* HMSO (December 1998) Tranche: 2, Volume: II, 25 pages.

Coastal and Transitional Waters

As with rivers and lakes, there will be contexts in which the biological quality elements of coastal and transitional water bodies encompass taxa and communities traditionally associated with ‘wetlands’; this is well illustrated by the importance of wetland vegetation in assessing the environmental quality of the Solway and Forth estuaries (Case Study 6).

Case Study 6. The Solway and Forth estuaries: significance of vegetation in assessing the biological quality of saltmarshes

The transitional nature of a saltmarsh leads to a zonation of vegetation from pioneer species that require frequent inundation to those that are more terrestrial in character, growing up the shore. Saltmarsh vegetation naturally traps sediment, slows water movement and encourages sediment deposition raising the level of the marsh which allows successional change and gradual terrestrialisation of the habitat. Within the pioneer, upper and lower marsh zones, 28 communities of saltmarsh vegetation have been described throughout the UK, each of them providing a unique habitat for invertebrates and fish and bird fauna.

The Solway and Forth estuaries are saltmarshes of international importance, harbouring large winter bird populations (Solway 120 000 birds, Forth 20 000 birds) and include mudflats and sandflats providing nursery and feeding areas for many fish species. At the Solway estuary the land abutting the saltmarshes is lowland grazing marsh, which allows controlled winter flooding and the majority of the coastline is unembanked. The transition from saltwater to freshwater habitats is wide and complete. Vegetation is present from *Puccinellia* pioneer communities through four distinct lower and mid marsh zones to terrestrial transition zones of mature upper marsh dominated by *Phragmites.*

In contrast, the area adjacent to the Forth estuary has high human population density. Land use includes agriculture and industry and much mudflat and saltmarsh has been reclaimed. Bird numbers have been reduced due to loss of invertebrate food, net loss of mudflats and saltmarshes. Vegetation surveys showed that 52% of the vegetation belongs to the *Puccinellia* community. A further 20% of vegetation belongs to the *Festuca rubra* community which tends to occur above the *Puccinellia* community. Vegetation of the upper marsh or later successional stages is missing due to the fact that most of the marsh is a thin 5-80 m strip backed by a sea wall which prevents the natural sequence moving up the shore. The community is extremely poor in species and community richness, reflecting the high level of disturbance resulting from land claim activities.

GeoData Institute (2002). *Inner Solway. Potential for managed realignment. Report by GeoData Institute to Scottish Natural Heritage.*

Proctor, J., Fraser, M.W. and Thompson, J. (1983). Saltmarshes of the upper Forth Estuary. *Transactions of the Botanical Society of Edinburgh. 44: 95-102.*

The COAST Guidance document (2.1.5) recognizes that:

> *The Directive gives no indication of the landward extent of either transitional or coastal waters. One of the hydromorphological quality elements for both transitional and coastal waters is the structure of the intertidal zone. Since it is likely that some of the quality elements may be monitored within the intertidal area, it is recommended that transitional and coastal water bodies include the intertidal area from the highest to the lowest astronomical tide.*

In particular, this is relevant to the monitoring of inter-tidal vegetation, whose composition and abundance are relevant to the assessment of ecological status as shown in the case study above which demonstrates how the condition and extent of intertidal mudflats (a 'coastal wetland') bears a direct influence on the biological quality elements measured in the WFD.

The biological quality elements illustrated in Table 3 are required for the assessment of status for coastal and transitional water bodies.

Table 3. Biological quality elements relevant in the assessment of the ecological status of coastal and transitional waters (Annex V)

Biota	**Characteristic**				
Phytoplankton	Taxonomic composition	Abundance	Biomass		
Macro-algae	Taxonomic composition (transitional)			Cover	Disturbance sensitive taxa (coastal)
Angiosperms	Taxonomic composition (transitional)	Abundance			Disturbance sensitive taxa (coastal)
Benthic invertebrate fauna	Diversity	Abundance			Ratio: disturbance sensitive to insensitive taxa
Fish (not coastal)	Species composition	Abundance			

3.2.2 Physico-chemical Quality Elements for Surface Water Bodies

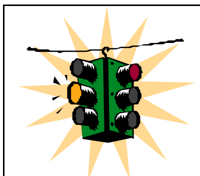
The general physico-chemical elements of ecological status for surface water bodies, such as thermal conditions, salinity, nutrient condition and acidification status (Annex V 1.1.1), may be affected by the condition of wetlands within the riparian, lakeshore or inter-tidal zones, or in the wider catchment. These potential impacts will need to be considered during the impacts and pressures analysis and subsequent design of programmes of measures to achieve the Directive's environmental objectives.
For example, nutrient levels and cycling in a lowland river with intact riparian wetlands will be significantly different to those in a river channel adjacent to drained land under intensive agricultural production.

In order to restore nitrogen and phosphorous fluxes to levels capable of supporting the functioning of the type-specific ecosystem, it may be necessary to consider the role which wetland restoration or enhancement could play as part of a programme of measures (see Chapter 7).

3.2.3 Hydro-morphological Quality Elements for Surface Water Bodies

The quality elements comprised in the assessment of surface water status include hydro-morphological elements *supporting biological ones* (Annex V,1.1.2.). Hydro-morphological quality elements include the structure and condition of the riparian zone of rivers, the shore zone of lakes and the inter-tidal zones of coastal and transitional waters; many of these include wetlands.

The definitions proposed here are compatible with, and form an elaboration of, similar definitions proposed in the HGIWB. This last Guidance document makes it clear that the water body itself '*comprises the quality elements described in the Directive for the classification of ecological status*', which includes the structure and condition of the riparian, lakeshore or inter-tidal zone.



Look Out! For some water bodies, the structure and condition of wetlands in the riparian, shore or intertidal zones will be important for supporting the achievement of the good status values for the biological quality elements.

The Directive's inclusion of hydro-morphological elements is designed to encompass the interactions between physical conditions in the catchment, hydrological processes and the biological condition of surface waters. In developing definitions of the riparian, lake-shore and inter-tidal zones, therefore, it is appropriate to consider first and foremost how adjacent land and ecosystems (including wetlands) help to determine the physical, chemical and biological characteristics of water bodies, rather than to rely on definitions based on size thresholds or return flood events. The definitions given here are designed to ensure that the land defined as riparian, shore or inter-tidal zone directly influences other quality elements within the Directive.

There is no requirement to map the boundaries of riparian and shore zones (nor the location of any other quality elements), however the significance of their influence on the status of water bodies should be given due consideration by Member States when assessing risks to the achievement of the Directive's environmental objectives for surface water bodies, and designing programmes of measures.

The level of effort required in determining the extent of the riparian and the shore zones should be proportional to the potential risks to the Directive's objectives caused by pressures which may alter the structure and condition of those zones.

Riparian zone: Land immediately adjacent to a river, the structure and condition of which significantly influences the river's other hydro-morphological quality elements, biological quality elements and physico-chemical quality elements, and which may in turn be influenced by the river. The zone will include relevant parts of islands and floodplains. It may include a variety of wetland habitats that rely on over-bank flows for their maintenance, but which in turn influence the conditions in the river. The extent of the riparian zone will be variable depending on the significance of its influence on the biological quality elements relevant to the classification of ecological status. Rivers flowing through gorges may depend on only a very narrow riparian zone, whereas rivers in delta areas may be directly dependent on the structure and condition of a more extensive area of land.

Shore zone: That part of the land immediately adjacent to a lake, the structure and condition of which significantly influences the values attained by other hydro-morphological quality elements, the biological quality elements or the physico-chemical quality elements, and which may in turn be influenced by lake flooding or wave action.
The level of effort required to determine the extent of the riparian and the shore zones should be proportional to the potential risks to the Directives' objectives from pressures which may alter the structure and condition of those zones.

Intertidal zone: The zone between mean high water spring tides and mean low water spring tides. The zone typically includes a variety of terrestrial and aquatic ecosystems such as salt, brackish and freshwater tidal marshes, mud flats, rock pools, beaches etc... (see 3.4). Table 4 illustrates the Hydro-morphological quality elements of surface waters (Annex V.1.2).

Table 4. Hydro-morphological quality elements of surface waters

Rivers	Lakes	Transitional Waters	Coastal Waters
Hydrological regime (flow and connection to groundwater)	Hydrological regime (flow, level, residence time, connection to groundwater)	Tidal regime (freshwater flow)	Tidal regime (freshwater flow, dominant currents)
River continuity			
Morphological Conditions (Channel patterns, width and depth variations, flow velocities, substrate conditions, structure and condition of riparian zone)	Morphological Conditions (depth variation, substrate, structure and condition of lake shore zone)	Morphological Conditions (depth variation, substrate conditions, structure and condition of inter-tidal zone)	Morphological Conditions (depth variation, substrate conditions, structure and condition of inter-tidal zone)

3.2.4 Categories of environmental quality

a) Objectives for water bodies at High Status or Maximum Ecological Potential

The provisions of the Directive for water bodies at high status and maximum ecological potential differ from those for other water bodies. High status water bodies must demonstrate, for their hydro-morphology, the conditions reported in Table 5.

For the purposes of classification, the definitions of ecological status set out in Annex V (1.2.1-1.2.4) describe the values for the quality elements of ecological status for each surface water category. Where a water body is at high status, the relevant values specified for the biological, hydromorphological, and physico-chemical quality elements in these tables must be maintained to achieve the Directive's objective of preventing deterioration in status.

To prevent a water body deteriorating from High Ecological Status, Member States must prevent any more than minor alterations to the water body's hydromorphological conditions, since the values of the biological quality elements on the boundary of the high good status class are defined in Annex V as those that are compatible with only very minor alterations to the hydromorphological quality elements. The hydromorphological conditions include the structure and condition of the riparian, shore or inter-tidal zones. These provisions have important implications for wetlands. For a river, lake, transitional or coastal water to be at High Status, adjacent land, which significantly influences its ecology (the riparian, lake or inter-tidal zone) must show no or only very minor disturbance. This may in turn, provide the conditions necessary for the development and maintenance of wetland ecosystems. In practice, this means that the WFD will help provide protection for our remaining 'natural' wetland ecosystems, where these are riparian zones, lake shores or intertidal zones of high status water bodies.

Table 5. Definitions of hydro-morphological quality elements at High Status (Annex V.1.2)

Rivers	Hydrological Regime	River Continuity	Morphological Conditions
	The quantity and dynamics of flow, and the resultant connection to groundwater, reflect totally, or nearly totally, undisturbed conditions.	The continuity of the river is not disturbed by anthropogenic activities and allows undisturbed migration of aquatic organisms and sediment transport	Channel patterns, width and depth variations, flow velocities, substrate conditions and both the structure and condition of the riparian zones correspond totally or nearly totally to undisturbed conditions
Lakes	Hydrological Regime		Morphological Conditions
	The quantity and dynamics of flow, level, residence time, and the resultant connection to groundwater, reflect totally or nearly totally undisturbed conditions.		Lake depth variation, quantity and structure of the lake shore zone correspond totally or nearly totally to undisturbed conditions.
Transitional	Tidal Regime		Morphological Conditions
	The freshwater flow regime corresponds totally or nearly totally to undisturbed conditions		Depth variations, substrate conditions, and both the structure and condition of the inter-tidal zones correspond totally or nearly totally to undisturbed conditions.
Coastal	Tidal Regime		Morphological Conditions
	The freshwater flow regime and the direction and speed of dominant currents correspond totally or nearly totally to undisturbed conditions		The depth variation, structure and substrate of the coastal bed, and both the structure and condition of the inter-tidal zones correspond totally or nearly totally to the undisturbed conditions.

