THE **N2K** GROUP
European Economic Interest Group

GUIDANCE DOCUMENT ON HYDROPOWER DEVELOPMENT AND NATURA 2000

4th draft for CGBN comments

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Guidance document on hydropower development and Natura 2000

This document reflects the view of the European Commission services and is not of a binding nature.

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INTRODUCTION

Purpose of the guidance document

Hydropower plants generate by far the largest share of electricity from renewable energy sources. Electricity generation from hydropower increased by 16 % between 1990 and 2012, even while its share of total renewable electricity generation shrank over the same period due to the more rapid expansion of electricity generation from other renewable sources[1]. As such, hydropower plays an important role in helping to meet the EU's renewable energy targets[2].

Hydropower is considered to be an environmentally-friendly source of energy, especially in view of its near zero emissions of CO_2 produced. Nevertheless, hydropower plants can also have an impact on freshwater ecosystems and can alter or damage the natural habitats and species present. The degree of influence is highly dependent on the characteristics of the hydropower plant and of the habitats and species present in the ecosystem.

This document aims to provide guidance on how to ensure activities related to the development and management of hydropower facilities are fully compliant with the provisions of the Habitats Directive[3] (92/43/EEC) and Birds Directive[4] (2009/147/EC) in particular. Other EU environmental laws, also relevant to hydropower development, are not the focus of this document, but are mentioned where appropriate.

The Habitats and Birds Directives form the cornerstones of the EU's biodiversity policy. Central to the two nature directives is the creation of a Natura 2000 network, which protects core sites for those species and habitat types listed in the Annexes. With 27,000 sites in the network to date, Natura 2000 sites cover the most valuable areas for nature protection in the EU.

Natura 2000 sites are not designed to be 'no go zones' and new developments are not excluded *a priori*. Instead any new developments must be undertaken in a way that safeguards the possibility to achieve the conservation objectives of the Natura 2000 sites which means, *a minima*, the preservation of the state of conservation[5] of the species and habitat types for which the sites have been designated.

The guidance document aims to explain various aspects of EU nature legislation in the context of hydropower and Natura 2000 and to showcase good practice examples of implementing these measures under a variety of circumstances across the EU. In particular, it offers practical advice on strategic planning and on how to carry out the

[1] *Eurostat web page on Energy from renewable sources - http://ec.europa.eu/eurostat/statistics-explained/index.php/Energy_from_renewable_sources*

[2] *EC web page on Renewable energy - http://ec.europa.eu/energy/en/topics/renewable-energy*

[3] *Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*

[4] *Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds amending the Directive 79/409/EEC*

[5] *Not to be confused with the term "favourable conservation status" explained in the chapter 2.2.*

Natura 2000 permit procedure in an efficient and effective way. It also examines various mitigation and streamlining options that can be used to ensure a smoother procedure.

The guidance document is designed principally for use by hydropower developers and authorities (responsible for the nature directives and for the spatial development of their territory) as well as for impact assessment consultants, Natura 2000 site managers and other practitioners who are involved in the planning, design, implementation or approval of hydropower plans and projects. It is hoped that it will also be of interest to potential investors in the hydropower sector as well as other river users and NGOs.

The document covers only freshwater conditions. It is not concerned with tidal and wave energy resources as they have different impacts from a conservation point of view[6].

Structure of the document

The guidance document contains eight chapters:

- **Chapters 1, 2 and 3:** provide an overview of the EU policy context as regards renewable energy deployment and EU nature legislation. It outlines the importance of hydropower in Europe and its role in meeting the Renewable Energy targets by 2020 under the Renewable Energy Directive[7] and beyond.

  It also outlines the legal provisions of the Habitats and Birds Directives that hydropower developers and authorities should be aware of, giving special attention to the permitting procedure under Article 6.3 of the Habitats Directive for any plans or projects that are likely to have a significant effect on Natura 2000 sites. Finally, it briefly explores the relationship between the Birds and Habitats Directives, the Water Framework Directive[8] (WFD), the Floods Directive[9], the EIA Directive[10] and the SEA Directive[11] and how this relates to the implementation of hydropower activities.

- **Chapter 4**: provides an overview of the different types of hydropower facilities in use in Europe and examines the potential interactions between hydropower plants and the surrounding river ecosystems. It outlines the kind of impacts they may have on habitat types and species protected within Natura 2000 sites. Being aware of these impacts will not only ensure that the impact assessment under Article 6 of the Habitats Directive is carried out correctly but should also help to identify suitable avoidance or mitigation measures that can be used to remove or reduce any significant effects on the Natura 2000 site.

[6] *Guidance document The implementation of the Birds and Habitats Directives in estuaries and coastal zones - http://ec.europa.eu/environment/nature/natura2000/management/docs/Estuaries-EN.pdf*

[7] *Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC*

[8] *Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy*

[9] *Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks*

[10] *Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 on the assessment of the effects of certain public and private projects on the environment amending the Directive 2011/92/EU*

[11] *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*

- **Chapter 5:** outlines the benefits of taking a more streamlined strategic and integrated approach to planning further hydropower development. Particular attention is paid to explaining how to develop integrated plans or projects which take account of the river's ecological processes early on in the design process and which help identify win-win solutions for both hydropower development and biodiversity wherever possible.

- **Chapter 6:** provides a practical step by step guide to the permitting procedure under Article 6 of the Habitats Directive for any plans or projects that are likely to have a significant effect on Natura 2000 sites. It practical provides advice and guidance on how to apply this permit procedure in the context of hydropower in particular.

- **Chapter 7:** describes the process of identifying appropriate mitigation measures. It also highlights the potential ecological benefits and win-wins solutions that could be derived from modernising and upgrading already existing hydropower installations and looks at the obligations of existing hydropower plants to ensure non-deterioration of the rivers and their biodiversity under both the WFD and the EU Nature Directives.

- **Chapter 8:** looks at the issue of already existing hydropower plants in and around Natura 2000 and how the provisions of the Habitats and Birds Directives apply to them. It also examines the potential for significant win-wins when modernising old hydropower plants.

Throughout the document, good practice examples are given to show how hydropower and EU nature legislation have been reconciled in practice. They provide a useful source of information based on the practical experience of different actors from across the EU.

Limitations of the guidance document

The document is not legislative in character but rather provides guidance on the application of already existing rules. As such, it reflects only the views of the Commission services. It rests with the European Court of Justice to provide definitive interpretation of EU directives. Wherever relevant, existing case law has been included. The document complements the Commission's existing general interpretative and methodological guidance documents on Article 6 of the Habitats Directive[12]. It is recommended that these guides are read in conjunction with the present document.

Finally, the document fully recognises that the two nature directives are enshrined in the principle of subsidiarity and it is for Member States to determine how best to implement the procedural requirements arising from the directives. The good practice procedures and proposed methodologies described in this document are therefore not prescriptive in their intent; rather they aim to offer useful advice, ideas and suggestions based on feedback and input from competent authorities, energy business representatives, NGOs and other experts and stakeholders.

The Commission would like to thank all those from Member States and key stakeholder groups who provided their valuable contributions during the preparation of the guidance document.

[12] *Managing Natura 2000 sites. The provisions of Article 6 of the Habitats Directive 92/43/EEC; Assessments of plans and projects significantly affecting Natura 2000 sites - methodological guidance on the provisions of Article 6.3 and 6.4 of the Habitats Directive 92/43/EEC; Guidance document on Article 6.4 of the Habitats Directive 92/43/EEC - http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm.*

1. HYDROPOWER IN THE EU

1.1 The EU Policy framework for promoting renewable energy sources

In 2009, the EU adopted an ambitious and far-reaching 'climate and energy package' to make the European economy less dependent on imported energy sources and to reduce greenhouse emissions. One of the targets is to increase the share of energy from renewable sources so that they represent at least 20% of Europe's gross energy consumption by 2020.

Directive 2009/28/EC on the promotion of the use of energy from renewable sources (**Renewable Energy Directive**[13]) establishes a common EU framework for the production and promotion of energy from renewable sources and sets mandatory national targets for the overall share of energy from renewable sources.

To meet these targets Member States are required to prepare National Renewable Energy Action Plans (NREAPs) which set out how they intend to increase the share of energy from renewable sources in their final energy consumption by 20% by 2020. Countries are free to choose their own specific mix of renewable energy sources, whether, for instance, from hydropower, wind or solar power, geothermal energy or biomass. The National Renewable Energy Action Plans should also take into consideration other energy efficiency measures to lower the overall energy consumption.

In 2014, the European Council approved the European Commission's proposals for a 2030 climate and energy framework for a competitive, secure and low-carbon EU economy. It endorsed:

- a binding target to reduce EU domestic greenhouse gas emissions by at least 40% below the 1990 level by 2030;
- a share of renewable sources in final energy consumption of at least 27% in 2030. This target will be binding at EU level;
- an indicative energy efficiency target of 27% to be reviewed in 2020 having 30% in mind.

1.2 The benefits of hydropower in the EU energy mix

The operation of hydropower plants is relatively cheap in comparison with other sources of renewable electricity because of the relatively low construction cost and the long economic life of the installations and sometimes also because environmental costs are not internalised. It represents a flexible source of electricity because hydropower plants can react very quickly (within milliseconds) and adapt to balance supply and demand.

[13] *Available at http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32009L0028*

As the share of electricity supply from variable renewable energy sources such as wind or solar power increases, this flexibility becomes increasingly important. Losses during transmission of electricity from hydropower are also often lower due to the short distances between supply and demand. Moreover, being an indigenous source of energy, hydropower can also help to reduce Europe's energy dependency from external sources, thus contributing further to security in terms of energy supply.

1.3 Development of hydropower in the EU

Hydropower is one of the most important forms of renewable energy in the EU generating by far the largest share of electricity from renewable energy sources overall. The gross electricity generation from renewable energy sources in the EU-28 between 1990 and 2012 is illustrated in Figure 1, the electricity generation from hydropower increased by 16 % during this period[14] (before it increased ca. four times since 1965 to 1990). The majority of hydropower plants have been installed to fulfil public electricity needs, but some plants are also designed to serve the energetic needs of specific industrial enterprises as well.