Concerning Heavily Modified Water bodies at maximum ecological potential, the condition of the hydro-morphological quality elements must be consistent with the only impacts on the surface water body being those which result from the artificial or heavily modified characteristics of the water body, once all the mitigation measures have been taken to ensure the best approximation to ecological continuum.

b) Objectives for water bodies at good status and below

At good status, (or for any less stringent objective) the hydro-morphological elements of a water body must be in a condition to support the values established for relevant biological quality elements (see also Art.11.3$_{(i)}$).

In reality, good ecological status is unlikely to be achieved where there are substantial changes to the flow and velocity of a river, the depth and residence time of a lake, or the tidal patterns of an estuary; changes of the kind which frequently result from damage to wetlands within the riparian, lake or inter-tidal zones. The mutual dependence of water bodies and associated wetlands should be included within the impact/pressure analysis when relevant as recognised by the IMPRESS Guidance (2.3.7):

> *"Pressures on wetlands (for example physical modification or pollution) can result in impacts on the ecological status of water bodies. Measures to manage such pressures may therefore need to be considered as part of river basin management plans, where they are necessary to meet the environmental objectives of the Directive."*

Where pressures on the floodplain have resulted in an impact on the status of a river, for example, the restoration of the floodplain to a more natural condition may be an effective remedy. In some cases, such restoration may form part of a combination of measures to achieve the Directive's objectives

unless economic tests demonstrate that it is not a practical or appropriate option (Art. $4.5_{(a)}$ and Annex III).
In all cases wetland management can be proposed as a supplementary measure at the discretion of Member States to assist in achieving river basin management objectives (see Chapter 7).

3.3 Wetlands and Groundwater

Although not all groundwater is within an aquifer, the Directives environmental objectives for good groundwater status apply *only* to groundwater bodies identified within aquifers.
Specifically, in the Directive (Article 2.2), 'groundwater' is defined as:

> *all water, which is below the surface of the ground in the saturated zone and in direct contact with the ground or subsoil*;

and 'body of groundwater' is given (Article 2.12) as:

> *a distinct volume of groundwater within an aquifer or aquifers.*

The first step in identifying groundwater bodies is to determine which geological strata qualify as aquifers. Following the definitions cited above and the requirements set by Article 7 and Article 1(a), the HGIWB (4.2) recommends (see Figure 3 below) that an aquifer is a subsurface layer or layers of rocks or other geological strata that:

- *is capable of supporting abstraction of 10 cubic meters per day on average or sufficient to serve 50 or more people;*

or:

- *provides a flow of groundwater the reduction of which may result in a significant diminution of the ecological quality of an associated surface water body, or significant damage to a directly dependent terrestrial ecosystem.*

The identification of aquifers is therefore partly dependent on determining whether groundwater supports directly dependent terrestrial ecosystems. Where such ecosystems are supported by groundwater, the groundwater upon which they depend will qualify as an aquifer.

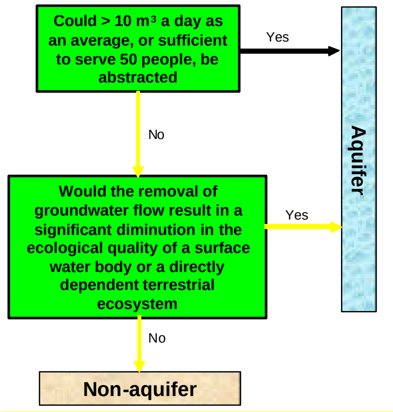


Figure 3: Illustration of the process for determining whether a geological stratum qualifies as an aquifer reproduced from the CIS Horizontal Guidance on Water Bodies

Figure 4 outlines a suggested approach to determining which terrestrial ecosystems to consider in deciding if a geological strata provides significant flow to directly dependent terrestrial ecosystems, and should therefore qualify as an aquifer.

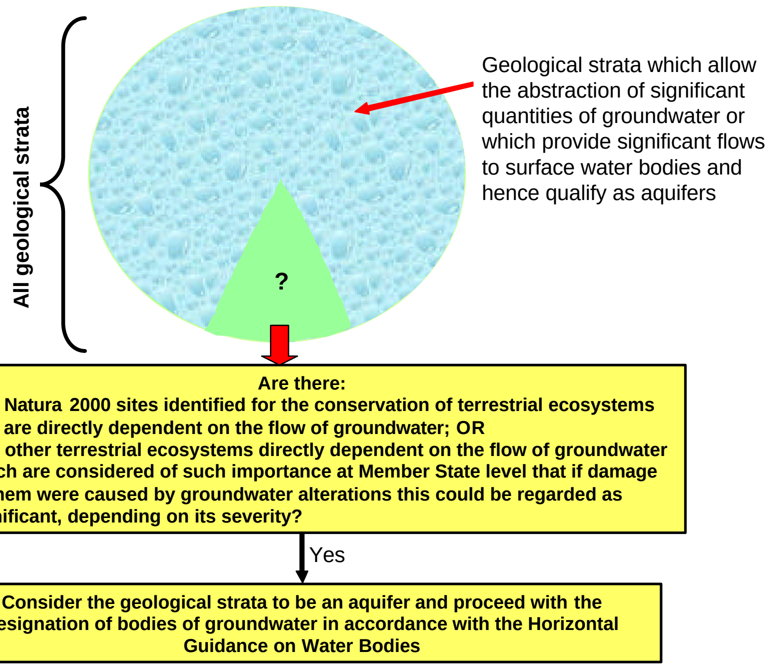


Figure 4: Suggested approach to deciding if a geological stratum qualifies as an aquifer on the basis of the significance of groundwater flow to directly dependent terrestrial ecosystems

The achievement of good groundwater status will require that the groundwater needs of directly dependent terrestrial ecosystems are protected, and where necessary restored to the extent needed to avoid or remedy significant damage to such ecosystems. It will also require that the groundwater needs of surface water bodies are protected and where necessary restored, to (a) ensure the achievement of relevant WFD objectives for surface water bodies and (b) avoid significant diminution in the ecological or chemical quality of such bodies.
For groundwater quantitative status [Annex V.2.1.2], the Directive requires that:

> *'the level of groundwater is not subject to anthropogenic alterations such as would result in…….*
> *any significant damage to terrestrial ecosystems which depend directly on the groundwater body.'*

For groundwater chemical status [Annex V.2.3.2], good status requires that the concentrations of pollutants:

> *'are not such as would result in failure to achieve the environmental objectives specified under Article 4 for associated surface waters nor any significant diminution of the ecological or chemical quality of such bodies nor in any significant damage to terrestrial ecosystems which depend directly on the groundwater body.'*

These provisions protect dependent terrestrial ecosystems from significant adverse impacts resulting from a reduction in the water table or from groundwater pollution. However, they are not designed to protect terrestrial ecosystems directly dependent on bodies of groundwater from other sources of damage; for example: drainage.

Figure 5 illustrates the general approach, within the river basin management planning process, to considering risks of significant damage to terrestrial ecosystems directly dependent on groundwater as a result of anthropogenic alterations to groundwater quality or levels.

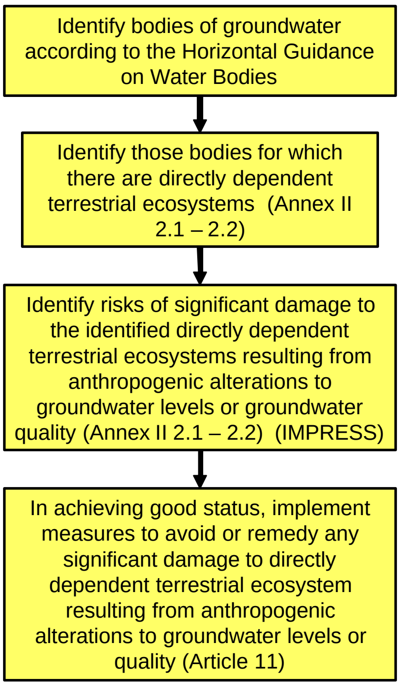


Figure 5: General approach to protecting and restoring the groundwater needs of terrestrial ecosystems directly dependent on groundwater bodies

There are potentially very large numbers of terrestrial ecosystems that are directly dependent on groundwater within the Community. Many of these terrestrial ecosystems will be of such low importance that managing groundwater to meet their water needs could create a substantial administrative burden for little or no environmental benefit.

The Directive is concerned with significant damage indicating that its intent is to provide a mechanism by which Member States can protect the water needs of wetlands already protected at Community level as part of the Natura 2000 network, and the groundwater needs of other important terrestrial and wetland resources if severely affected by groundwater alterations. To enable Member States to use their management resources to achieve the greatest benefits for wetland protection and improvement, the practical approach outlined in Figure 6 is recommended.

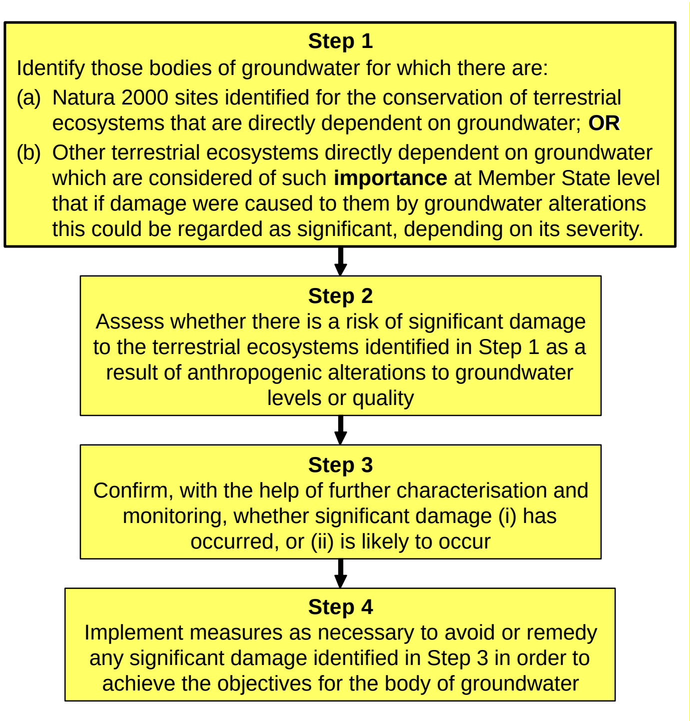


Figure 6: Outline practical approach to identifying terrestrial ecosystems which could be significantly damaged by alterations to groundwater level or quality

An example of how this approach is being implemented in the United Kingdom is illustrated in Figure 7. Because of the limited time available for the 2004 pressures and impacts analysis, work will focus on identifying risks of damage to the most important terrestrial ecosystems in conservation terms. After 2004, other directly dependent terrestrial ecosystems of conservation importance will be considered.