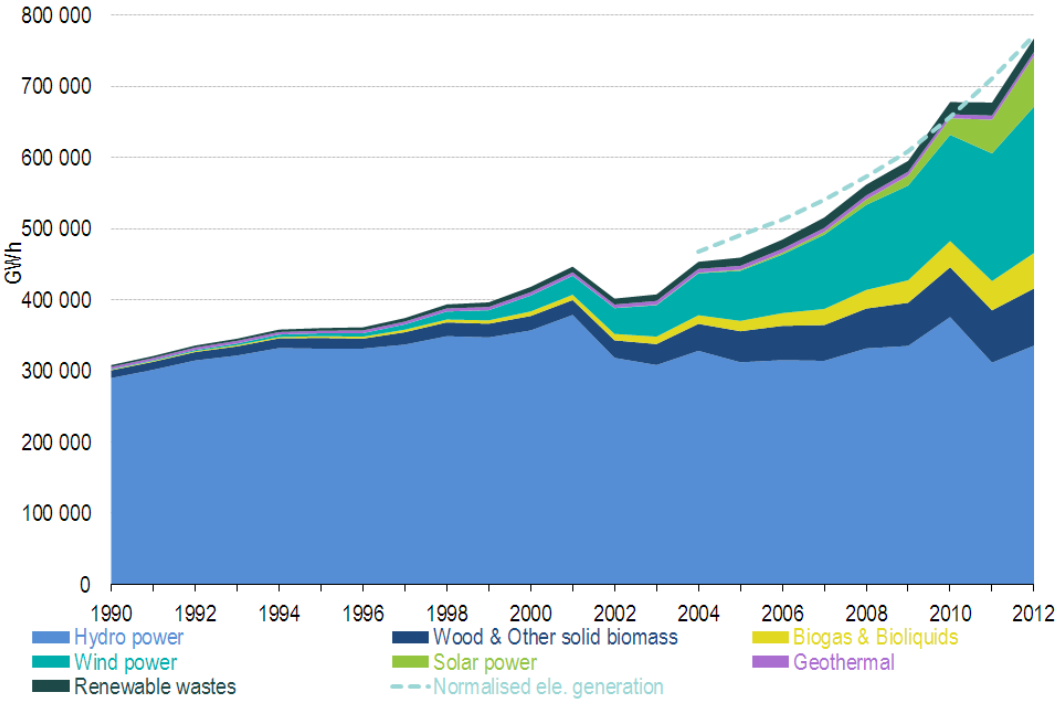

Figure 1: The gross electricity generation from renewable energy sources in the EU-28 (Eurostat online Supply, transformation, consumption - electricity - annual data)[15]

[14] *Eurostat web page on Energy from renewable sources*
- *http://ec.europa.eu/eurostat/statistics-explained/index.php/Energy_from_renewable_sources*

[15] *Eurostat online data - code (nrg_105°)*
- *http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_105a&lang=en*

Box 1: Opportunities for development of hydropower in Rhône-Alpes

Purpose of the case: demonstration of French approach for estimation of hydropower potential (taking into account environmental limitations and restrictions) / France

Although most of the hydropower potential in France has been exploited many years ago, there is still the potential to improve and expand this potential in the future. Future growth prospects must however incorporate environmental regulations to ensure that the quality of water bodies will not be impacted. Hydropower potential can be divided into three types of potential:

A - Potential in over-equipment, optimization/modernization or adaptation of residual flow of existing hydropower plants
The assessment was made through a census of professionals on specific sites that may be subject to over-equipment, optimization or adaptation of residual flow. The impact of environmental standards was also evaluated. The upgrading of existing structures is in particular based on raising the minimal residual flow. This upgrading also concerns the structures on the rivers where it is necessary to restore ecological continuity (fish migration and sediment transport).

The loss of production due to the increase of residual flow is calculated for the Rhône-Alpes region to be nearly 1 TWh/year. This value is an estimation based on the data transmitted by the operators. The loss of hydropower production was estimated in proportion to the regional energy production of these facilities and the minimum flow of hydropower plants under the concession.

By 2020, identified improvements of existing plants could represent 160 MW, i.e. an increase of approximately 300 GWh/year. It represents approximately 1% of annual theoretical production. Five hydroelectric concessions have to be renewed in 2020 and about thirty more will be completed by 2030 with a grant from the National Hydroelectric Company of the Rhone which accounts for nearly 40% of the production of the Rhône-Alpes region.

It is difficult to quantify the potential productivity gains from these plants considering the trade-offs that must be made in relation to other issues. However a gain of 2% to 5% of production capacity can be assumed given the technical progress made in recent years. The energy optimization of hydropower concessions would gain production of approximately 24-60 GWh/year in 2020 and 298-745 GWh/year in 2030, given the higher number of substantial improvements.

B - Potential in new development (increase of production by the creation of new facilities)
For the Rhône-Alpes region, the residual theoretical annual hydropower energy production is about 9 TWh on streams with a flow higher or equal to 200 l/s according to the classification grid:
· 40% non-feasible;
· 30% very difficult to implement;
· 8% feasible under certain conditions;
· 22% feasible.
The potential at the regional level is about 3 TWh of production feasible or feasible under certain conditions. This regional distribution varies depending on the department.

C - Potential in peak production capacity of pumped-storage hydropower plants (without creating new plants)
Achieving a new large project of a pumped-storage hydropower plant seems difficult to consider in light of environmental issues in the Rhône-Alpes region. However, some projects could be developed on smaller power ranges of about 200 MW to 400 MW.

Source:
http://srcae.rhonealpes.fr/static/cms_page_media/24/comite_technique_hydroelectricite_VERSION_FINALE.pdf

There are significant **differences between EU countries** in terms of the extent to which hydropower is used in their energy mix. This is highly influenced by geographic conditions, climate, precipitation patterns, the availability of affordable energy supply alternatives, as well as institutional capacities and technical competences. For instance, in the relatively mountainous countries of Austria, Slovenia and Croatia more than a third of the renewable energy is from hydropower.

The EU's recent national renewable energy action plans point to an increase in hydropower production in 2010-2020 of around 8% (25TWh). The increase in pumping hydropower by 2020 is expected to be higher, by around 35% (8,6TWh). Part of this increase will come from the refurbishment of old installations. However, the growth of other renewables could see the overall contribution of hydropower to renewables electricity production fall. Certain countries plan an increase in electricity production from hydropower by 2020 (PT, FR, AT, DE, FI, IT, SI, SK, PL, BE, LU whereas other countries may see the electricity production from hydropower drop by 2020 (SE, RO, CZ, LV).

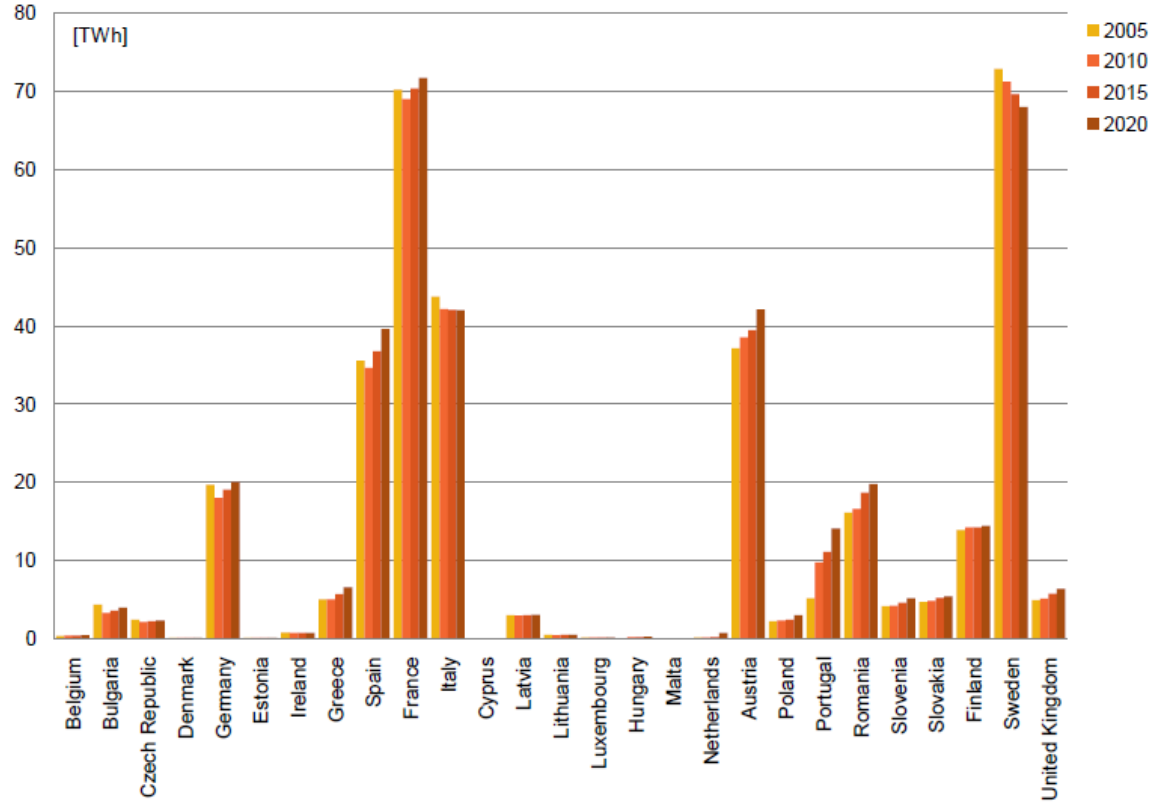

Figure 2: Projected total hydropower electricity generation (TWh) for the period 2005-2020, all capacity ranges excluding pumped storage) based on National Renewable Energy Action Plans EEA 2011[16]

Most of the European hydropower energy comes from large conventional, reservoir-based plants capable of balancing seasonal as well as intra-day fluctuations. The second most common type is run-of-river plant (definition of hydropower plant types is in the Chapter

[16] *EEA (2011): Renewable Energy Projections as Published in the National Renewable Energy Action Plans of the European Member States - http://www.eea.europa.eu/data-and-maps/figures/national-renewable-energy-action-plan/nreap_draft_report_eea-ecn_20100830.pdf*

4.3).[17] Around **23.000 hydropower installations** have been recorded in the European Union in 2011, the vast majority (91%) are small and generate around 13% of the total production. On the other hand, the large hydropower plants represent only 9% of all hydropower facilities but generate about 87% of the total production as illustrated on following Figure 3[18].

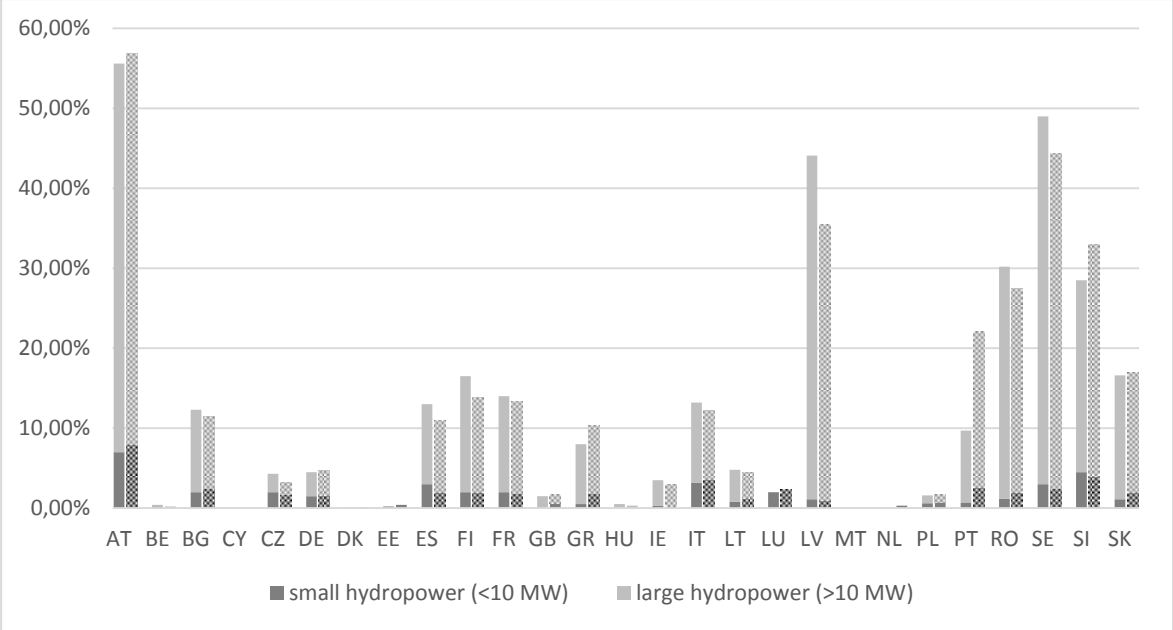

Figure 3: Contribution of large and small hydro power plants to the total of electricity generation in 2005 and 2020 - situation from 2005 fully coloured, prediction for 2020 hatched (based on data from Arcadis 2011: Hydropower generation in the context of the EU WFD)

[17] *Strategic Energy Technologies Information System - http://setis.ec.europa.eu/technologies/Hydropower/info*

[18] *Arcadis 2011: Hydropower generation in the context of the EU WFD. EC DG Environment. 168 pp. See also Water management, Water Framework Directive & Hydropower. Common Implementation Strategy Workshop" (2011)*

2. AN INTRODUCTION TO EU NATURE LEGISLATION

Some hydropower plans and projects may potentially affect one or more Natura 2000 sites in the EU Natura 2000 network or may have an impact on certain rare and threatened species protected under EU nature legislation. The Habitats and Birds Directives lay down the provisions that need to be respected in such cases.

A general overview of these provisions is provided in this chapter. Later on, in chapter 6, a more detailed explanation of the specific elements of the Natura 2000 permitting procedure under Article 6.3 is provided, as it relates to hydropower plans or projects in particular.

2.1 The EU Policy framework for biodiversity

Like renewable energy, **halting the loss of the EU's biodiversity** is high on the political agenda. In March 2010, the EU Heads of State and Government set themselves the ambitious target of halting, and reversing, the loss of biodiversity in Europe by 2020. In May 2011, the European Commission adopted a new **EU Biodiversity Strategy to 2020**[19] which sets out a policy framework for achieving this.

Halting the loss of the EU's biodiversity is identified as one of the key operational objectives of the EU Sustainable Development Strategy (SDS)[20], the 7th Environment Action Programme (EAP)[21] and the EU Framework Programme for Research and Innovation (Horizon 2020)[22] and is recognised as an important element of the Europe 2020 Strategy[23], calling for a smart, inclusive and sustainable growth policy that takes account of the important socio-economic benefits that nature provides society.

2.2 The Birds and Habitats Directives

The Birds and Habitats Directives are the cornerstones of the EU's nature and biodiversity policy. They enable all 28 EU Member States to work together, within a common legislative framework, to conserve Europe's most endangered and valuable species and habitats across their entire natural range within the EU, irrespective of political or administrative boundaries.

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[19] *see http://ec.europa.eu/environment/nature/biodiversity/comm2006/2020.htm*

[20] *Renewed EU Sustainable Development Strategy (2006) - http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2010917%202006%20INIT*

[21] *EC web page on Environment Action Programme to 2020 - http://ec.europa.eu/environment/newprg/*

[22] *EC web page on Horizon 2020 - http://ec.europa.eu/programmes/horizon2020/*

[23] *EC web page on Europe 2020 - http://ec.europa.eu/europe2020/index_en.htm*

The overall objective of the two directives is to ensure that the species and habitat types they protect are **maintained and restored to a favourable conservation status**[24] throughout their natural range within the EU. This target is defined in positive terms, oriented towards a favourable situation, which needs to be reached and maintained. It is therefore more than just avoiding deterioration.

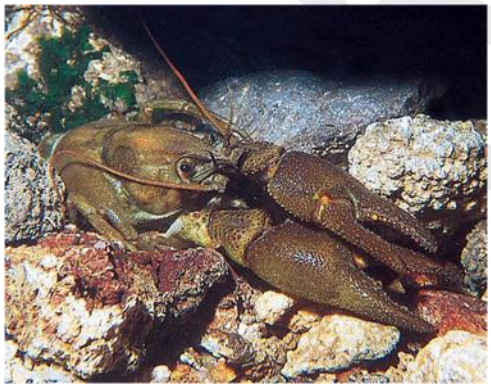
To achieve this objective, the EU Nature directives require Member States to implement two main types of measures:

- The **designation and conservation of core sites** for the protection of species and habitat types listed in Annex I and II of the Habitats Directive and Annex I of the Birds Directive, as well as for all migratory birds. These sites make up the EU-wide **Natura 2000 Network**;
- The **establishment of a species protection regime** for all wild European bird species and other endangered species listed in Annex IV of the Habitats Directive. These measures apply across the species' entire natural range in the EU, i.e. also outside protected sites such as Natura 2000.

2.3 The Natura 2000 Network

To date, **over 27,000 sites** have been designated as Natura 2000 sites. Together they cover around 18% of the land area in the EU-28 as well as significant marine areas[25].

Lake and river ecosystems cover around 4% of the surface of Natura 2000 (EEA, 2010). They have been designated for a range of freshwater habitat types and species listed in the two nature directives. including species such as the Atlantic salmon (*Salmo salar*), otter (*Lutra lutra*) or kingfisher (*Alcedo atthis*) as well as lesser known species such as the white-clawed crayfish (*Austropotamobius pallipes*), the thick-shelled river mussel (*Unio crassus*) or the European river lamprey (*Lampetra fluviatilis)*.`

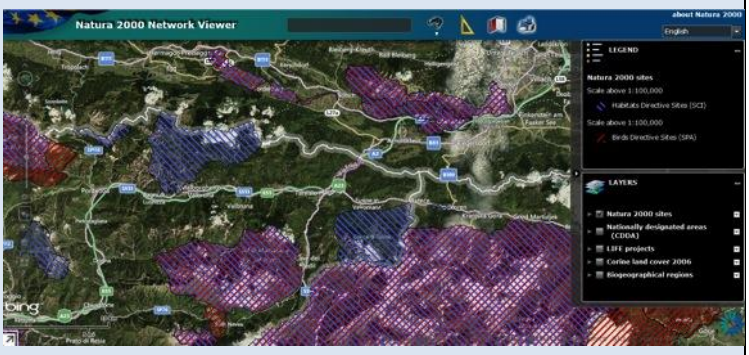


They have also been designated for a number of threatened types of water courses (like water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation) and associated habitats such as alluvial forests, wet meadows, humid grasslands and fens. The groups of habitats and species that are most likely to be affected by hydropower activities are presented further in Chapter 4.4 and Annex 1.

[24] *The concept of "favourable conservation status" is not mentioned in the Birds Directive but there are analogous requirements for SPAs.*

[25] *There is sometimes considerable overlap between SPAs and SCIs so the figures are not cumulative.*

Box 2: THE NATURA 2000 VIEWER: a useful tool for developers
http://natura2000.eea.europa.eu/



The Natura 2000 viewer is an on-line GIS mapping system that enables developers to locate and explore each Natura 2000 site in the EU Network. The sites can be examined at a very fine scale (1:500). This shows the boundaries of the site and its main landscape features at a very high resolution. For each site, a Standard Data Form (SDF) can be downloaded which lists the species and habitat types for which it was designated, as well as their estimated population size and conservation status on the site, and the importance of that site for the species or habitat type.

2.4 The protection and management of Natura 2000 sites

The protection and management of Natura 2000 sites is governed by the provisions of Article 6 of the Habitats Directive, which also determines the relationship between the sites' conservation and other land-uses, such as hydropower, in and around the area.

Article 6 is divided into two types of measures – the first (governed by Article 6.1 and 6.2) concerns the **conservation management** of the sites and applies to all Natura 2000 sites at all times, whilst the second (governed by Article 6.3 and 6.4) lays down a **permit procedure** for plans or projects likely to have a significant negative affect on a Natura 2000 site.

It is clear from this Article that in principle Natura 2000 are not 'no-go zones for development'. New plans and projects are entirely possible provided certain procedural and substantive safeguards are respected. The permitting procedure is in place to ensure that such plans and projects are implemented in a way that is compatible with the conservation objectives of the Natura 2000 sites.

2.4.1. Taking positive conservation measures and ensuring non-deterioration

Articles 6.1 and 6.2 require Member States to:

- **Take positive conservation measures** that are necessary to maintain or restore habitat types and species for which the site has been designated (Article 6.1);
- Take measures to **avoid any deterioration** of habitat types or any significant disturbance of the species present (Article 6.2).

As can be seen, Article 6.1 is about the need to take active measures to improve or restore the state of conservation of the EU protected species and habitats on the site whereas Article 6.2 sets an overall obligation to ensure non deterioration of the site.

In respect of the former, Member States are encouraged to set clear **conservation objectives for each Natura 2000 site** based on the conservation status and ecological requirements of the habitat types and species of EU interest present. This not only

provides a clear and transparent target to aim for as regards the conservation of the site in question but also makes it easier to identify the practical measures required to reach that objective and to determine the role of the site in achieving the wider objective of reaching a Favourable Conservation Status for species and habitat types across their entire natural range in the EU[26].

Being aware of the conservation objectives for a Natura 2000 site is particularly important for hydropower developers, planners and authorities as the potential negative effects of the plan or project will need to be assessed against these conservation objectives.

These conservation objectives are most likely summarised in the sites' Natura 2000 management plans, where they exist. Although not obligatory, the Habitats Directive encourages nature authorities to elaborate Natura 2000 **management plans** in close cooperation with local stakeholders and land owners concerned. These can also be a very useful source of information for other sectors, including for hydropower operators as they usually provide detailed information on the species and habitat types for which the site has been designated, explain the site's conservation objectives and, where appropriate, the relationship with other land-uses in the area.

For sites where no explicit conservation objectives have been set yet, the non-deterioration obligation under Article 6.2 can be considered as a general protection framework for each Natura 2000 site. In other words the potential negative effects of the plan or project will need to be assessed against their baseline status at the time when the site was either classified (SPAs) or submitted to the Commission as a proposed Site of Community Importance (pSCIs).

It also means that any existing hydropower facility, which is negatively affecting the maintenance of species´ population or habitat type for which the site has been designated, will need to be adapted to ensure that it will not cause any further deterioration of the habitat or species present in that site. This could be achieved through measures involving, for instance, the renovation of existing facilities and the use of more environmentally-friendly technologies (see chapter 7.2 for more details).

2.4.2. The permit procedure for plans and projects affecting Natura 2000 sites

Articles 6.3 lays down the permit procedure that must be followed when a plan or project is proposed that **could affect one or more Natura 2000 sites** (NB this section is just a first brief introduction to the permit procedure, see chapter 6 for full details). The Habitats Directive does not define the terms 'plan' or 'project'. However, the EIA Directive 2011/92/EU defines a project as "*the execution of construction works or of other installations or schemes; other interventions in the natural surroundings and landscape including those involving the extraction of mineral resources*" (Article 1.2 (a)).

Such a definition of a project is also relevant to defining the concept of plan or project in the Habitats Directive, which, seeks, as does the EIA Directive, to prevent activities which

[26] *The European Commission has issued two notes on setting conservation objectives for Natura 2000 sites and guidance document on establishing conservation measures for Natura 2000 sites to ensure a better understanding of these provisions*
- *http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/commission_note2.pdf*
- *http://ec.europa.eu/environment/nature/natura2000/management/docs/conservation%20measures.pdf*

are likely to damage the environment from being authorised without prior assessment of their impact on the environment (Case C-127/02).

The permit procedure is applicable to plans or projects both inside a Natura 2000 site and those outside where they could have a significant effect on the conservation of the EU protected species and habitats within the site. For instance a project proposing to construct a hydropower plant upstream might alter the habitat conditions of an important wetland for birds within an SPA further downstream in which case that project would also need to go through the Article 6 permitting procedure (see chapter 6 for details).

It should also be noted that the Article 6.3 must always be done on a **case by case basis** since no Natura 2000 site or hydropower plan or project is exactly the same. The potential impacts will be strongly dependent on the interaction between the detailed characteristics of the project and the specific ecological requirements of EU protected habitats and species on the site.

In essence, the permit procedure under article 6.3 requires that any plan or project that is likely to have a significant negative effect on a Natura 2000 site undergoes an **appropriate assessment** (AA) to study these effects in detail, in view of that particular site's conservation objectives.

The competent authority can only agree to the plan or project if, based on the findings of the AA, it has ascertained that it will not have an adverse effect on the integrity of the site concerned. It is important to note that the onus is on demonstrating the absence (rather than the presence) of significant negative impacts.

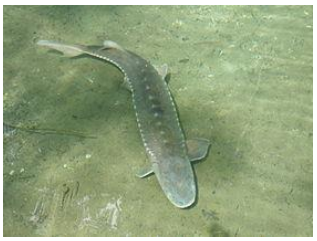
Of course, it may be possible to further adjust the plan or project and/or introduce certain **mitigation measures** in order to avoid, remove or reduce these potential impacts to a non-significant level so that the plan or project may be approved. But if this is not the case, then the plan or project cannot be approved and alternative less damaging solutions will need to be explored instead.