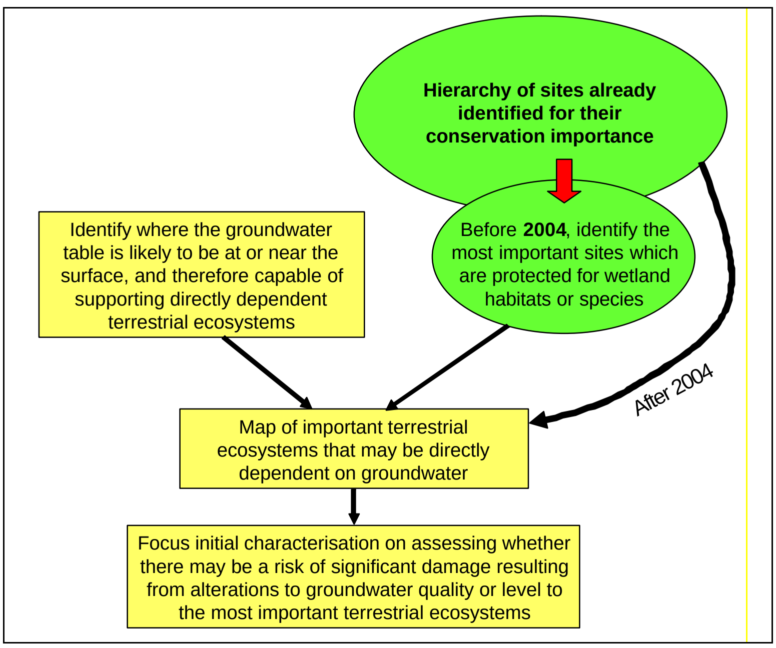
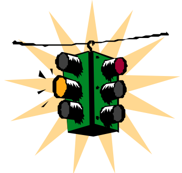


Figure 7: Outline of phased approach being developed in the UK

3.3.1 What is significant damage and how should it be measured?

The environmental objectives for groundwater bodies require the protection of dependent terrestrial ecosystems from *significant damage*. However, the Directive does not provide a definition of the term 'significant'. The term *'significant damage'*, should be interpreted primarily in respect to the ecological quality of terrestrial ecosystems that depends on the inter-linkage with groundwater. Beside this, other factors should be taken into account. Existing data held by Member States about the ecological and socio-economic significance of dependent systems could be used to form the basis of a 'significance test' in this context. For example, where a wetland is of conservation importance, impairment of its conservation objectives as a result of alterations to groundwater could be regarded as constituting significant damage. In such a situation MS may need to assess the risk of incurring into significant damage by relating it to the water needs of critical species and habitats and may determine a boundary of tolerable alteration of groundwater levels defined specifically for each type of ecosystem.



Look Out! Wetlands linked to unsaturated strata or karstic systems, may play a crucial role in protecting the saturated zone from pollution. In these cases Member States may need to design specific conservation measures for these ecosystems.

3.4 Wetlands in relation to transitional and coastal waters

Most brackish wetlands fall under the definition of transitional waters given in Article 2.6 of the Directive:

> *Transitional waters are bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters but which are substantially influenced by freshwater flows.*

The CIS COAST Guidance recommends that surface waters in the vicinity of river mouths that are ecologically significant in the river basin district be identified as transitional water bodies. The Directive gives no indication of the minimum size of transitional waters to be identified as separate water bodies. The expression *'discrete and significant elements of surface water'*, which is used to help identify significant water bodies (Article 2.10), can be interpreted in terms of the risk of failing to meet good ecological status following assessment by Member States.

Operational needs for the achievement of the main environmental objectives dictate whether a given transitional water should be identified as a discrete surface water body or not. The intertidal area, defined as the discrete area between the highest and the lowest astronomical tides, should be included among water bodies as recommended by the COAST Guidance in 2.7.3.

In a similar way, coastal lagoons are defined in respect to the function within the river basin. They fall within transitional waters when they are found *'in the vicinity of river mouths'* and *'substantially influenced by freshwater flows'* (Article 2.6). In other cases, lagoons can be identified as lakes if larger than 0.5 km². As suggested in the horizontal guidance on transitional and coastal waters, lagoons smaller than 0.5 km² can be included by Member States in the water body definition if they are significant elements of surface water in the context of the purposes of the Directive.

Case Study 7. Groundwater and wetland interactions on a UK floodplain

The River Idle washlands comprise four isolated floodplains covering 84 ha of low lying land in Nottinghamshire and South Yorkshire (UK). The washlands have been designated as a Site of Special Scientific Interest (SSSI) for the wet grassland communities and waterfowl they support.

The River Idle has been subject to modification since the 19th century culminating in the *"River Idle Improvement Scheme"* that saw the construction of flood defence banks and a pumping station which allows drainage to the River Trent during periods of flood and/or high tides when, historically, hundreds of hectares of land would have been flooded.

As a result of these modifications the washlands that survive today represent a tiny fragment of the historic wetland landscape and there has been a long-standing concern that even these are subject to drying and degradation.
Initial suspicion fell on the operating regime of pumping station which was thought to be drawing water levels down so quickly after storm events that the period and depth of inundation was insufficient to maintain the shallow water-table depth.

A series of shallow groundwater monitoring boreholes were installed to verify this hypothesis and develop control rules for the pumping station that would restore and maintain the wetland interest. However, the data that was gathered suggests that the shallow water table drops rapidly after flooding to levels below that of the river. This indicates that the fundamental control on the shallow water table in the washlands is the regional aquifer and not the level at which the river is maintained.

While the exact nature of the interaction between river, aquifer and washland is still being investigated, these findings have serious implications for the long-term management of the underlying aquifer which is heavily exploited for public water supply and has water levels lying below sea level.

4 THE RELATIONSHIP BETWEEN WETLAND SYSTEMS AND HEAVILY MODIFIED WATER BODIES

4.1 Heavily Modified Water Bodies and Wetlands

The Heavily Modified Water Body (HMWB) category of the WFD is the subject of a CIS Guidance document, the principles of which underpin the following discussion (Identification and designation of Heavily Modified and Artificial Water Body – Policy summary to the HMWB and AWB document, Chapter 2):

> *'Heavily Modified Water Bodies are ones which as a result of physical alterations by human activity are substantially changed in character and cannot, therefore, meet the 'good ecological status' (GES). In this context:*
> - *Physical alterations mean changes to the hydro-morphological characteristics of a water body, and*
> - *A water body that is substantially changed in character is one that has been subject to major long-term changes in its hydro-morphology as a consequence of maintaining the specified uses listed in Article 4(3). In general, these hydro-morphological changes alter morphological and hydro-logical characteristics.'*

If the current specified uses of the water body (i.e., navigation, hydropower, water supply or flood defence) or the wider environment are significantly adversely affected by restoration measures required to achieve GES, and if no other technically feasible and cost effective environmental option exists, then these water bodies may be designated as HMWB. The environmental objectives for such water bodies imply reaching Good Ecological Potential (GEP), which represents a less stringent requirement than achieving GES.

Riparian, lakeshore or inter-tidal zones, including the wetlands comprised within water bodies, constitute part of the hydro-morphological characteristics of a water body. Where the condition and extent of these is relevant to the achievement of the environmental objectives for the associated water body, modifications to or destruction of these wetlands should be taken into account in the HMWB designation process.

The identification of water bodies at risk, and the role of wetlands in this process, is described in the section of this Guidance document on Impacts and Pressures (section 6). The current chapter considers the relevance of wetlands to the HMWB designation tests and to establishing appropriate values for Good Ecological Potential.

Significant hydromorphological changes which may be judged as incompatible with the achievement of GES, even in the long term, and therefore could prompt HMWB designation would include structural changes such as embankments, drainage, etc., that cannot be removed without incurring disproportionate costs, damaging the wider environment, or posing a risk to specified uses (see Article $4.3_{(a)}$). Actual designation is subject to a series of clear tests outlined in Article 4.3. These are outlined in the following section, along with their relevance for wetland (re)creation, maintenance or enhancement.

4.1.1 Steps in HMWB Designation Process, and their possible relevance to wetlands

There are two key 'designation tests' for Heavily Modified Water Bodies identified in the Water Framework Directive and explored in the HMWB Guidance document.

Designation test 4.3$_{(a)}$: Do the restoration measures necessary to achieve Good Ecological Status have significant adverse effects on the wider environment or the 'specified uses'?

Where impacts on wetlands in the riparian, lakeshore or intertidal zones of a water body result in a risk of failure to achieve Good Ecological Status, restoring the wetlands may constitute part or all of the 'measures necessary to achieve GES'. The 'designation test' will require an assessment of whether these measures can take place without significant impacts on the wider environment or compromising the specified uses. Where this use is flood defence, for instance, wetland restoration linked to the provision of additional flood storage capacity may be possible without significant adverse affects. In this case, the water body would not require designation as an HMWB.

'Designation test 4.3$_{(b)}$: Can the beneficial objectives served by the modifications of the HMWB be achieved by other means, which are a significantly better environmental option, technically feasible and not disproportionately costly?

There may be contexts in which the restoration or creation of wetlands can help to deliver the beneficial objectives in a way that meets the requirements of this designation test. Examples of the roles which wetlands can play in delivering flood defence benefits are described in Chapter 7.

4.1.2 The Establishment of Good Ecological Potential

Following the designation process, Member States will be required to establish environmental objectives for each Heavily Modified Water Body. This process is outlined below, identifying where and how the development of a reference condition (Maximum Ecological Potential) and an appropriate environmental objective (Good Ecological Potential) may be relevant to wetland systems.

Table 6. Development of ecological objectives for HMWBs relevant to wetlands

HMWB Ecological Objectives	Relevance to wetlands
Establishment of Maximum Ecological Potential. **Comparison with closest comparable surface water body (Annex V.1.2.5), considering all mitigation measures, which do not have a significant adverse effect on the specified uses or the wider environment.**	**! Opportunities may exist for restoring relevant wetland function without significant adverse affects on the specified uses or the wider environment. These should be investigated when identifying the closest comparable surface water body.** **Where no comparable 'natural' system exists (which may be the case when considering heavily modified rivers disconnected from their floodplains), expert judgement may be used to identify the best possible environmental outcome in the context.** **! An appropriate reference condition will reflect the restoration of hydro-morphology, in so far as this does not have adverse impacts on the wider environment or specified uses.**
Establishment of Good Ecological Potential. **Only slight changes in the biological elements found at MEP, otherwise measures have to be taken to ensure GEP is achieved (Art. 4.1(a)$_{(iii)}$ and Annex V.1.2.5).**	**GEP represents only slight changes concerning biological quality elements from MEP, and should therefore provide a driver for the restoration of the physical condition of the water body, in so far as this is compatible with the HMWB designation.**

4.2 Artificial Water Bodies and Wetlands

According to the CIS Guidance on the Identification and Designation of Heavily Modified and Artificial Water Bodies, an artificial water body (AWB) is defined as (4.3):

> *'a surface water body which has been created in a location where no significant surface water existed before and which has not been created by the direct physical alteration of an existing water body or movement or re-alignment of an existing water body.'*

A similar, but not identical process to the identification of HMWBs applies to the identification of artificial water bodies and the establishment of maximum and good ecological potential. The potential relevance of this process to wetlands is identified in the table below.

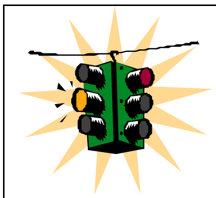
Table 7. Identification of Artificial Water Bodies and their relevance to Wetlands

Is the water body artificial?	Relevance to wetlands
Designation test 4.3(b): Can the beneficial objectives served by the AWB be achieved by other means, which are a significantly better environmental option, technically feasible and not disproportionately costly?.	
Establishment of Maximum Ecological Potential. **Comparison with closest comparable surface water body (Annex V.1.2.5), considering all mitigation measures, which do not have a significant adverse effect on the specified uses or the wider environment.**	**! Care should be taken to ensure that in selecting a natural type for comparison, hydro-morphological condition is properly considered and reflected in the biological standards for maximum ecological potential.** **Thus, for a relevant lake type, the condition of the lakeshore zone, and of littoral communities associated with it, should help to determine MEP, if mitigation measures could enhance these elements without adverse impacts on the specified uses or the wider environment.** **This might be particularly relevant to the design or improvement of reservoirs.** **An appropriate reference condition will reflect the enhancement of hydro-morphology, in so far as this does not have adverse impacts on the wider environment or specified uses.**
Establishme nt of Good Ecological Potential. **Only slight changes in the biological elements found at MEP, otherwise measures have to be taken to ensure GEP is achieved (Art. 4.1(a)(iii) and Annex V. 1.2.5).**	**GEP represents only slight changes in biology from MEP, and should therefore provide a driver for the enhancement of the physical condition of the water body, in so far as this is compatible with the AWB designation.**

5. PROTECTED AREAS AND THE WATER FRAMEWORK DIRECTIVE

Article 6 of the Directive requires Member States to establish a register or registers of Protected Areas by 22/12/2004. The Register must include all areas lying within each river basin district that have been designated as requiring special protection under specific Community legislation for the protection of their surface water or groundwater and conservation of habitats and species directly depending on such water. The purpose of the Register is to ensure that the integrated river basin planning system created by the WFD helps to deliver the objectives of other water-related legislation, as it applies to environmentally vulnerable or important parts of the river basin. The Protected Areas register will include some sites designated under the Birds and Habitats Directives as part of the Natura 2000 network.