Nevertheless, in exceptional circumstances, a derogation under Article 6.4 may be invoked to approve a plan or project having an adverse effect on the integrity of one or more Natura 2000 sites if it can be demonstrated that there is an absence of alternatives *and* the plan or project is considered to be necessary for **imperative reasons of overriding public interest.** In such cases, adequate compensation measures will need to be put in place to ensure that the overall coherence of the Natura 2000 network is protected.

Finally, it is important to note that the permit procedure under the Habitats Directive is not the same as that foreseen under the EIA or SEA Directives[27] even if they may be integrated (see the Chapter 3.4 for details). Unlike the EIA/SEA assessments, the result of which needs to be taken into consideration when deciding to approve the plan or project, the conclusions of the AA will condition the authorization of the project.

[27] *EC web pages on EIA and SEA - http://ec.europa.eu/environment/eia/eia-legalcontext.htm and http://ec.europa.eu/environment/eia/sea-legalcontext.htm*

2.5 Species protection provisions



The second set of provisions of the two EU nature directives concerns the protection of certain species across their entire range within the EU, i.e. both **within and outside Natura 2000 sites**. These provisions may also need to be taken into account for certain hydropower plants, especially on rivers harbouring **protected freshwater species that are highly migratory** such as the European sea sturgeon (*Acipenser sturio*), or anadromous populations of houting (*Coregonus oxyrhynchus*) in certain areas of the North Sea.

The provisions also apply for all naturally occurring wild bird species in the EU and for species listed in Annex IV of the Habitats Directive. The exact terms are laid down in Article 5 of the Birds Directive and Article 12 (for animals) and Article 13 (for plants) of the Habitats Directive[28].

In essence they require Member States to prohibit, for these species:

- deliberate disturbance during breeding, rearing, hibernation and migration;
- deterioration or destruction of breeding sites or resting places;
- deliberate destruction of nests or eggs, or the uprooting or destruction of protected plants.

When planning hydropower developments it is important to be aware of these obligations outside Natura 2000 sites. Hydropower development almost always changes the riverine habitat of a species and often has direct impacts on animal populations, inside and outside Nature 2000 alike. The use of appropriate technology might help avoid such significant impacts, but it is sometimes more appropriate to simply avoid highly sensitive areas altogether through careful strategic spatial planning at the outset (see chapter 5 for more details).

Derogations to the species protection provisions are allowed in some circumstances (e.g. to prevent serious damage to crops, livestock, forests, fisheries and water) provided that there is no other satisfactory solution and the consequences of these derogations are not incompatible with the overall aims of the Directives. The conditions for applying derogations are set out in Article 9 of the Birds Directive and Article 16 of the Habitats Directive[29].

With reference to hydropower, it is primarily reasons related to 'the interests of public health and public safety', or for 'other imperative reasons of public interest' (Article 16.1c) that might apply.

[28] *Guidance document on the strict protection of animal species of Community interest under the Habitats Directive - http://ec.europa.eu/environment/nature/conservation/species/guidance/index_en.htm*

[29] *see Commission Guidance document on the strict protection of animal species of Community interest under the 'Habitats' Directive 92/43/EEC - http://ec.europa.eu/environment/nature/conservation/species/guidance/index_en.htm*

3. THE RELATIONSHIP BETWEEN THE BIRDS AND HABITATS DIRECTIVES AND THE WFD, FLOODS, EIA AND SEA DIRECTIVES

A number of other EU environmental laws are directly relevant to hydropower installations. They concern in particular the WFD, the Floods Directive, the EIA Directive and the SEA Directive. Whilst the focus of this guidance is primarily on the Habitats and Birds Directives, the present chapter gives a brief overview of how the nature directives interact with these other EU environmental laws in the context of hydropower facilities in particular.

In view of the multifunctional character of rivers in general, there is considerable merit in having a coordinated approach to their management and development, especially in relation to the implementation of EU environmental laws and the EU's wider biodiversity Strategy objectives as regards ecosystems restoration and the provision of a wider Green Infrastructure for Europe.

3.1 Links between the WFD and the Birds and Habitats Directives[30]

There are strong links between the WFD and the Birds and Habitats Directives. Both operate at least in part on the same environment. They also have broadly similar ambitions in terms of aiming to ensure the non-deterioration of rivers and enhancing the ecological condition of aquatic ecosystems. There are clear references in the WFD to the Birds and Habitats Directives, which ensure full cross compliance between them (Articles 4.1.c, 4.2, 4.8, 4.9, Article 6 and Annex IV, Article 8 and Annex V (1.3.5), Article 11.3.a, and Annexes VI and VII of the WFD). The following are of particular note:

- Article 6 calls on Member States to establish a **register of all areas** lying in each river basin district which have been designated as requiring special protection under specific Community legislation for the protection of their surface water and groundwater or for the conservation of habitats and species directly depending on water. This includes relevant Natura 2000 sites designated under the Birds and Habitats Directives. Maps of these areas should be included in the river basin management plan.
- Article 8: requires that programmes be established for **monitoring water status** within each river basin district. As the Birds and Habitats Directives also require monitoring of the status of the species and habitat types they protect, these programmes should be coordinated wherever possible so they can be mutually supportive of one another.
- Article 11, outlines the contents of the **programme of measures** and states that measures should be included for the implementation of the Birds and Habitats Directives in so far as these measures are needed for those protected species and habitats, covered by the two directives, which are directly dependent on water. In other

[30] *for further details see the Commission FAQ on the links between WFD and Nature directives - http://ec.europa.eu/environment/nature/natura2000/management/docs/FAQ-WFD%20final.pdf*

words, conservation measures for Natura 2000 sites should be integrated into the Programme of Measures within the RBMP, even when they impose stricter conditions (see below). The fact that the WFD sets a deadline of 2015 for achieving "good ecological status" provides added impetus for an early implementation of conservation measures under the Birds and Habitats Directives.

Box 3: River basin management plans (RBMP) and Natura 2000

Purpose of the case: Linking habitats to conserve Danube fish

Integrated approaches are central to the RBMP initiative, which promotes joined-up planning and harmonised action in riparian habitats. Several LIFE projects are actively involved in supporting such co-ordinated RBMP activities, a good example of which is demonstrated by the results of a recently completed LIFE project on the Danube, in Austria.

The Danube and its tributaries are one of the most important waterway systems in the EU, and a large number of natural hydrological features in the Danube basin have been altered to help strengthen their socio-economic potential. However, the impacts of these interventions can have negative effects on fish or other species that rely on the rivers for migration and spawning.

Austrian nature conservation partners involved in the development of the Danube RBMP identified a programme of actions to help improve habitat conditions for protected fish species. As part of this wider RBMP programme, LIFE support was awarded to a river management project which involved restoring natural habitat conditions at the mouth of the Ybbs and establishing a fish pass (bypass) around the Melk hydo-power station in lower Austria. Both parts of the LIFE's 'Donau-Ybbs Linkage' project have been highly successful. The fish path now enables fish to migrate once again past the station, and opens up a river continuum of 22 km on the Danube, plus 13 km on the Ybbs.

These outcomes complement the actions of two other LIFE projects operating in the vicinity, which aim to improve habitat over a 90 km stretch of the river. Endangered species, including zingel (*Zingel zingel*), streber (*Zingel streber*) and schraetzer (*Gymnocephalus schraetzer*), are among the fish that have already been recorded using the 2 km-long LIFE-funded bypass. High-tech engineering solutions ensure a dynamic flow of water through the meandering channel, which has been constructed from natural materials – some 5 000 willow trees were planted on the banks.

The new fish migration route is supplemented by activities at the mouth of the Ybbs to improve fish spawning areas. Here natural hydrological functions have been restored by removing infrastructure that previously controlled the Ybbs' merger with the Danube. Results from the project actions allowed the two rivers to re-create a natural confluence containing a diversity of habitat structures. This new delta has already been colonised as a spawning ground by Danube fish, including protected species like the Danube roach (*Rutilus pigus*), as well as by birds and mammals such as Common sandpiper (*Actitis hypoleucos*), kingfisher (*Alcedo atthis*), beaver (*Castor fiber*).

LIFE's Donau-Ybbs Linkage project demonstrates the type of synergies that can be achieved by co-ordinated planning of different conservation actions in EU river basins. This example of good practice in Austria is first of hopefully many more throughout Europe to result from RBMPs.

Source: *EC presentation of the Best LIFE Nature projects 2009*
- *http://ec.europa.eu/environment/life/publications/lifepublications/bestprojects/documents/bestnat09.pdf*

3.2 Key distinctions between WFD and that Habitats Directives

There are also a number of key distinctions between the three directives that are important to be aware of. The most relevant are described below.

3.2.1 Different environmental objectives but a coordinated approach

The first, most important distinction is that, whilst the WFD, Birds and Habitats Directives apply to similar environments, they have different objectives. The WFD aims to protect and enhance all surface waters and groundwater so that they reach a good status as a rule by 2015. The Birds and Habitats Directives, on the other hand, aim to protect, maintain and restore specific species and habitat types within these waters and to bring them up to a favourable conservation status across their natural range within the EU.

So whilst the WFD may make a significant contribution to the implementation of the Birds and Habitats Directives and vice versa they have different legal requirements. This is reflected in Article 4.1.c of the WFD which recognises that the WFD objective may need to be complemented by additional measures in order to ensure that the conservation objectives for protected areas are achieved.

For instance, if a Natura 2000 site is designated because of the presence of otters, additional measures on top of those required for achieving good ecological status of the water body may also be necessary in order to conserve the species, eg to regulate overfishing, protect the species from disturbance, or restore and defragment its habitat. These measures are not relevant for fulfilling the objectives of the WFD as they do not contribute to achieving 'good ecological status' but they are directly relevant to the Habitats Directive as they are intended to help the species reach a favourable conservation status across its range.

This is further re-enforced by Article 4.2 of the WFD which states that '*where more than one of the objectives […] relates to a given body of water, the* ***most stringent shall apply'***. This allows for situations where the two objectives affect the same aspect of water quality but where, for instance, the Habitats and Birds Directives require more stringent measures than are foreseen under the WFD to meet their conservation objectives. This needs to be decided on a case by case basis.

3.2.2 Good ecological status and favourable conservation status

The objectives of each directive are also judged on different criteria. In the case of the Habitats Directive "success" is measured according to whether a protected species or habitat has reached **a favourable conservation status**. In the case of the WFD, success is measured, inter alia, according to whether the surface water bodies within a river basin district reach **good ecological status (or potential),** and good chemical status and if the groundwater bodies have reached good quantitative and chemical status.

As the table below illustrates the WFD takes account of the composition and abundance of a wide range of aquatic species (phytoplankton, aquatic flora, benthic invertebrates and fish fauna) as well as of hydro-morphological quality elements, the chemical and physico-chemical conditions (which includes the specific pollutants at national level). But it won't necessarily take specific account of riverine species protected under the Birds and Habitats Directives, such as the kingfisher or European pond turtle or beaver, if they are not considered 'indicators' of water quality.

Box 4: Good ecological status versus favourable conservation status?

The good ecological status of a river under the WFD is determined by a number of factors:
(a) biological elements:
- the composition and abundance of aquatic flora;
- the composition and abundance of benthic invertebrate fauna;
- the composition, abundance and age structure of fish fauna;

(b) hydromorphological elements supporting the biological elements:
- the quantity and dynamics of river flows;
- connection to groundwater bodies;
- river continuity;
- river depth and width variation;
- structure and substrate of the river bed;
- structure of the riparian zone;

(c) chemical and physico-chemical elements supporting the biological elements:
- thermal conditions, oxygenation conditions, salinity, acidification status, nutrient conditions;
- specific pollutants identified at national level.