Under Article $4.1_{(c)}$, by 22/12/2015, unless otherwise specified in the Community legislation establishing the Protected Area, Member States must achieve compliance with relevant groundwater-related and surface water-related standards and objectives. This requirement concerns areas identified pursuant to Article 6 and Annex IV, designated for the conservation of habitats or species for which the maintenance or improvement of the status of water is an important factor in their protection. There are possibly conflicting objectives between the various directives. The RBMP must deal with these.



Look out! Under the WFD, "Protected Areas" include drinking water abstraction sites, recreational areas, nutrient-sensitive areas as well as areas for the protection of economically significant species and species of conservation concern (see Annex IV).

5.1 Ecological criteria for water dependency

Some of these Protected Areas will include wetland habitats and species directly depending on surface water or groundwater. A crucial part of the development of the Protected Areas Register will therefore be the identification of those habitats and species within the Natura 2000 network which qualify under WFD criteria. The following discussion and criteria offer a starting point for considering how this process might be developed.

Natura habitats include specific surface water habitats, such as oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*, and Natura species include those that live in surface waters, such as lampreys and Atlantic salmon.

Other Natura habitats and species may depend on saturated conditions, groundwater at or near the surface of the ground or frequent flooding. Others may depend directly on aquatic processes (e.g. sand dunes reliant on the movement of sediment in adjacent coastal waters) or on increased humidity associated with nearby water (Table 8).

Table 8. Ecological criteria for identifying Natura Habitats and Species

that are directly dependent on the status of water

Natura 2000 SPECIES	Natura 2000 HABITATS
1.a Aquatic species living in surface waters as defined in Article 2 of the WFD (e.g. bottle-nose dolphin, freshwater pearl mussel).	2.a Habitats which consist of surface water or occur entirely within surface water, as defined in Art. 2 of the WFD (e.g. oligotrophic waters; estuaries; eelgrass beds).
1.b Species with at least one aquatic life stage dependent on surface water (i.e. breeding; incubation, juvenile development; sexual maturation, feeding or roosting - including many Natura bird and invertebrate species).	2.b Habitats which depend on frequent inundation, or on the level of groundwater (e.g. alluvial alder wood, blanket bog, fens).
1.c Species that rely on the non-aquatic but water-dependent habitats relevant under 2.b and 2.c in the HABITATS column of this Table (e.g. Killarney fern).	2.c Non-aquatic habitats which depend on the influence of surface water - e.g. spray, humidity (bryophyte-rich gorges) should be considered.

5.2 Identifying relevant standards and objectives

The WFD requires that any relevant standards and objectives for Protected Areas should be achieved by 2015, unless stated otherwise in the Community legislation under which the sites were designated. The single most significant standard for Natura 2000 sites is the achievement of Favourable Conservation Status for the designated features of interest. This will generally be expressed in biological terms and it is appropriate that this biological outcome remains the final measurement against which WFD obligations are judged. However, it is also widely acknowledged that for the purposes of the pressures and impacts analysis, and the establishment of a Programme of Measures, such standards and objectives will need, where practicable, to be understood in terms of relevant physico-chemical or hydro-morphological attributes.

A second, vital step in delivering WFD obligations towards Natura 2000 wetlands is therefore to determine the surface water and groundwater related needs of sites, to the extent required to decide if there is a significant risk of failing to achieve their water-related standards and objectives, and to ensure that measures are taken to address this. The water-related standards needed to meet the objectives for Natura Protected Areas may be more or less stringent than those required to achieve good surface water status, good groundwater status, other Protected Area objectives or other relevant objectives specified under paragraph 1 of Article 4 of the Directive. In accordance with Article 4.2, the most stringent objective will apply.

River Basin Management Plans (RBMPs) should also include any water management action required to meet the wider provisions of the Birds and Habitats Directives in relation to habitats outside the Natura 2000 network. Article 10 of the Habitats Directive states that:

> *'Member States shall endeavour, where they consider it necessary, in their land-use planning and development policies and, in particular, with a view to improving the ecological coherence of the Natura 2000 network, to encourage the management of features of the landscape which are of major importance for wild fauna and flora. Such features are those which, by virtue of their linear and continuous structure (such as rivers with their banks or the traditional systems for marking field boundaries) or their function as stepping stones (such as ponds or small woods), are essential for the migration, dispersal and genetic exchange of wild species.'*

Where Member States create compensatory habitat (including wetlands), as part of their action to implement the Birds or Habitats Directives, the water needs of such additional habitats will also need to be integrated into the river basin planning process.

5.3 Using GIS to assist with developing the Protected Areas Register

To assist in the river basin management planning process, the register of Protected Areas could be incorporated into a GIS layer, capable of performing complex tasks needed to enhance and support decision-making. Such an approach is being developed by the Danube Ecological Expert Group.

6. WETLANDS AND THE IMPACTS AND PRESSURES ANALYSIS

The impacts and pressures analysis required by the WFD is a key part of the River Basin Planning Cycle. The CIS Guidance on the Analysis of Impacts and Pressures reviews the action Member States will need to take to identify water bodies at risk of failing their WFD objectives. This section of the Wetlands Guidance builds on the IMPRESS guidance to establish the relevance of wetlands in assessing risks to the environmental objectives of the Directive.

6.1 Relevant Objectives in the Impacts and Pressures Analysis

The following objectives, relevant to wetlands, will be considered during the impacts and pressures analysis:

Table 9. Objectives of the IMPRESS analysis
(Text in italics extrapolated from IMPRESS GD)

Prevent deterioration in the status of all bodies of surface water, including wetlands that are, or form part of surface water bodies. This will include preventing deterioration in the hydro-morphological condition of water bodies at high status (including the condition of any wetlands in the riparian, lakeshore or intertidal zones). Preventing deterioration in the hydro-morphological condition of water bodies at good status and below, in so far as it is necessary to support the achievement of the relevant standards for biological quality elements.
Prevent deterioration in the status of all bodies of ground water, including preventing significant damage to any terrestrial ecosystem (including wetlands) directly dependent on the groundwater body.
Protect, enhance and restore all bodies of surface water and wetlands that are, or form part of surface water bodies, with the aim of achieving good ecological status by 2015. This will include achieving hydro-morphological condition of water bodies (and therefore of any wetlands included within the riparian, lakeshore and inter-tidal zones) necessary to support the achievement of the relevant standards for biological quality elements.
Protect, enhance and restore all bodies of ground water including the reversal of significant damage to any terrestrial ecosystem (including wetlands) directly dependent on the groundwater bodies, by 2015.
Protect, enhance and restore all artificial and heavily modified bodies of surface water with the aim of achieving good ecological potential and good surface water chemical status by 2015. This will include the restoration of wetland functions, where this is necessary to achieve Good Ecological Potential and good surface water chemical status, i.e., where such restoration will not adversely affect specified uses or the wider environment.
Compliance with the standards and objectives for Protected Areas by 2015 at the latest, including the objectives for areas designated for the abstraction of drinking water under Article 7. This will include standards and objectives for wetlands included within the Natura 2000 network, identified in order to implement the Habitats and Birds Directive; similarly consider regulations prescribed by the Drinking Water Directive.

6.2 Understanding relevant pressure-impact relationships

The Guidance on Impacts and Pressures points out that the achievement of the broad range of objectives established by the WFD will require an understanding of a greater number of impact/pressure relationships than has been required by previous European legislation, or is common practice in most Member States.

> *'The objectives include new ecological objectives, the achievement of which may be compromised by a very wide range of pressures, including point source discharges, diffuse source discharges, water abstractions, water flow regulation, morphological alterations and artificial recharge of groundwater. These and any other pressures that could affect the status of aquatic ecosystems must be considered in the analyses.'*

This is particularly relevant to understanding pressures on wetlands, and their relevance to WFD objectives. Whilst the IMPRESS guidance recognises that the initial characterisation process (deadline 2004) may rely heavily on existing data, it also emphasises the need for Member States to ensure that this can be refined and supplemented during the river basin planning cycle(s) which follow. Less significant elements of surface waters such as small streams, canals and wetlands, often form networks which play a relevant role in sustaining catchment stability acting as pressure indicators; impacts on these may reveal existing pressures increasing catchment vulnerability.

Table 10 identifies some of the key driver/pressure/impact relationships that may need to be better understood, to meet the objectives relevant to wetlands.

Table 10. DPI relationships and wetlands

Pressure	Impact	Information	WFD relevance
Drainage of floodplain wetlands	Changes to physical extent, biological composition of water body. Changes to condition of the riparian zone and its vegetation. Changes to other hydro-morphological elements of the water body, including flow regime, depth, substrate. Changes to the physico-chemical and chemical quality of water reaching water bodies.	Understanding of the interaction between floodplain wetland condition and the physical, chemical and biological condition of the water body.	Objectives for surface water bodies.
Flood embankments resulting in reduction of floodplain	Changes to physical extent, biological composition of water body. Changes to condition of the riparian zone and its vegetation. Changes to other hydro-morphological elements of the water body, including flow regime, depth, substrate. Changes to the physico-chemical and chemical quality of water reaching water bodies.	Understanding of the interaction between floodplain extent and connectivity and the physical, chemical and biological condition of the water body.	Objectives for surface water bodies.

Table 10(continued). DPI relationships and wetlands

Pressure	Impact	Information	WFD relevance
Drainage or destruction of peatlands and other wetland systems in the wider catchment	Changes to catchment hydrology affecting the quality and quantity of flow reaching downstream water bodies.	Understanding the interactions between wetlands in the wider catchment, hydrological regimes of water bodies, and the elements making up good status.	Objectives for surface water bodies.
Groundwater abstraction	Reduction in water available to support wetland ecosystems	Hydrological regime necessary to support relevant components of wetland ecosystems. Interactions between groundwater bodies and wetland hydrology	Preventing deterioration and achieving good status for groundwater bodies.
Groundwater pollution	Deterioration of quality of water reaching dependent terrestrial ecosystems, including wetlands.	Water quality necessary to support relevant components of wetlands ecosystems. Interactions between groundwater and surface water quality.	Preventing deterioration and achieving good status for groundwater bodies.
Abstraction from surface water bodies	Reduction in amount of water available to support the achievement of relevant conservation objectives for wetland sites in the Natura 2000 network.	Understanding of the water needs of Natura 2000 wetlands, including interactions with relevant water bodies.	Objectives for Protected Areas.
Pollution of surface water bodies	Reduction in the quality of water available to support the achievement of relevant conservation objectives for wetland sites in the Natura 2000 network.	Understanding of the water quality needs of Natura 2000 wetlands, including interactions with relevant water bodies.	Objectives for Protected Areas.