These are all key elements of a healthy functioning riverine ecosystem but they do not include the assessment of the status of specific species or habitat types listed under the Birds and Habitats Directives present in the water body. Only if such a species is an essential part of the biological elements (e.g. a dominant fish species) will it also influence the ecological status of the water body.

In the same way the Habitats Directive only measures favourable conservation status on the basis of features such as range, area, population size and structure and functions of the habitats or species for which the site is designated – not the aquatic community in general.

In the case of a species protected under the Habitats Directive, a favourable conservation status is achieved when the species:
- has a stable population that is maintaining itself on a long term basis as a viable component of its natural habitats;
- the natural range of the species is neither reduced nor likely to be reduced in near future;
- there is and probably will continue to be, a sufficiently large habitat to maintain its populations in the long term.

In the case of habitat types protected under the Habitats Directive, a favourable conservation status is achieved when:
- its natural range and areas it covers within that range are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of both habitat types and species is determined at biogeographical level (i.e. not at the level of each individual site or water body).

3.2.3 Heavily modified water bodies or artificial water bodies and Natura 2000

According to Article 4.3 of the WFD, some water bodies that are heavily influenced by human activities may be designated as heavily modified water bodies (HMWB) or as

artificial water bodies (AWB) if they are newly created by human activities.[31] The situation varies widely between Member States. For these water bodies the objective is to achieve good ecological "potential" rather than "status".

But how does this relate to the Birds and Habitats Directives? Again, it is important to bear in mind that the three directives have different objectives. Even though a site is designated as a HMWB or AWB, it may still be designated under Natura 2000. This means that conservation measures will need to be taken to ensure the EU protected species and habitat types present are maintained or restored to a favourable conservation condition, even if these measures are stricter than those required for achieving "good ecological potential" under the WFD. This is in line with Article 4.2.

3.2.4 Assessing new developments under the WFD: a comparison with the appropriate assessment under the Birds and Habitats Directives

According to Article 4(7) of the WFD, exemptions can be made for new modifications and sustainable human development activities that result in the deterioration of the status of the water body or prevent the achievement of good ecological status or potential, or good groundwater status. This may, for instance, include new developments related to hydropower.

These exemptions must however respect the following conditions (Article 4(7) (a)-(d)), and Articles 4(8) and 4(9)[32]:

- the project must be of overriding public interest and/or the benefits of achieving the WFD objectives must be outweighed by the benefits of the new modification to human health, to the maintenance of human safety or to sustainable development;
- all practical steps must be taken to mitigate the adverse impacts on the status of the water body;
- the beneficial objectives of the modification cannot be achieve by other means which are a significantly better environmental option;
- the reasons for the modification are explained in the RBMP;
- the achievement of WFD goals in other water bodies within the same river basin district will not be compromised or excluded;
- the project is consistent with the implementation of other Community environmental legislation;
- steps are taken to ensure that the at least the same level of protection as in the existing Community legislation is guaranteed.

If the development potentially affects both a WFD objective and a Natura 2000 site then both the procedure described above, and the Natura 2000 permit procedure under Article 6.3 of the Habitats Directive must be undertaken. They will have a different focus: one will assess if the project is likely to compromise the objectives of the WFD, the other will assess whether it will adversely affect the integrity of a Natura 2000 site.

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[31] *For further details see EC Guidance document N°4 on the identification and designation of heavily modified and artificial water bodies*
- *https://circabc.europa.eu/sd/a/f9b057f4-4a91-46a3-b69a-e23b4cada8ef/Guidance%20No%204%20-%20heavily%20modified%20water%20bodies%20-%20HMWB%20%28WG%202.2%29.pdf*

[32] *Guidance document N° 20 on exemptions to the environmental objectives*
- *https://circabc.europa.eu/sd/a/2a3ec00a-d0e6-405f-bf66-60e212555db1/Guidance_documentN%C2%B020_Mars09.pdf*

The WFD also makes it clear that a development cannot go ahead if it is not consistent with other EU environmental legislation. In other words, if the project does not compromise the objectives of the WFD but does adversely affect the integrity of a Natura 2000 then it cannot be approved under the WFD unless the derogation procedure under Article 6.4 of the Habitats Directive has also been accepted.

Box 5: EU WFD and Natura 2000 guidelines

Purpose of the case: Guidelines for cross border implementation in Germany and Austria

The aim of this research and development project "EU-Water Framework Directive and Natura 2000 – the cross-border implementation in Germany and Austria" is to develop and test a harmonised procedure and detailed guidelines for the trans-sectoral and cross-border implementation of the WFD and the Birds and Habitats Directives.

The main tasks are to:

- develop EU-wide recommendations for a harmonised implementation procedure of the EU Directives based on the results and experiences in the investigation areas;
- clarify the methodological approach and the coordination of the planning process in two different water bodies;
- calibrate aims and conservation and development measures for habitats and species according to Annexes I, II and IV of the Habitats Directive;
- harmonise public participation according to the WFD and Habitats Directive, and according to the individual regulations of the federal states.

The project was commissioned by the German Federal Agency for Nature Conservation in Bonn (BfN), the contractors are the Bavarian Academy for Nature Conservation and Landscape Management (ANL) and BOKU University of Natural Resources and Applied Life Sciences, Vienna, Inst. for Hydrobiology & Aquatic Ecosystem Management (IHG) and Inst. of Landscape Development, Recreation and Conservation Planning (ILEN).

More details: http://www.wrrl-natura2000.info/en/index.html and http://www.buchweltshop.de/bv-heft-85-wasserrahmenrichtlinie-und-natura-2000.html

3.3 The Floods Directive

In November 2007, Directive 2007/60/EC was adopted. It establishes a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods.

The Directive requires Member States to undertake:

- Preliminary flood risk assessment, which identifies areas where serious floods have occurred in the past and where there is a likelihood of significant floods again in the future (deadline December 2011).
- Flood hazard and flood risk maps, which map out the identified flood risk areas per river basin (or other agreed unit area of management). These maps should also show the potential adverse consequences associated with different flood scenarios, including information on potential sources of environmental pollution as a consequence of floods, as well as protected areas such as Birds and Habitats Directives in those areas (deadline December 2013).
- Flood risk management plans on the basis of the above, flood risk management plans should then be established focusing on managing and reducing the potential adverse consequences of flooding. These plans should include a prioritised set of measures, addressing all aspects of flood risk management from prevention and protection to

preparedness (e.g. flood forecasts and early warning systems) taking into account the characteristics of the particular river basin or sub-basin (deadline December 2015).

Because of the diversity in flood events and impacts throughout Europe, the directive does not prescribe any further detailed community-wide objectives for managing flood risks; this is left up to the Member States to define.

As regards the relations between the Floods Directive and EU nature legislation, there is - in addition to the requirement to include protected areas in the flood risk maps (as listed in point 1(i), (iii) and (v) of Annex IV to the WFD), - also a specific reference in Article 7 to the need to take into account nature protection in the flood risk management plans.

Through the links to the WFD it is also clear that all activities under the Floods Directive must be in line with the requirements of these two directives as well, for instance if a flood protection measure risks affecting one or more Natura 2000 sites, it too, must follow the procedure under Article 6 of the Habitats Directive, and where necessary an appropriate assessment should be carried out to assess the potential effects of the plan or project on the integrity of the Natura 2000 site(s).

The Floods Directive also recognises (recital 14) that *"with a view to giving rivers more space, the flood risk management should consider where possible the maintenance and/or restoration of floodplains"*. There is ample evidence these days to show that maintaining and restoring healthy ecosystems, for instance through Natura 2000, can be a very effective way of preventing and mitigating floods, and will be an important tool in adapting to climate change as well.

3.4 The SEA Directive and the EIA Directive

Two other key pieces of EU environmental legislation are directly relevant to hydropower developments: Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (commonly referred to as "SEA Directive"); and Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, – commonly referred to as the "EIA Directive" as amended by Directive 2014/52/EU.

3.4.1 The SEA Directive

The purpose of the SEA Directive is to ensure that the environmental consequences of certain plans and programmes are identified, assessed and taken into account during their preparation and before their adoption.

In this respect, Member States are required to prepare an environmental assessment report that identifies and assesses the likely significant environmental effects of the plans and programmes, and of any reasonable alternatives. In addition they must provide certain authorities (including environmental ones) and the general public with an opportunity to express their opinion on the environmental report as well as on the draft plan or programme.

The environmental report and the results of the consultations must then be taken into account before adoption. Once the plan or programme is adopted, the environmental authorities and the public are informed and relevant information is made available to them. Moreover, in order to identify unforeseen adverse effects at an early stage, any significant environmental effects of the plan or programme must be monitored.

An SEA is mandatory for a variety of plans and programmes (i.e. prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning or land use) which set the framework for future development consent of projects listed in the "EIA Directive"[33]. **An SEA should also be carried out on any plans or programmes, which, in view of the likely significant effect on sites, have been determined to require an assessment pursuant to Article 6.3 of the Habitats Directive.**

Ultimately, the strategic environmental assessment (SEA) aims to encourage a more integrated and efficient approach to territorial planning where environment, including biodiversity considerations, are taken into account much earlier on in the planning process and at a much more strategic level. This should lead to fewer conflicts further down the line at the level of individual projects. It also allows for a more appropriate siting of future developments away from areas of potential conflict with nature conservation (see also chapter 5 for details on integrated planning and management).

3.4.2 The EIA Directive

While the SEA process operates at the level of plans and programmes, the EIA Directive operates at the level of individual public and private projects. Thus, development consent for projects[34] which are likely to have significant effects on the environment should be granted only after an assessment of its likely environmental effects has been carried out.

The EIA Directive distinguishes between projects requiring a mandatory EIA (so-called "Annex I projects") and those where Member State authorities must determine, in a procedure called “screening”, if projects are likely to have significant effects, taking into account criteria in Annex III of the Directive (so-called "Annex II projects"). All installations for hydroelectric energy production are Annex II projects[35].

3.4.3 The relationship between SEA, EIA and appropriate assessments

According to the new EIA Directive, in the case of projects for which the obligation to carry out assessments of the effects on the environment arises simultaneously from this Directive and from the two EU nature directives, Member States shall, where appropriate, ensure that coordinated and/or joint procedures are provided for. Under the coordinated procedure, Member States must endeavour to coordinate the various individual environmental assessments of a particular project by designating an authority for this purpose and providing, wherever possible, for a single assessment of the environmental impact of a particular project.

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[33] *Useful guidance on how to carry out SEAs for transport plans and programmes is provided in the BEACON Manual (Building Environmental Assessment Consensus) available from*
- http://ec.europa.eu/environment/eia/sea-studies-and-reports/beacon_manuel_en.pdf

[34] *The EIA Directive defines "project" as the execution of construction works or of other installations, schemes, or interventions in the natural surroundings and landscape.*

[35] *Projects that fall under Annex I include those for “dams and other installations designed for the holding back or permanent storage of water, where a new or additional amount of water held back or stored exceeds 10 million cubic meters’.*

Nevertheless, **the appropriate assessment under EU nature legislation should still remain a clearly distinguishable and identifiable part of the overall environmental report**. This is because the Habitats Directive's appropriate assessments measure different aspects of the natural environment and have different criteria for determining "significance" than the EIA /SEAs. Also the scope of each is different: SEAs/EIAs apply in the case of all plans and projects that fall within their remit irrespective of where they are to be located. The appropriate assessment, on the other hand, is only applicable to those plans and projects that could have a negative effect on a Natura 2000 site.

There is also an important distinction as regards the outcome of the assessment. The assessments under the SEA and EIA lay down procedural requirements and do not establish obligatory environmental standards. The assessment under the Habitats Directive, on the other hand, lays down obligations of substance. In other words, if the appropriate assessment determines that the plan or project will adversely affect the integrity of a Natura 2000 site, the authority cannot agree to the plan or project as it stands unless, in exceptional cases, they invoke special procedures under Article 6.4. Thus, an **SEA and EIA cannot replace, or be a substitute for, an appropriate assessment** as neither procedure overrides the other.