6.3 Understanding the impact of future pressures

A key requirement of the impacts and pressures analysis will be to identify future activities in the river basin which may put at risk the achievement of WFD objectives (IMPRESS, Policy summary):

> *'Accordingly, in assessing risks to the achievement of these objectives, the analyses of pressure and impacts must identify:*
>
> - *Existing pressures and impacts (identified in 2004) likely to be causing the status of water to be lower than good.*
> - *How pressures would be likely to develop prior to 2015, in ways that would cause a failure to achieve good status if appropriate programmes of measure were not designed and implemented.*

These observations also apply to any plan or project likely to cause deterioration in status, from the date at which the 'no deterioration' objective is deemed to apply.
This is particularly relevant when considering the possible impacts on water status of major hydro-morphological modification projects, for example to support agricultural production or the construction of transport infrastructure. Pressure-impact relationships between wetlands and water bodies will need to be investigated, as part of the assessment of such future pressures, if river basin planning is to secure the long-term ecological status of water. The relevance of this point to the protection of Europe's few remaining pristine or near pristine floodplain environments cannot be over stated.

6.4 Pressure screening and threshold values

In order to undertake the analysis of impacts and pressures in a cost effective manner, the IMPRESS guidance recommends that screening criteria are used in relation to particular pressures. This will lead to the gradual 'narrowing' down of the analysis to those water bodies whose risk of failure is subject to greatest uncertainty, and where it is therefore appropriate to invest resources in investigating pressure-impact relationships.
Member States need to consider risks to the achievement of the Directive's objectives resulting from impacts on hydromorphological quality elements in undertaking the pressure and impacts analysis. This should include consideration risks of deterioration in the type-specific hydromorphological conditions of high status water bodies.

Member States may also find that data acts as a useful bench-mark, from which to develop threshold criteria for the assessment of water bodies likely to fail to achieve GES as a result of hydro-morphological modifications (this is proposed in links between the IMPRESS and Heavily Modified Water Bodies guidance documents). These threshold criteria will include a measure of acceptable deviation from reference condition for any wetlands included within the riparian, lakeshore and intertidal zones.
Wetlands outside of these zones will be under pressures that impact on the status of water bodies, broader threshold criteria for assessing such pressures will be needed to undertake a comprehensive impacts and pressures analysis. Wetlands functional evaluation is useful to highlight pressure on the river basin as illustrated in the case study below.

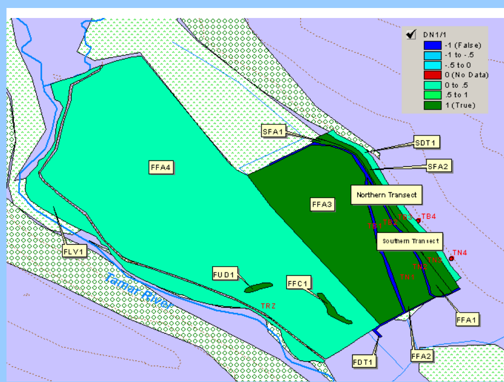
Case study 8. Impact assessment through wetland functional evaluation: The Cheimaditida case

Functional evaluation, using appropriate physicochemical and biological indicators, may identify the degraded processes, the possible sources of degradation, and the functions that should be restored. The impact assessment through functional evaluation is taking into account the characteristics of the entire watershed, not just the degraded wetland. Activities throughout the watershed can have adverse effects on the aquatic resources. A single wetland management project may not be able to change conditions in the whole watershed. Several methods of functional evaluation have been developed; these are: (a) cost effective, in proportion to the value of information derived, (b) easily interpreted, provide unambiguous information and are easily understood, and (c) policy relevant, address key environmental issues. These methods are used to assess the impacts on wetland ecosystems and furthermore to evaluate proposed management solutions.
Lake Cheimaditida in Greece is a characteristic case where the functional evaluation at watershed level was used for impact assessment and development of a sustainable restoration plan. Ground water recharge and water storage were found degraded due to water abstraction for agricultural purposes. Although the wetland hosts several rare bird species, the functional evaluation revealed that the foodweb support function was not performed to the desirable degree and biodiversity problems were to arise in the near future if no measures were taken. The poor performance of the above mentioned functions resulted in: i) drop of groundwater levels, ii) shortage of irrigation water, iii) loss of wetland habitats, and iv) gradual decrease of biodiversity. These environmental problems had direct impacts on the local economy. Reduced crop production and deterioration of fisheries led to lower family income and higher social instability. In order to cope with the above-mentioned problems, wetland evaluation was used to set a sustainability reference levels for wetland restoration. Today a program for the restoration of the degraded wetland is under way.

Assessment of wetland function can be performed by means of specific tools and spatial analysis such as the Wetland Evaluation Decision Support System illustrated in the Case Study below.

Case Study 9. A wetland evaluation tool: WEDSS

One of the key outputs of the EVALUWET project is the development of a Wetland Evaluation Decision Support System (WEDSS) (Mode *et al.*, 2002; www.rhbnc.ac.uk/rhier/evaluweb/index.shtml). In simple terms the WEDSS links a functional assessment knowledge base with methods of socio-economic valuation within a GIS environment. The knowledge base carries out assessments of hydrological, biogeochemical and ecological wetland functions using data which can be rapidly gathered in desk studies or field visits. The WEDSS is supported by a simple user interface with input data and outputs being displayed as GIS layers (Figure 1). Users will be able to access the WEDSS online so that they are not required to invest in expensive GIS software. The use of a GIS environment permits decision support at the various scales, from individual wetlands up to catchments. By integrating functional and valuation information within a single tool, decision makers can consider all of the relevant information within wetland management and can fully consider wetlands within integrated catchment management. In this way, the WEDSS will facilitate wetland management in the context of the WFD and support the implementation of other national, European and international policies such as the Habitats Directive, Birds Directive, Convention on Wetlands (Ramsar), Convention on Biodiversity (CBD) and Convention on Sustainable Development (CSD). The WEDSS will be tested in each of the seven study catchments, which represent a variety of wetland types and climatic regions. The WEDSS can be used for a variety of purposes, such as targeting sites for restoration or establishment of buffer zones, comparison of wetland sites and testing of management scenarios.



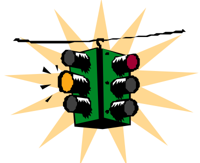
Figures: WEDSS input layer (left) showing wetland Hydrogeomorphic units (HGMUs) to be assessed (blue areas) and output layer (right) showing degree of denitrification occurring in HGMUs (denitrification is an important process improving or maintaining water quality and has higher rates in darker areas).

E Maltby, D V Hogan & R J McInnes(1996). 'Functional Analysis of European Wetland Ecosystems - Phase I (FAEWE). Ecosystems Research Report No 18. European Commission Directorate General Science, Research and Development. 448 pp. ISBN: 92-827-6606-3. Brussels.

7. THE PROGRAMME OF MEASURES AND WETLANDS

Article 11 of the Directive requires Member States to establish a Programme of Measures in order to achieve the objectives stated under Article 4.

As part of the Programme of Measures, wetland creation, restoration and management, may prove a cost-effective and socially acceptable mechanism for helping to achieve the environmental objectives of the Directive [Article 11.4; Annex VI, Part B(vii)].
Wetlands have the potential to offer benefits in terms of flood prevention, nutrient and pollutant load abatement, wildlife protection, tourism and recreation. This section of the document examines the role which wetlands can play in the Programme of Measures, in helping to achieve the Directive's environmental objectives.



Look out! The greatest value of measures involving wetland enhancement (creation, restoration, management) is in the multi-purpose solutions they offer.

7.1 Basic and supplementary measures

Each programme of measures must include 'basic' measures, which are described in detail in Article 11.3, and, where necessary, 'supplementary' measures (see Article 11. 2).

7.1.1 Wetlands and Basic Measures

Basic measures may include action directly to protect, enhance or restore wetlands, where:

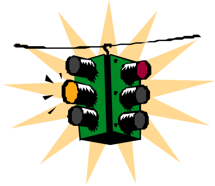
- The wetland is a terrestrial ecosystem that is directly dependent on groundwater (Article 1(a), and the achievement of good groundwater status requires measures to ensure that anthropogenic alterations to groundwater levels and chemical quality are not such as would result in significant damage to that wetland (Annex V.2.1.2 and 2.3.2);
- The wetland concerned is a river, lake, transitional or coastal water body (Article 4.1(a));
- The wetland is part of a hydromorphological quality element of a surface water body and requires protection, enhancement or restoration to ensure that the hydro-morphological conditions of the water body are consistent with the achievement of the relevant good status values for the biological quality elements (Annex V.1.2);
- The wetland is a Natura 2000 Protected Area and depends, in part, for the achievement of its standards and objectives, on appropriate measures to protect, enhance or restore a surface water body or groundwater body in accordance with Article 4.1(c).

Some measures described in Article 11 might gain benefit from wetland management such as those included under the combined approach principle illustrated in Article 10 (see 7.3).

7.1.2 Wetlands and Supplementary Measures

Supplementary measures are those designed and implemented in addition to the basic measures, with the aim of achieving the objectives of the Directive (see Article 11, paragraph 4). Part B of Annex VI of the Directive provides a non-exclusive list of such measures, including *the recreation and restoration of wetland areas*.

In some circumstances, wetland management may be a necessary measure to achieve the objectives of the Directive. In such cases, wetland restoration and recreation may be obligatory. In other circumstances, Member States may choose to use wetland management measures if they judge it would help ensure the most cost-effective approach, or otherwise most appropriate combination of measures. At their discretion, Member States may also choose to use supplementary measures to provide for any additional level of protection or improvement of surface waters or groundwater over and above that required by the Directive.



Look out! Supplementary measures are not always discretionary. Where the achievement of the objectives of the Directive can only be secured with the help of supplementary measures, Member States will be obliged to use them.

7.2 Wetlands and the Concept of Cost Effectiveness

The economic analysis required under Article 5 and Annex III is designed to help Member States make judgements about the most 'cost effective combinations of measures' to achieve the Directive's objectives. The analysis itself should contain enough information in sufficient detail (taking account of the costs of collecting information) to make considered judgements about cost-effectiveness, with a principal focus on basic measures. The comparison of the costs and benefits (including environmental costs and benefits) of measures involving the creation and restoration of wetlands with other options for achieving the Directive's Article 4 objectives may therefore form part of the assessment of cost effectiveness.

In many instances, the appropriate evaluation and costing of wetland management measures may reveal the great value of goods and benefits provided by wetlands. This is illustrated in many of the case studies included in this Chapter of the Guidance.

7.3 Using Wetlands in Programmes of Measures

This section of the document describes the practical role of wetlands in managing pressures on the water environment.

Where wetlands are relevant to the application of a particular basic measure (see above), the section headings refer to the appropriate provisions of Article 11.3.

Otherwise, section headings refer to the *functions* of wetlands, which may help in controlling significant pressures on the water environment (including pollution and the depletion of groundwater resources) and hence assist in the achievement of the Directive's environmental objectives outlined in Article 4.

Throughout, case studies are used to illustrate the role which wetlands can play in managing water status within the river basin.

7.3.1 Measures required to implement Community legislation

Article 11.3 (a) refers to measures required to implement Community Legislation for the protection of water, including those specified in Article 10, for instance the use of wetlands to improve water quality (see 7.3.4), and part A of Annex VI, which includes the Birds and the Habitats Directives relevant to wetland protection and wetland management.