Comparison of procedures under AA, EIA and SEA

	AA	EIA	SEA
Which type of developments are targeted?	Any plan or project which - either individually or in combination with other plans/projects - is likely to have an adverse effect on a Natura 2000 site (excluding plans or projects directly connected to the management of the site).	All projects listed in Annex I. For projects listed in Annex II the need for an EIA shall be determined on a case by case basis or through thresholds or criteria set by Member States (taking into account criteria in Annex III).	Any plans and programmes or amendments thereof which are (a) prepared for ….. water management,….and which set the framework for future development consent of projects listed in Annexes I and II to EIA Directive, or (b) which, in view of the likely effect on sites, have been determined to require an assessment pursuant to Article 6 or 7 of Directive 92/43/EEC; (c) which set the framework for future development consent of projects other than those referred to in (a) and that have been determined to be likely to have significant environmental effects.
What impacts need to be assessed relevant to nature?	The assessment should be made in view of the site's conservation objectives (which are set in function of the species/ habitat types for which the site was designated). The impacts (direct, indirect, cumulative, etc.) should be assessed to determine whether or not they will adversely affect the integrity of the site concerned.	Direct and indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative significant effects on, amongst others, fauna and flora.	Likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors;

Who carries out the assessment?	It is the responsibility of the competent authority to ensure that the AA is carried out to the required standard. In that context the developer may be required to carry out studies and to provide all necessary information to the competent authority in order to enable the latter to take a fully informed decision. The competent authority should also collect relevant information from other sources as appropriate.	The developer/authority.	The competent planning authority.
What are the time limits for Competent authorities to deliver their decision?	No time limit is set.	Member States shall ensure that the competent authority makes its decision as regards the EIA permit as soon as possible and within 90 days from the date on which the developer has submitted all the information. In exceptional cases, for instance relating to the nature, complexity, location or size of the project, the competent authority may extend that deadline to make its determination; in that event, the competent authority shall inform the developer in writing of the reasons justifying the extension and of the date when its determination is expected.	No time limit set

Are alternatives assessed and when?	The Derogation procedure under Article 6.4 requires competent authorities to ensure that the alternative put forward for approval is the least damaging for habitats, for species and for the integrity of the site, and no other alternatives exist that would not affect the integrity of the site.	The information to be provided by the developer in the environmental report shall include an outline of the main alternatives studied by the developer and an indication of the main reasons for this choice, taking into account the environmental effects.	An environmental report should be prepared containing relevant information as set out in this Directive, identifying, describing and evaluating the likely significant environmental effects of implementing the plan or programme, and reasonable alternatives taking into account the objectives and the geographical scope of the plan or programme;
Are the public/ other authorities consulted?	Not obligatory but encouraged "if appropriate".	Compulsory –consultation to be done before adoption of the development proposal. Member States shall take the measures necessary to ensure that the authorities likely to be concerned by the project are given an opportunity to express their opinion on the request for development consent. The same principles apply for consulting the public. In case of likely significant effects on the environment in another Member State, the relevant authorities and the public of the later have to be consulted.	Compulsory –consultation to be done before adoption of the plan or programme. The authorities and the public shall be given an early and effective opportunity within appropriate time frames to express their opinion on the draft plan or programme and the accompanying environmental report before the adoption of the plan or programme or its submission to the legislative procedure. Member States must designate the authorities to be consulted which, by reason of their specific environmental responsibilities, are likely to be concerned. In case of likely significant effects on the environment in another Member State, the relevant authorities and the public of the later have to be consulted.
How binding are the outcomes?	Binding. The competent authorities can agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site.	The results of consultations and the information gathered as part of the EIA *"must be taken into consideration*" during the approval procedure.	The environmental report, as well as the opinions expressed *"shall be taken into account"* during the preparation of the plan or programme and before its adoption or submission to the legislative procedure.
How are the various measures implemented and monitored	Monitoring may be imposed as a pre-condition on the approval of a permit but only if the authority has ascertained that the plan or project will not adversely affect the integrity of the N2000 sites.		Member States shall monitor the significant environmental effects of the implementation of plans and programmes in order, *inter alia*, to identify at an early stage unforeseen adverse effects, and to be able to undertake appropriate remedial action.

4. A REVIEW OF POTENTIAL IMPACTS OF HYDROPOWER ON NATURA 2000

The benefits of hydropower plants as a renewable source of electricity production is well known but there is also a need to recognise that they can significantly affect the ecological functions of rivers and adjacent habitats in which they are located. This chapter describes the multifunctional role of river ecosystems and their main pressures before going on to provide an overview of the types of impacts to look out for when planning hydropower projects that might affect one or more Natura 2000 sites.

The full understanding of potential impacts on Natura 2000 sites is very useful for the developer and planning authorities for two main reasons:

- It can help to plan projects away from areas where there is a high risk of serious negative impacts (and where there is little chance of approval unless the project can meet all the terms of the derogation procedure under Article 6.4),
- It provides an overview of the type of impacts that would need to be studied and assessed as part of the Appropriate Assessment under Article 6.3 of the Habitats Directive as well the kind of mitigation measures that might be considered to overcome or remove these potential effects on the Natura 2000 site(s).

4.1 Main threats and pressures on rivers ecosystem

Recent studies under the WFD found that classified water bodies are under pressure from a variety of activities on rivers[36]:

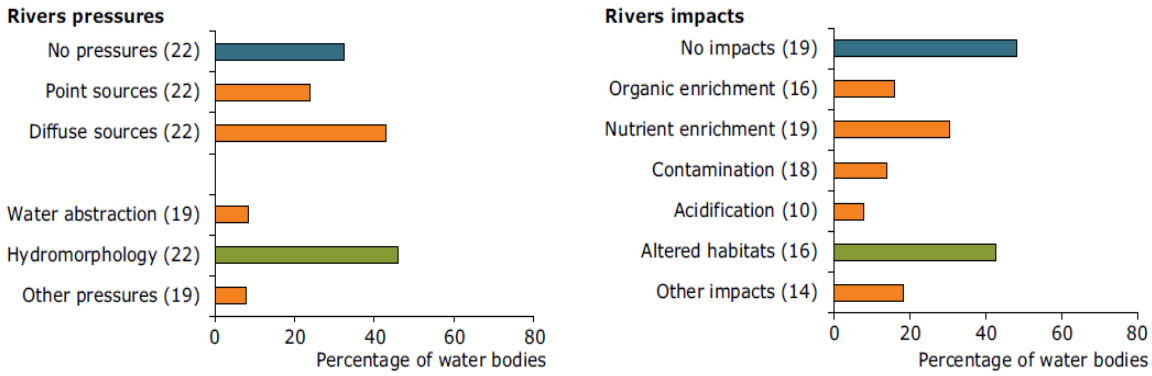


Figure 4: Significant pressures (left) and impacts (right) for rivers, the number of MS included is indicated in parentheses (European waters - assessment of status and pressures 2012)

[36] *European waters - assessment of status and pressures (2012) - http://www.eea.europa.eu/publications/european-waters-assessment-2012*

According to the findings, over 40% of river and transitional water bodies are affected by hydro-morphological pressures. This factor is caused mainly by man-made structures and activities which have impacted on the ecological functioning of European rivers. In the RBMPs, the majority of EU Member States indicate that urban development, flood protection, power generation including hydropower, inland water navigation, river straightening, and land drainage for agriculture are all important pressures affecting the hydromorphological status of water bodies.[37]

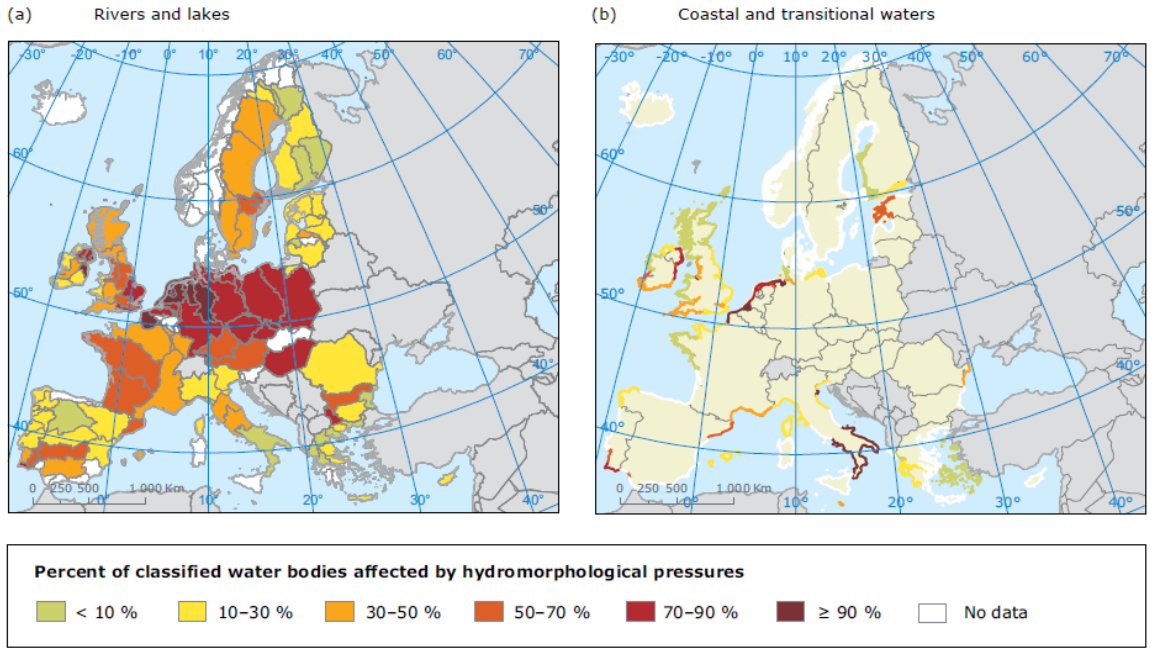


Figure 5: Proportion of classified water bodies in different RBDs affected by hydromorphological pressures for (a) rivers and lakes and for (b) coastal and transitional waters (European waters - assessment of status and pressures 2012)

The river flow regime (seasonal and inter-annual variation in flow) and water level fluctuations are two of the major determinants of ecosystem functioning of rivers. The main challenge in managing water flows and water levels is to meet the reasonable needs of different water users, while leaving enough water in the environment to maintain fluvial habitats and species.

The **quantity, quality and timing of water flows** required to sustain ecosystems and the services they provide are collectively referred to as ecological (environmental) flows[38]. Ecological flows are an important mechanism to protect and enhance the status of aquatic ecosystems and promote sustainable water use, thus contributing to the achievement of EU water policy goals[39]. The establishment and maintenance of ecological flows serves to maintain essential processes of healthy river ecosystems and a good ecological status of the water bodies. Where water resources are over-allocated or overexploited, ecological

[37] *Ecological and chemical status and pressures in European waters – Thematic Assessment for EEA Water 2012 Report - ETC/ICM Technical Report 1/2012*
[38] *Securing Water for Ecosystems and Human Well-being: The Importance of Environmental Flows*
[39] *A key document "Ecological flows in the implementation of the Water Framework Directive" is currently finished, see the version agreed by Water Directors - https://circabc.europa.eu/d/a/workspace/SpacesStore/847bd875-5ccb-46f5-965d-311a99ddc0ac/DraftEflowsGuidance-V5.1.pdf*

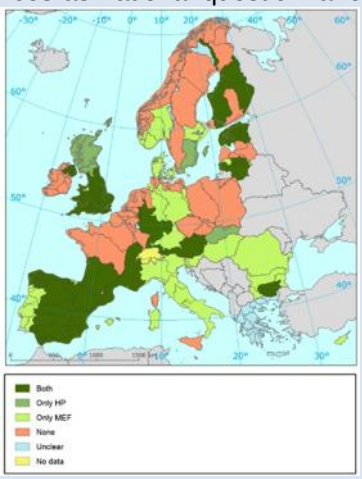
flow requirements impose a reduction (a cap) on water withdrawal, which the water-intensive economic sectors have to bear.