7.3.2 The role of Wetlands in Cost recovery

Article 11.3 (b) states that basic measures will include those:

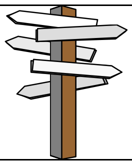
deemed appropriate for the purposes of Article 9

Article 9.1 requires Member States to take account of the principle of the recovery of the costs of water services, including environmental and resource costs, and to ensure, by 2010, that

- water pricing policies provide adequate incentives for users to use water resources efficiently;
- an adequate contribution of the different water uses to the recovery of the costs of water services.

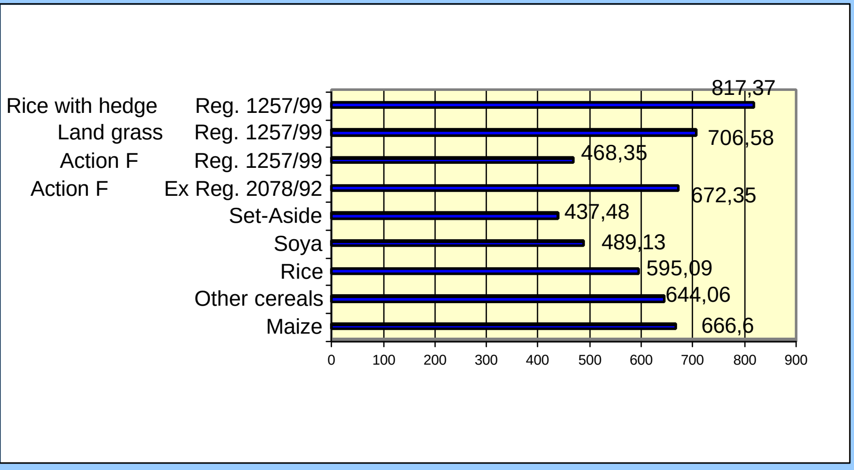
Water services are defined in Article 2.38 as all services which provide for households, public institutions or any economic activities:

a) abstraction, impoundment, storage, treatment and distribution of surface water or groundwater;
b) waste water collection and treatment facilities which subsequently discharge into surface water.

	Concerning methods on how to determine the environmental and resource costs readers should refer to the drafting group under WG 2B on Environmental Costs.

Case Study 11. The "wet farm" Cassinazza: interaction between agriculture and water policy

The estate Cassinazza covers approximately 400 hectares within the Po floodplain, at the southern edge of the Milan district. Traditional farming patterns included rice, winter cereals, maize, soya beans and sunflowers. Since 1996 intensive production has given way to extensive land management systems aimed at revitalising the natural environment. Under the CAP (Common Agricultural Policy) agri-environment instruments: Regulation 2078/92, the recent Rural Development Regulation 1257/1999, and with the support from the Italian Ministry of Agriculture, a biodiversity enhancing agricultural landscape has been achieved over just 7 years. The farm consists of: marshland (50 ha), wet grassland (15 ha), meadow (100 ha) and woodland (70 ha). Agricultural fields are trespassed by a network of streams and 75 km of hedgerows with shrubs and trees planted in double or triple rows. A large pond (11 ha) stores more than 200.000 m3. Agricultural infrastructures for rice production (dams, bridges, roads) have been restored for agriculture and alternative use. Fifty-nine ha are under traditional farming, while 38 ha developed into "integrated farming". The Figure below illustrates gross margins related to commodities and agri-environment provisions in 2002.



Significant returns are achieved through the sale of small quantities of hay and rice supported through Regulation 1257/99. In comparison to traditional intensive rice cultivation, the Cassinazza rice paddies are smaller in size and contained within hedge rows thus reducing agro-environmental impacts. Under the perspective of direct economic returns extensive rice production revealed to be overall more profitable than intensive farming and than solutions aiming at reducing diffuse pollution supported through 'set-aside' incentives or new Action F.
In November 2002 part of the wet farm was used as a flood prevention basin to collect the stormwater and reduce risk of flooding at a nearby village. Estimated potential storm damages greatly overcome the public funds invested in wetland management at the farm.
CAP agri-environment measures have potential to be much more progressive towards the protection and improvement of water quality and landscape. On the basis of those principles a project called Energy Agriculture and Environment is funded by the Lumbardy Administration to develop an "assembly line", sited at Cassinazza, including wetland recreation from rice fields, cultivation and energy production from biomass. The project wants to overcome typical farmers attitudes whereby "tidiness" equals efficiency, while uncropped areas are seen as wastelands.

The nature of environmental and resource costs, and methods to include them in economic analysis, are highlighted in the guidance *Economics of the Environment – The Implementation Challenge of the Water Framework Directive* (*WATECO*), and discussed in detail in its Annex IV.I, 'Estimating Costs (and Benefits)'[N.B. WATECO Annexes were not adopted by the Water Directors].

Where wetland management forms part of a programme of measures, or wetlands are impacted by programmes of measures, relevant environmental and resource costs relating to their functions and values may need to be included in the economic analysis proposed under the Directive.

Case Study 12. Heritage value of UK wetlands

The archaeological resource of England's wetlands alone is estimated at 13,400 monuments, of which 11,600 can be found in lowland wetlands (Van der Noort et al., 2001). The value of wetlands to England's inhabitants, at far back as the Mesolithic Age, is demonstrated by the large numbers of ritual deposits and monuments they contain (e.g. Roos Carr, Seahenge, Flag Fen, Fiskerton). The anaerobic wetland environment preserves evidence of human activity that is normally lost, particularly the organic remains of buildings and artefacts. Wetlands also preserve long palaeo-environmental sequences. These are the year-by-year accumulations of plants and micro-fauna which tell us how past environments were affected by human influences and climatic change. This rich archaeological storehouse is highly vulnerable, both to habitat destruction and drainage. Even seasonal drying can cause the rapid decay of organic evidence. It is difficult to give statutory protection to archaeological sites in wetlands, because they are hard to locate without disturbing the very environment that preserves them.

Wetlands are a vital component of the evolution of our cultural and historical landscape. This principle has been advocated by the Assynt Crofters Trust's objection to establishment of forestry on their hard-won in-bye land. In restoring wetland ecosystems, this inheritance should be acknowledged as part of the history of the intimate connections between people, the water cycle and the wetland environment.

The cultural value of wetlands is more than historical. People who live and work around wetlands today celebrate them in the arts, drama, literature, poetry, and folklore, and use them as a valuable educational tool. The recent "Confluence" project, organised by Common Ground for the River Stour in Dorset, promoted the awareness of the importance of rivers and wetlands to the everyday lives of thousands of residents in the Stour catchment from Stourhead to Poole Harbour.

7.3.3 Managing hydro-morphological impacts

Article 11.3(i) requires controls over any other significant adverse impacts on the status of water bodies not covered by Articles 11.3(a) to (h). In particular, it requires measures to ensure that the hydro-morphological conditions of water bodies are consistent with the required ecological status objectives. Mechanisms for controlling pressures on wetlands within the riparian, lakeshore and inter-tidal zones may be a basic measure where alterations to such wetlands cause a significant adverse impact on the status of water.
The relationship between wetland ecosystems, hydro-morphology (including the condition of the riparian, lake and inter-tidal zones) and ecological status is described in 3.2.3.

In order to determine an appropriate controls regime to comply with Article 11.3(i), Member States will need to consider the major pressures on hydro-morphology which may create a risk failing to meet the environmental objectives of the Directive. Assistance in this process is provided in the CIS Guidance on impacts and pressures analysis, IMPRESS. The following check-list of hydro-morphological pressures is provided in Chapter 4 of the cited guidance document. Many of the pressures identified could affect the structure and condition of the riparian shore or inter-tidal zones of water bodies, and that of the wetlands those zones contain.

Table 11. Indicative lists of hydro-morphological pressures relevant to the application of article 11. $3_{(i)}$

Flow regulation hydroelectric dams	Fisheries enhancement
Water supply reservoirs	Land infrastructure (road/bridge construction)
Flood defence dams	Dredging
Diversions	Estuarine/coastal dredging due to transitional and coastal management
Weirs	Marine constructions, shipyards and harbours
Physical alteration of channel due to river management	Land reclamation and polders
Engineering activities	Coastal sand suppletion (safety)
Agricultural enhancement	Other morphological barriers

This list of potentially significant pressures includes traditional ‘hard’ engineering solutions to flooding and drought problems (such as the canalisation of rivers, and the construction of walls, culverts and reservoirs), which may have significant impacts on the hydro-morphology of water bodies. They may also prove unsustainable in the long-term on the scale necessary to support people, property and the environment in the context of increased population growth and accelerating climate change. The role which wetland creation can play in offering alternatives to such ‘hard’ solutions is increasingly recognised, and is illustrated in the case studies below.

Case Study 13. Wetlands for flood mitigation: the Lafnitz river, Austria

The Lafnitz is one of the few remaining natural lowland rivers in Austria. Since the mid 1980s about 220 hectares of agricultural land have been purchased and managed more extensively. Another 610 hectares have been taken out of intensive agricultural production through compensation payments to landowners. The area is used for natural flood storage. The original plan was to build dams along the river, but this would have caused a higher flood risk for the villages further downstream and it would have been more expensive.

Extensive agricultural management on land surfaces prone to flooding is part of risk avoidance strategies practiced by floodplain peoples since ancient times. Such “soft” solutions are being revived by integrating high quality agricultural products grown under an extensive fashion with integrated river basin management and hold the promise of contributing to a more sustainable future cultural landscape.

The recent update of the UN/ECE *Guidelines on Sustainable Flood Prevention* (2000) presented at the Water Directors meeting in Athens, June 2003, provides numerous best practices on flood prevention, protection and mitigation. Non-structural measures such as the storage effect of vegetation, soil, ground and wetlands are vital to mitigate effects of medium scale floods and beneficial in reducing sediment yield. The conservation, protection and restoration of degraded wetlands and floodplains, including river meanders, oxbows, and especially reconnecting rivers with their floodplains is a main preventive non-structural measure.

Case Study 14. Enhancing the effectiveness of coastal flood defence through inter-tidal habitat creation

The Environment Agency of England and Wales assessed the economic impacts of inter-tidal habitat creation in relation to coastal flood defences. 'Managed re-alignment' is the term used to describe the deliberate breaching of current sea defences to allow flooding to a new line, landward of the present structures. The newly created salt marsh or inter-tidal flats can act as a 'buffer' between the sea and the land during high tides and storm floods, dissipating wave energy and allowing the coast to respond more naturally to changes in sea-level.
The economic advantages of managed re-alignment are significant. Re-alignment to rising ground will usually result in a lower and/or shorter length of flood defence, and therefore reduced maintenance costs. In addition, there may be longer-term savings where a natural defence is provided by the newly created area of inter-tidal land. The Environment Agency estimate that where there is an 80 meter width of saltmarsh fronting a flood defence, maintenance costs would be reduced in the order of £3,000 (4,700 euro approximately) per kilometre. This is due to the buffering effects of the inter-tidal habitat in attenuating wave action.

Seas of Change, A report by the RSPB, January 2002. www.rspb.org.uk

Consideration of how wetlands can be used to manage floods and droughts in a manner compatible with WFD objectives could greatly assist Member States with implementation, and in integrating flood management strategies with River Basin Plans. It is highly likely that a mixed range of flood management options will be part of sustainable flood management in the future.

Case Study 16. Retention zones in Twente, Netherlands

The Twente rural estates located in the basins of the rivers Regge and Dinkel, drain into the Overijsselse Vecht, a transnational river (Germany and the Netherlands) have high cultural historical and natural value. Urbanisation and river channelization have accelerated the discharge of the water. During heavy precipitation, rising water levels, cause flooding in nearby cities; conversely in summer the farmland tends to suffer from drought. A current restoration project aims to store water during periods of heavy precipitation, restore the streams network, control drought, develop natural landscape features, and restore rural estates to their historical condition.