Box 6: Environmental Flows in the wider context of the River Basin Management Plans

Purpose of the case: Analysis of the implementation of Environmental Flows

With the available information, two main environmental flows components have been screened: the minimum ecological flow requirements and the operational modification for hydro-peaking (this one mainly linked with hydropower exploitation). From the simple absolute minimum flow, genuine and more complex environmental flows regimes may include other aspects such as the hydrological variability (inter-annual and seasonal) and connectivity (both longitudinal and lateral), essential for proper structure and functioning of aquatic ecosystems.

The screening, starting from River Basin Management Plan Assessments, has been extended by own assessment and complemented by consulting a variety of sources as national questionnaires and personal contributions, mainly from Water Scarcity & Drought Expert Group members.



According to these analysis, up to 88 River Basin Districts (RBDs) (47%) either have already implemented minimum ecological flow (or similar tools) or have planned it in the framework of the Programme of Measures, while other 69 (34%) show no explicit intention in this regard. Finally, in 29 RBDs (16%), available information is not sufficient to assess. On the other hand, some kind of hydro-peaking conditioning scheme is considered in 48 RBDs (26%), while this is not so in 101 RBDs (54%) with 37 RBDs (20%) with unclear assessment. 45 RBDs (24%) have both measures either implemented or planned, 35 RBDs only minimum ecological flow (19%) and 3 only hydro-peaking conditioning scheme (3%), while 66 have included neither of the two (35%).

Source:http://ec.europa.eu/environment/archives/water/implrep2007/pdf/Water%20abstraction%20and%20use%20-%20Eflows.pdf

Other factors that affect ecological flows are the thousands of barriers and transverse structures present in European rivers. Some are large dams (it is estimated there are currently about 7000 large dams[40]). But the vast majority of barriers are created by smaller obstacles. They include more than 21 000 small hydropower plants in the EU[41].

The impacts can be significant not only along the traditional migratory routes of migratory species but also on the river ecosystem itself and its surrounding habitats. Migration barriers play an important role because of the fundamental influence these barriers have on the life cycle of the species. They also can influence the gene flow and habitat choice of other species.

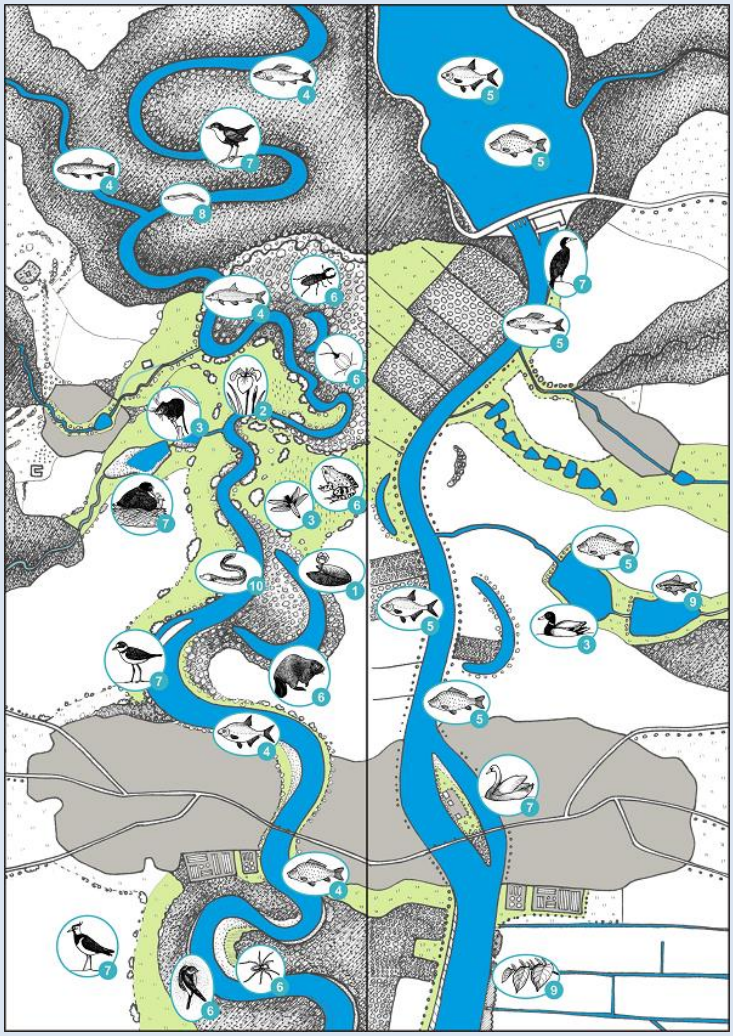
The following graphics illustrate the importance of the river ecosystem for biodiversity and the multifunctional role of rivers for society, respectively. Both schemes are important to understand the overall context in which hydropower operate. The altered rivers might never be able to provide the full range and amount of ecosystem services anymore, causing loss of business opportunities, costs to society, health and well-being of citizens.

[40] *http://www.eea.europa.eu/themes/water/european-waters/reservoirs-and-dams*
[41] *http://setis.ec.europa.eu/technologies/Hydropower/info*

Box 7: Importance of the river ecosystem for biodiversity

Rivers are habitats for numerous species of aquatic and wetland organisms.

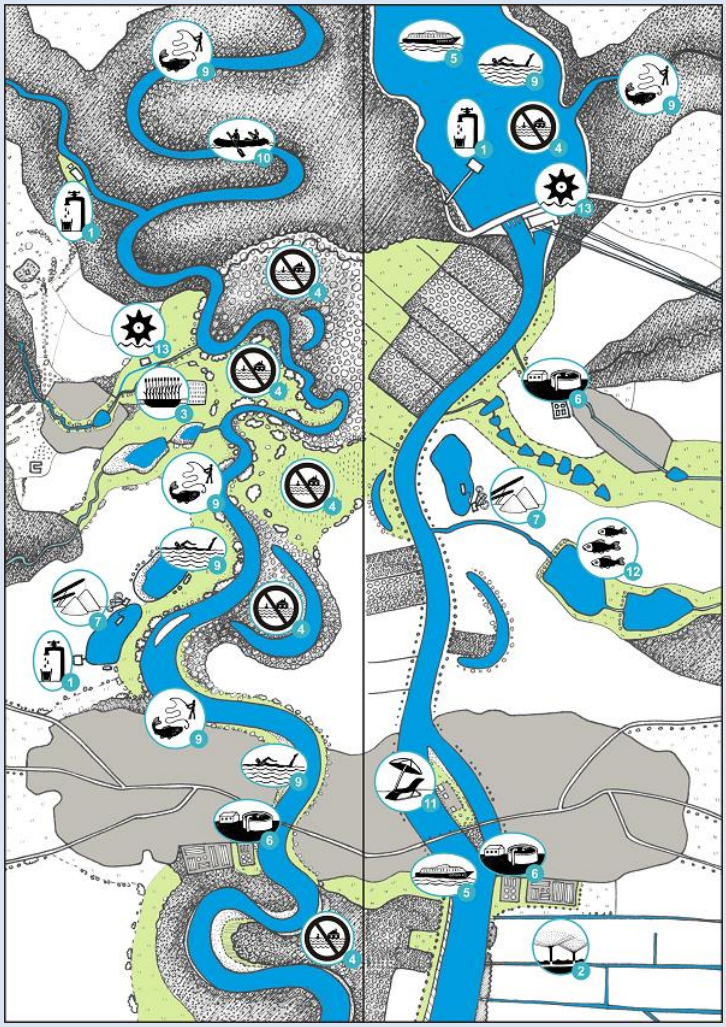
- Both aquatic **plants** (living in rivers) [1] and, more importantly, riparian plants [2] (growing along the banks and on islands) play critical roles in **building and sustaining habitats** for colonisation by other species [3], and in the chemical and biochemical processes that keep rivers and their ecosystems healthy.
- River habitats could be divided into **four main habitats** – current, bed, bank and surrounding biotopes. Each of them hosts different fauna and flora. The river ecosystem is naturally very dynamic and the species are adapted to it and they search for the right conditions for them (e. g. different fish species occupy different part of the river – [4].
- Biodiversity of rivers is endangered mainly by human stabilization of watercourses´ direction and shape (see change in fish distribution – [4] in a natural watercourse, [5] in a regulated one).
- Water flow and temperature, bedrock and water chemical composition are the most important factors dictating if the aquatic species will be there or not. High biodiversity reflects primarily the **diversity of the** features present (compare natural and regulated watercourse - left vs. right side of the figure). In a few hundred meters, different substrates (stones, gravel, sand, mud), trees roots and dead wood, and varying water depth form a range of microhabitats suitable for different organisms.



- Habitats surrounding rivers are not so variable. However, streams, floodplains with natural flooded areas, wetlands, ponds, river backwaters, oxbows and floodplain forests are also colonized by **very rich communities** of organisms [6]. They belongs to one of the richest ecosystems in the world in terms of biodiversity.
- **Terrestrial animals exploit river ecosystems** because of food, possibilities of hideouts and reproduction. Birds are a popular example [7].
- All components of autochthonous flora and fauna play an irreplaceable role in the functioning of aquatic ecosystems [8]. However, water habitats are also increasingly influenced by **non-native alien species.** Some of them are invasive and are able to alter the structure and functioning of food chains and to negatively affect the native species in rivers [9].
- Rivers can serve as **biological corridors** [10]. Terrestrial organisms have a tendency to migrate along the rivers too. This is also one of the reasons why river ecosystems are so vulnerable to biological invasions [9]. The second reason that these habitats, especially wetlands, serve as a storage for nutrients from whole river basin and are therefore vulnerable to invasive species due to their high nutrient levels.

In addition to their biodiversity value, rivers also provide **a wide range of valuable ecosystems services to society**, such as self-cleaning water, stabilization of nutrient cycling, water and carbon, production of fish and many others.

Box 8: Multifunctional role of rivers



The landscape in Europe together with climatic conditions predetermines the conditions for a very heterogeneous network of rivers and streams. Human society has always been connected with water exploitation and entirely dependent on water resources. This overview covers only the main activities even though there are a large number of others in operation as well (e.g. for fire extinction, snowmaking etc.).

- The human society cannot exist without sources of drinking water [1]. The acquisition of surface water is mostly connected with the construction of dams which strongly influence local river ecosystems (see Chapter 4.4.)
- Irrigation [2] of fields and orchards is connected with the significant expansion of modern agriculture in Europe. The scale and importance of irrigation differs between countries – it represents around 60% of total water use in the Southern Member States and around 30% in the Northern countries. The main types of environmental impact arising from irrigation are: water pollution from nutrients and pesticides [3], damage to habitats and aquifer exhaustion by abstraction of irrigation water and intensive forms of irrigated agriculture which displace high value semi-natural ecosystems, increased erosion of cultivated soils, salinization or contamination of water by minerals.
- Riparian habitats are very important in flood control [4] as well as some artificial constructions. Healthy wetlands have the ability to act like sponges holding back a high amount of water and thus slowing down a flood wave.
- European rivers have been used for transport [5] of goods and people for thousands of years. Of decisive effect are river engineering measures that impact the original situation (e.g. bed-load transport, morpho-dynamic development of the channel network, exchange processes between rivers and floodplains, groundwater regime) and/or the natural composition of ecological communities (e.g. through migration barriers or destruction of sensitive habitats).
- Rivers and streams were historically used as a rubbish dump. Industries and cities have been located along rivers because the rivers provide transportation and have traditionally been a place to discharge waste [6]. Currently the majority of sewage treatment plants empty into rivers, causing three significant types of pollutions: organic, nutrient and hazardous substances.
- Riverine sand and gravel are often extracted and used for construction. Sand mining in streams [7] results in bed degradation, bed coarsening, lowered water tables near the streambed, and channel instability.
- Rivers and their surroundings represent a favourite location for recreation. Lots of camps and cottages are placed near to the riverbank because of the possibility of swimming [8], fishing [9], yachting, enjoying nature [10] and other relaxing activities [11]. Spawning and nesting sites are particularly susceptible to damage or disturbance through physical destruction of streambeds and riparian vegetation, and through human noise.
- Freshwater habitats are used in industry too, for example for fisheries [12] and of course, gaining electric energy [13] as well as for industrial cooling facilities

4.2 Hydropower development – the need for a case by case approach

Since there are many technologies involved, hydropower plants can affect habitats and species protected in Natura 2000 sites in many ways and on different levels. Therefore there is a need to look at each case individually. Although there can be some common features for some species/habitats or technologies, the effect of hydropower plants on particular sites, its species and habitats is always site specific.