7.3.4 Wetlands and Pollution Control.

Achieving the environmental objectives of the Directive will require Member States to take action to control significant impacts of both point source and diffuse pollution pressures on water bodies (Article 10).
It has long been recognised that wetland vegetation and soil processes can play an important role in cycling nutrients, retaining pollutants and trapping suspended solids that 'carry' pollutants into aquatic environments. The reductions in clean-up costs, along with the added biodiversity and leisure benefits accruing from wetland creation, should be considered when assessing the financial viability of options for water treatment in case of both point and non-point source pollution. When considering this function of wetlands, it is also important to safeguard the wildlife and cultural value of existing sites, which might be compromised if these wetlands were treated as nutrient sinks. 'Created' wetlands (constructed wetlands), on the other hand, may provide greater opportunities for nutrient cycling, with areas of increasing nature conservation value potentially 'zoned' around the areas carrying the greatest pollutant loads.

The potential role of wetlands in respect to water supply and pollution management is highlighted in the Common Text on Wetlands agreed by the Water Directors in November 2002 and in the 1995 Commission Communication on the *Wise Use and Conservation of Wetlands* to the European Council and Parliament.

The case studies given in this document illustrate the important contribution offered by wetlands in reducing the technical and financial burden of pollutants removal (in particular nutrients).

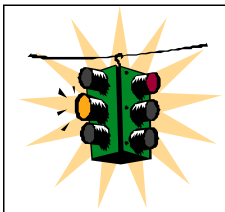
Case Study 17. Nutrient retention value of the lower Morava river

The Morava River is one of the main tributaries of the Danube, extending for some 328 km. Its lower reaches pass through Austrian (right bank) and Slovak (left bank) territory. Of the original 160 km^2 of floodplain on the Slovak side, only about 25% remains, with much of this being under arable agriculture. GIS analysis of historical maps showed that the area of arable land in the functional floodplain had doubled between 1920 and 1999, leading to a corresponding 50% reduction in semi-natural meadows with declines in flora and fauna and in the floodplain nutrient abatement value.

Traditional meadow management in the lower Morava floodplains had an indicative nitrogen retention value of 434 t per year. The monetary value of this natural nutrient removal is equivalent to the operating cost of a wastewater treatment plant for a city of 216,000 citizens – approximately 700,000 Euros per year. Moreover, the initial cost of building such a treatment plant would be around 7 million Euros. These results provided a powerful economic argument in favour of restoring 140 ha of former arable land into meadow. The overall economic investment required in floodplain restoration is far below that for conventional water treatment.

Ongoing restoration of the Morava meadows is enhancing the status of several habitats and species which have declined across Europe, it is improving flood storage through the re-establishment of a more natural flood regime and it fosters tourism/recreation opportunities. Farmers producing hay from the Morava meadows find a ready market across the border in Austria, where the demand for organic products is not currently satisfied by domestic production.

Seffer, J. and Stanova, V., 1999, Morava River Floodplain Meadows: importance, restoration and management. DAPHNE – Centre for Applied Ecology, Bratislava



Look Out! It is recommended that wetlands should be protected from pollution in order to maintain their value. The discharge of anthropogenic wastewaters has to be prevented to maintain the appropriate quality status of wetlands and connected aquatic ecosystems. Such areas should not be compromised by the imposition of an inappropriate pollution control function.

Case Study 18 Le Meleghine, a reconstructed wetland for pollution control

Natural wetlands receive and transform through biogeochemical processes, large fluxes of water carrying concentrated loads of dissolved and suspended pollutants. In many instances the most efficient way to improve pollution abatement consists of measures aiming at restoring the natural self-purification capacity of the rivers.
Situated in the lower Po valley, near the city of Modena, Le Meleghine consists of 36 ha of shallow ponds and vegetated marshland. The reconstructed wetland, functional since 1994, receives water from the Canalazzo main artificial drainage channel characterised by an average flow of 0,37 m^3/s, draining 8,380 ha of intensively cultivated farmland. The main artificial pond extends over 18 ha with an average depth below 1 m.
Before extensive drainage, the area used to host vast marshlands accumulating hydromorphic clayey soils. Today the surrounding farmland has low agricultural potential and can be easily converted into a reconstructed wetland due to a natural impermeable substrate consisting of a 4 m thick layer of impermeable clay deposits which separate surface waters from the underlying shallow sandy alluvial aquifer connected to the Po river system. Spontaneous vegetation includes associations dominated mainly by *Phragmites communis*, species of *Typha*, *Carex*, *Scirpus* and alluvial forest. Bird counts totalled 138 including 30 species nesting within the reconstructed wetland.
Ideal conditions for nutrient load abatement are provided by modulating water residence time (nominal maximum residence time is about two weeks) and expanding the vegetated surface. Overall nutrient retention was shown to vary significantly along with changes in hydrological and climatic conditions; nonetheless the wetland demonstrated a distinct capacity to control peaks in nutrient loading due to strong concentration variability at the inlet.
Intensive monitoring programmes show that the wetland is very efficient in reducing nutrient fluxes especially through nitrification and denitrification as shown in the table below.

	Load abatement
Ammonia	75%
Dissolved Inorganic Nitrogen	64%
Total Phosphorus	63%
Dissolved Phosphorus	94%
Chemical Oxygen Demand	40%
Total suspended solids	63%

This reconstructed wetland is the only effective instrument that could have been deployed to control diffuse pollution produced by farming, treated and untreated industrial discharges (including food processing activities) and effluents produced by sewage treatment plants discharging into Canalazzo which drains into the Po river and then further into the highly euthrophic north Adriatic sea (sensitive area according to Directive 91/271/EEC).

7.3.5 Using wetlands to enhance groundwater recharge.

The achievement of good groundwater status includes requirements to protect and restore the quantitative status of aquifers, in some cases this may be facilitated through the protection and restoration of wetlands.

Case Study 19. Drinking Water from the Danube National Park

The water quality in 45 km stretch of the Danube riverine fringe is high and can provide 250,000 people with clean drinking water. If this area were dammed for hydropower (as was and is suggested), the cost of compensating for the loss in water quality could amount to 6.3 million Euros per year.

(Technical University Vienna 1995)

The winter storage capacity of wetlands can contribute to aquifer recharge. Wetlands retain more water than, for instance, arable land, which is often drained as quickly as possible to aid crop growth. Water from the wetland is thus able to re-infiltrate the aquifer over a longer period, achieving greater re-charge than would be likely where land-drainage and soil conditions direct water rapidly and in greater quantity into main river systems. Infiltration of this kind takes place via infiltration areas in most direct connection to the underlying aquifer, such as ditches, trenches, ponds and lagoons. In this way, wetland creation on flood plains could contribute to improving the quantitative status of alluvial aquifers, as well as alleviating the impacts of flood peaks in winter. It is also possible that small-scale wetland creation in chalk uplands could create a more amenable environment for percolation, and hence aquifer recharge. Further benefits could accrue where more surface water was available in wetlands adjacent to arable land, limiting the agricultural demand for groundwater.

Case Study 20. Wetlands providing drinking water for the Netherlands

As from the 1960s, most of rivers in the Netherlands became progressively too polluted to provide sources of drinking water at an acceptable cost; the Dutch government started looking into natural water purification strategies by letting streamwater percolate through sand dunes. The main processes include mechanical filtration through the sand and bacterial remediation within the aquifer. In this way natural landscape features significantly contribute in reducing the technological and financial burden involved in drinking water preparation. Drinking water for the city of The Hague is still pretreated using sand dune infiltration; the same used to occur for the drinking water for Amsterdam until year 2000 when large reservoirs were built.

In some parts of the country such as the South of the Holland Province, there are no sand dunes suitable for water purification. Here the main source is the river Meuse (Maas); a river characterized by an erratic discharge with low summer minima. The natural morphology of the Meuse estuary region was definitely changed by the building of the large Haringvliet dam constructed in 1970 as part of the Delta Plan. A large freshwater basin interrupted the gradual succession between inland freshwater and coastal saline habitats, significantly affecting the estuarine flora and fauna. The project contributed to extend the accessibility of land and water to human uses.

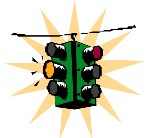
Further inland from Haringvliet, water managers decided to store water to supply the city of Dordrecht and further reclaim land for agriculture. The Biesbosch district, once upon a time a wild shallow coastal zone characterized by estuarine islands, was chosen for the siting of three shallow reservoirs covering and area of 673 ha. Flowing from one reservoir to next, the river water reduces its suspended and dissolved load, reaching values, in the last reservoir, that are close to water fit for human consumption. Today the Biesbosch is a National Park extending over some 7100 hectares which forms a very popular recreation resort and artificial aquatic habitats providing a precious resource for wildlife. The reservoirs supply an abundant and high quality source of drinking water.

As part of the Rhine "vision", a look ahead at the condition of the river in a generation's time, the Dutch government is undertaking a series of collaborative projects involving a large number of public organizations. New plans aim at recreating a brackish water zone between the estuary of the Rivers Rhine and Meuse and the North Sea partially restoring a tidal environment in the former sea inlet and in the Biesbosch tidal area which lies behind it. By ultimately opening a third of the Haringvliet sluices permanently, plants and animals that live in fresh and brackish water tidal environments will be able to flourish again and migratory fish such as salmon will be able to swim unhindered from the sea to their spawning areas along the rivers.

Plans are ahead in the Netherlands to give the river more space, primarily in the existing and restored winter beds. These recreated wetlands are an opportunity for the development of flood retention areas, water purification schemes, nature conservation areas and other functions provided by natural and restored wetlands.

8. MONITORING AND WETLANDS

Article 8 of the Directive requires the establishment of monitoring programmes (in accordance with Article V) in order to progressively reach a comprehensive overview of water status within each river basin district. The Directive calls for the monitoring of surface water, groundwater and Protected Areas.

	**Look Out! CIS WG 2.7 have produced a comprehensive Guidance on Monitoring to which readers are advised to refer to.**

Section 2.6 of the Guidance on Monitoring (WG 2.7) Inclusion of wetlands within the monitoring requirements of the Directive, mentions the relevance of wetlands for the achievement of the Directives environmental objectives but does not focus on wetland monitoring specifically

On the basis of characterisation and impact assessment, Member States are required to set up surveillance and operational monitoring programmes and eventually conduct investigative monitoring activities. Definitions are summarized in Ttable 12 below, and further details are described in the Guidance on Monitoring prepared by WG 2.7.

Table 12. Definitions of monitoring according to Annex V.

Monitoring	Reference	Objective	Relevance
Surveillance	Annex V, 1.3.1	- supplementing and validating the impact assessment procedure (Annex II); - the efficient and effective design of future monitoring programmes; - the Assessment of long-term changes in natural conditions; - the assessment of long-term changes resulting from widespread anthropogenic activity.	Water bodies, at risk and not at risk, of failing the objectives.
Operational	Annex V, 1.3.2	- provide information on water body status as indicated by biological and hydro-morphological quality elements.	Water bodies identified as being at risk of failing the objectives and water bodies which have undergone restoration measures.
Investigative	Annex V, 1.3.3	- to resolve unknown reasons for exceedences;- to contribute to an efficient operational monitoring programme; - to monitor accidental pollution.	Case by case

For surface waters, the results of well designed surveillance, operational and investigative monitoring programmes should help improve understanding of the relationship between the hydro-morphological quality elements (including the structure and condition of the riparian, shore and intertidal zones) and the condition of the biological quality elements. This will enable increased confidence in the results of future pressures and impacts analyses, and improvements to the design of programmes of measures.

The scope of the monitoring programmes applies to wetlands which are designated as water bodies or form part of them (see 2.3), as well as for those included in the Register of Protected Areas . Monitoring requirements concerning Protected Areas (*sensu* Annex IV) are to be carried out according to the requirements set by the specific legislation establishing each area.

Wetlands which are river, lake, transitional or coastal water bodies or form part of them (see 2.3), as well as for those identified as Protected Areas (see Chapter 5) fall within the scope of the Directive's monitoring programmes. Monitoring requirements concerning Protected Areas (*sensu* Annex IV) are to be carried out according to the requirements set by the specific legislation establishing each area. The amount of monitoring in relation to surface water bodies that is necessary will depend on the information needed to assess risks to, design measures for, and monitor the achievement of, the Directive's environmental objectives.

The monitoring of other wetlands is not required as part of the surface water monitoring programmes. However, in case of uncertainty about water body ecological status, the assessment of the ecological health and functioning of dependent wetlands may be useful in helping to evaluate the likelihood of failing to meet the Directive's objectives.

8.1 Monitoring groundwater bodies and dependent ecosystems

In order to assess groundwater status, information will be required about groundwater levels and quality needed to prevent significant damage to terrestrial ecosystems directly dependent on groundwater (Annex V.2). Once these water needs have been defined, monitoring results for groundwater levels and quality can be used to determine whether the needs of the ecosystems are being met. In many cases an investigation of the typical water requirements of different wetland types and critical species, which are not as yet clearly understood, may be needed. This will mean monitoring wetland habitats and species directly to determine their response to groundwater levels and quality variations, where suitable information to make such estimates is not already available.

Defining the groundwater needs of directly dependent terrestrial ecosystems is likely to require an initial assessment of the typical water requirements of different wetland types and critical species. In many cases, these needs are not yet fully understood. The lack of understanding means that, where a risk has been identified, a direct assessment of the condition of a terrestrial ecosystem may be required to help design appropriate measures for controlling alterations to groundwater quality and levels, and to confirm whether these measures are being effective in avoiding or remedying significant damage to the terrestrial ecosystem (see Figure 8).

Investigations of specific water requirements of individual wetlands are strongly recommended where a body of groundwater is at risk of failing its objectives because of impacts on the water needs of these ecosystems. For example, agricultural drainage disrupting surface water supply to wetlands may significantly reduce recharge in the near groundwater preventing the groundwater body from reaching its environmental objectives. This obligation depends on the potential risk of water needs not being met.

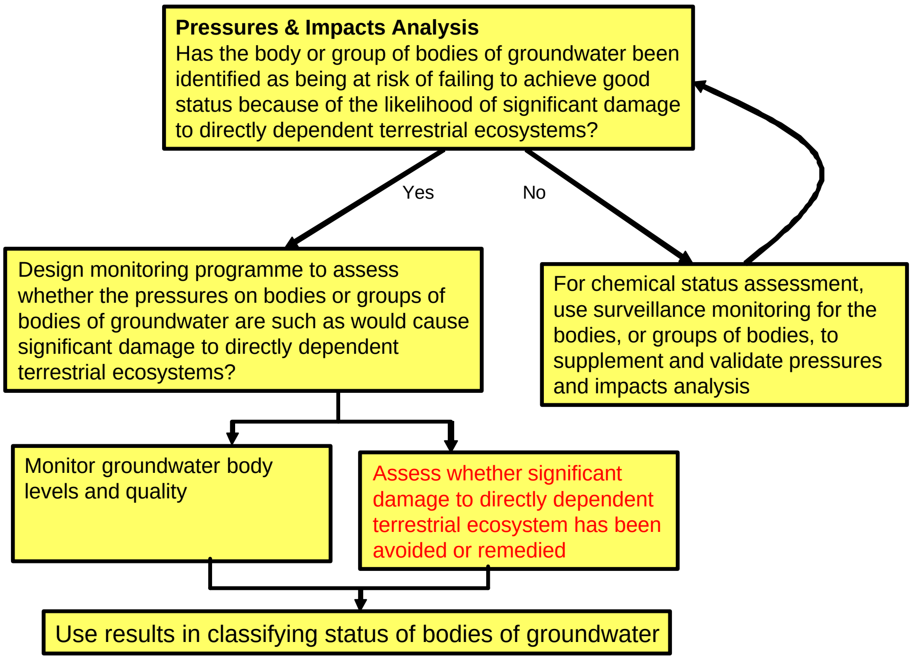


Figure 8: General principles for the design of a monitoring programme and for the assessment of status in relation to the interaction of groundwater and directly dependent terrestrial ecosystems

In the Guidance on Statistical Aspects of the Identification of Groundwater, Pollution Trends, and Aggregation of Monitoring Results (CIS WG 2.8), Annex 2, sec. 6.3, the following elements:

- depth to groundwater;
- annual groundwater level amplitude;
- hydraulic conductivity;
- recharge situation;

are listed as essential factors to be considered in the interpretation of groundwater quality data, for the characterisation of groundwater bodies or groups of groundwater bodies (as requested in WFD Annex II). These indicators are relevant to wetland function and are likely to reveal impacts on wetlands.

Collection of information is required under Annex V.1.3 of the Directive during the initial characterization and impact assessment phases for the establishment of reference conditions for surface water body types and to describe hydro-morphological quality elements for sites (including riparian, lake and inter-tidal zones) at High Status and Maximum Ecological Potential (Reference Sites). Obtaining information about wetlands may be warranted to improve the understanding of catchment system functions which is a prerequisite for a successful impact and pressures study as highlighted by the IMPRESS Guidance (3.3.2). Targeted monitoring of specific wetland characteristics and ecological processes (nutrients uptake, floodwater retention,…) within reasonable cost, is considered good practice especially in cases when links are not clear and when wetlands protection and restoration is carried out as a supplementary measure.
For water bodies at good status or good ecological potential and below, the Directive will require information about hydro-morphology, where a water body is at risk of failing its biological objectives because of impacts on these quality elements.
Although not specifically requested by the Directive, an investigation of hydrological connectivity, may be useful and could be carried out at the discretion of Member States. Case study 6 in 3.4 illustrates this point. In case of evident potential damage to dependent ecosystems or to the degree of connection between these and water bodies, detailed targeted investigations are advisable. The effort required in any assessment should be proportionate to the difficulty in understanding and managing the risks to the Directive's objectives.

9. CONCLUSIONS

Wetlands play a role in the achievement of the environmental objectives of the Directive and help in the fulfilment of the programme of measures and in its adjustment to regional and local conditions.

This guidance document introduces recommendations clarifying the role of wetlands in the river basin management process. Case studies provide an illustration of the circumstances under which Member States may choose to use wetland management measures to ensure the most environmental and cost-effective approach.

Some issues could benefit from further development and some topics should be revisited in future activities (PRB testing). Consideration to be given to:

- defining more in detail how to include wetlands in the programme of measures when preparing the programme of measures themselves;
- recognizing the diversity of wetlands in the EU and therefore understanding the different ways in which wetlands restoration may contribute to RBM;
- setting indicators for assessing the progress achieved regarding wetland restoration as part of the river basin management plan;
- defining indicators and monitoring methods to establish a relationship between wetland health and groundwater quality and quantity status;
- identifying wetlands within protected areas;
- elucidating the contribution of wetlands to the environmental cost recovery;
- investigating links between wetland management under both the WFD and the Ramsar Convention.

Finally, it is important to consider that the outcome of the wetlands guidance document testing within the Pilot River Basin Exercise could provide precious practical advice on the role of wetlands in river basin planning.

Annex I

Wetlands Working Group: group members sheet

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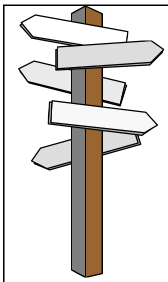
ANNEX II

Examples of wetland functions relevant to delivery of the objectives of the WFD (based on Maltby *et al.*, 1996)

Function	Article 1 – Purpose
Flood Water Detention	"mitigating the effects of floods and droughts" "water needs, (of) terrestrial and wetlands"
Groundwater Recharge	"mitigating the effects of floods and droughts" "water needs, (of) terrestrial and wetlands"
Groundwater Discharge	"mitigating the effects of floods and droughts" "water needs, (of) terrestrial and wetlands"
Sediment Retention	"protects and enhances the status of aquatic systems"
Nutrient Retention	"protects and enhances the status of aquatic systems" "reduction of pollution of groundwater"
Nutrient Export	"protects and enhances the status of aquatic systems" "reduction of pollution of groundwater"
In-situ Carbon retention	"protects and enhances the status of aquatic systems" "reduction of pollution of groundwater"
Trace Element Storage	"protects and enhances the status of aquatic systems" "reduction of pollution of groundwater"
Organic Carbon Concentration Control	"protects and enhances the status of aquatic systems" "reduction of pollution of groundwater"
Ecosystem Maintenance	"protects and enhances the status of aquatic systems"
Food web Support	"protects and enhances the status of aquatic systems"

Annex III

Recent projects financed by the European Union



Wetland functions and values have been reviewed in the 1995 *Wise Use and Conservation of Wetlands*, Communication from the Commission to the European Parliament on Wetlands. Readers are asked to consult this document for a more detailed review of these issues, as well as the following EU financed (concluded) projects:

- *Ecological-economic analysis of wetlands: functions, values and dynamics* (Project Ref: ENV4960273) 1996-1999, gives a complete assessment of wetland processes, functions and their related economic values;
- *European River Margins: role of biodiversity in the functioning of riparian systems* (ERMAS Project) (Ref: ENV4950061) 1996-1999, provides information on the processes controlling the structure and function of river margin ecosystems;
- *Dynamics and stability of reed dominated ecosystems in relation to major environmental factors that are subject to global and regional anthropogenically induced changes*, 'EUREED II', 1996-1999, (Ref: ENV4950147), importance of wetland functions and of reed beds in securing these functions (http://botanik.aau.dk/eureed/);
- *Biodiversity of micro-organisms in aquatic ecosystems,* 1996-1999, (Ref: ENV4950026), is an assessment of microbial diversity from an ecologically relevant perspective;
- *Impacts of climate change flux in freshwater ecosystems* 1998-2001, (Ref: ENV4970570) reviews the impacts of rising CO2 levels on the structure and dynamics of lake ecosystems;
- *Microbenthic communities in European Rivers used to assess effects of land-derived toxicants* 1996-1999 (Ref: ENV4960298), study on the Community effects of toxic fluxes in rivers;
- *Nitrogen cycling in estuaries* 1996-1999, 'NICE' (Ref: MAS3960048), 1996-1999, a study on the fate of anthropogenic nitrogen discharged into estuaries and coastal waters. Quantification of nitrogen removal to evaluate to what extent nitrogen is being transported from land to sea;
- *Response of European freshwater lakes to environmental and climatic change*, 'REFLECT' (Project Ref: ENV4970453), 1998-2000, a study to show the natural and anthropogenic factors influencing the dynamics of plankton in lakes in 3 climatic zones;
- *Techniques and Procedures for the Functional Analysis of Wetland Ecosystems (TECWET)*, 2003, ref: EVK1-CT-2001-80001, this study developed two publications: *A Generic Wetland Functional Evaluation Tool* and *A Generic Manuel of Wetland Investigation Approaches and Methods*;
- *Functional Analysis of European Wetlands – FAEWE*, 1991 – 1994, ref. STEP-CT90-0084