Habitat alteration can vary from mild for some types of hydropower plants to very heavy, especially for large reservoir hydropower plants. But even small hydropower schemes can have significant adverse impacts on water habitats, particularly if they are inappropriately located or they are a part of the cumulative impact of multiple barriers and flow disturbance in a single catchment. The degree of impact depends a lot on the habitat condition. For instance, the impact of a weir placed on the regulated stream in poor ecological condition will be markedly lower than one placed in natural flow river which is, additionally, a migrating path of Atlantic salmon *Salmo salar*.

4.3 Overview of the types of hydropower facilities used in the EU

It is important to consider the different types of hydropower facility that could be developed as each can have very different types and levels of impacts on the surrounding freshwater ecosystems. They can also have an impact at different stages in the project cycle – whether during the construction, renovation or modernisation or decommissioning. Hydropower plants can be classified according to several parameters, for example the generating capacity range, generating methods, head heights or the type of turbine use. These characteristics are briefly described below.

4.3.1 Types according to generating capacity range

The generating capacity range of the hydropower facility usually recognises the following five groups from pico to large.[42] Over 90% of hydropower capacity is generated by large hydro facilities with the remaining 10% coming from small plants. Nevertheless, mini, micro and pico hydropower plants are growing in importance and represent an effective way of providing distributed electricity.

Type	*generating capacity range (kW)*
Pico	< 5
Micro	5–100
Mini	100-1.000
Small	1.000–10.000
Large	> 10.000

4.3.2 Types of generating methods

In terms of generating methods, the following are most frequently used:

Run-of-river hydropower plants without pondage. In the run-of-river hydropower systems, electricity production is driven by the natural flow and drop in elevation of a river.

[42] *The values used for sorting can vary between different countries and purposes, no official unified classification exists.*

These plants (predominantly small hydropower plants) use water without storing it. They use water as and when available. In this particular configuration, generating capacity depends primarily on the rate of the flow of water. A high flow rate can mean some water is wasted during low run-off periods. On the contrary, the generating capacity may be low due to poor flow rates. The run-of-river schemes are often found downstream of reservoir projects as a reservoir can regulate the generation of one or more run-of-river plants downstream.

Run-of-river hydropower plants with pondage. The pondage allows for the storage of water during low demand periods and the use of this water during high demand periods. Depending on the size of the available pondage it is possible to deal with hour-to-hour fluctuations. When providing pondage, tail race conditions guarantee that floods do not raise water levels, thus reducing the head on the plant and impairing its effectiveness. This type of plant is more reliable and its generating capacity is less dependent on availability of the water flow.

Reservoir hydropower plants. The conventional reservoir plant has a reservoir of a big enough size to permit the storage of water during both wet and dry seasons. Water is stored behind the dam and is available to the plant as and when required. Such a plant has a better capacity and can be used efficiently throughout the year. Its capacity can be increased and can be used either as a base load plant or as a peak load plant as required.

Pumped-storage hydropower plants. The pumped-storage hydroelectric power stations are special strategic constructions based on reservoirs at different elevations, which make it possible to generate supplementary electricity during high peak demands. The water is pumped to the higher reservoir at the time of a lower demand and released down through turbines when the demand is high. The direction can change in minutes. Although the losses of the pumping process contribute to the cost of storage, they are able to provide large-scale energy storage and can be a useful tool for providing grid stability services and integrating variable renewables, such as wind and solar. Pumped storage represents about 19% of all generation capacity in Austria (IEA, 2011)[43].

[43] *IEA 2011: Key Word Energy Statistic, IEA, OECD, Paris*

However, pumped storage plants are generally more expensive than conventional large hydropower schemes with storage, and it is often very difficult to find good sites to develop pumped hydro storage schemes. Refurbishment and upgrading of existing power plants can be a solution to increase pumped storage capacity.

Box 9: Development of Bulk Energy Storage & Natura 2000

Purpose of the case: Presentation of important project dealing with Pumped Hydro Energy Storage

The 'stoRE' project, co-financed by the EU's Intelligent Energy Europe Programme, aimed to facilitate the realisation of the ambitious renewable energy targets for 2020 and beyond by unblocking the potential for energy storage infrastructure.

The Final Report summarized the possibilities of developing Bulk Energy Storage with respect to Natura 2000 conservation. The report aims to provide sector specific guidance on how best to ensure that new Pumped Hydro Energy Storage (PHES) and Compressed Air Energy Storage (CAES) are compatible with the provisions of the Birds and Habitats Directives with particular focus on Article 6 procedures.

Source: stoRE - Final Publishable Report - www.store-project.eu

Underground hydropower plants. These hydropower plants are not frequently used. They work on the basis of a naturally large difference in elevation between two water bodies. The water goes down through an underground tunnel from a higher reservoir to turbines at the lowest point

4.3.3 Types of head height

- ***Low-head hydropower plants***. Power plants of this type can utilize a low dam or weir to channel water, or no dam at all and simply use the run-of-river. The limit between low-head and medium-head used can be around 15-30 m of the head's height.

- ***Medium-head hydropower plants.*** These reservoir hydropower plants consist of a large dam which creates a huge reservoir. The majority of large hydropower plants belong to this category. The upper limit of this category is around 70-300 m of the head's height.

- ***High-head hydropower plants.*** Heads of this type of a power plant can be higher than 1000 m. Electricity systems need to be flexible in order to guarantee at every moment the equilibrium between generation and consumption. Especially pumped storage hydropower plants have this character in European conditions.

4.3.4 Types of hydropower turbines

There are two main types of hydro turbines: **impulse and reaction**. The selection of the type of hydropower turbine is based on the height of standing water - referred to as "head"

- and the flow or volume of water at the site. Other deciding factors include depth to which the turbine has to be set, efficiency, and cost.

The type of turbine used is important, not only in terms of optimal energy production, but also because of its potential to impact on wildlife, especially downstream migrating or dispersing fish species. On this basis, turbines could be sorted into two groups: "fish-friendly" turbines, and other turbines which have to be equipped with a device to prevent the inflow of fish into the turbine, like screens and fish guidance and deterrence devices (i.e. "fish-friendly" intakes). Details of both groups are described further in the Chapter 7.2.

Impulse turbines generally use the velocity of the water to move the runner and discharges to atmospheric pressure. The water stream hits each bucket on the runner. There is no suction on the down side of the turbine, and the water flows out from the bottom of the turbine housing after hitting the runner. The impulse turbine is generally suitable for high head and low flow applications. *Pelton turbines* (wheels) are preferable for high-head hydropower plants, special multi-jet Pelton can be utilized for medium-head plants. *Turgo turbines* (wheels) are used for high-head or medium-head plants. For low head hydropower plants a special cross-flow turbine is developed. Advantages of *Archimedes screw turbine* are described in the Chapter 7.2.

Reaction turbines develop power from the combined action of pressure and moving water. The runner is placed directly in the water stream flowing over the blades rather than striking each individually. Reaction turbines are generally used for sites with lower head and higher flows compared to the impulse turbines. *Propeller turbine* has a runner with three to six blades in which the water is in contact with all of the blades at all times. The pitch of the blades may be fixed or adjustable.

There are several types of the propeller turbine – Kaplan, Straflo, Bulb and Tube turbines. *Francis turbine* has a runner with fixed buckets (vanes), usually nine or more. Water is introduced just above the runner and all around it and then falls through turbine, causing it to spin.

4.4 Potential effects of hydropower plants on EU protected habitat types and species

When assessing the impacts of a hydropower project under the Natura 2000 permit, it is important to recall that the Appropriate Assessment **must focus on the EU protected species and habitat types for which the site has been designated**, in light of the site's conservation objectives. The scope of the AA under the Habitats Directive is therefore narrower than that of the EIA Directive which requires the impacts on all plants and animals species to be investigated.

Overall, the kinds of impacts in Natura 2000 sites tend to fall into the following main categories:

- *Habitat changes:* construction or renovation of a hydropower plant can impact in various ways on the river ecosystem. These changes might include not just physical habitat loss but also its deterioration and degradation (through changes in its functionality and resilience), and habitat fragmentation.
- *Direct impacts on the species* present: animal species may be prevented from circulating because of the use of certain hydropower turbines and the existence of dams and weirs which act as barriers to movement and migration. These impacts can include loss or injury of specimens, as well as displacement, disturbance, and barrier effects etc.

Evaluation of impact's significance must always be done on a case by case basis.

A. Habitat changes

Inundating of terrestrial and alluvial habitats

Dams and weirs cause the inundation of natural non-water areas upstream of the dams which can transform naturally rich riverine valley forests, marshlands and grasslands. These inundations can also cause habitat fragmentation and the displacement of wild species populations.

Disruption of ecological continuity by destruction of naturally flowing sections

The alteration of the flowing parts of rivers and streams can substantially influence the character of the habitat and all related ecosystems both above and below dams and weirs. The composition of fauna and flora communities may be altered because of the complete modification of the stream and the riparian ecosystem. Populations of native species can also be significantly altered.

Sediment dynamics

Transverse structures such as weirs or dams that are built for ground impoundment or water retention can slow the water flow and reduce its driving capabilities. Large reservoirs without low level outlets trap more than 90% and sometimes almost 100% of incoming sediment. Clear water below a dam seek to recapture its sediment load by eroding the bed and banks of the river. The sediment picked up by the river may be deposited further downstream.

This in turn disrupts life cycle processes by constantly clogging material in the flow and impacts further ecosystem services such as navigability of downstream rivers due to the increased erosion of the riverbed, lowering of the drinking water table, and further degeneration of alluvial habitats further downstream. It can also lead to the local destruction of important hydro-morphological structures such as gravel bars.

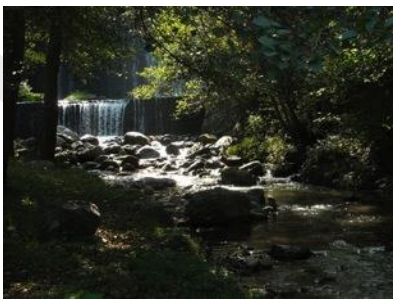
Upstream of a dam, in a reservoir or in impounded sections, the reduction of the sediment transport capacity of the water results in sediment deposition. This can also affect the species associated with such habitats. Accumulation of gravel may be especially important for the lithophile species such as grayling *Thymallus thymallus*, which needs these areas as spawning grounds. For some bird species, such as the plover or sandpiper, the dry gravel benches are very important as nesting places. The fine-grained accumulation is also important for the lamprey larvae.

Water chemical changes

Dams can fundamentally change the chemical and mineral composition of the river downstream. In karst areas or areas with limestone rocks such changes can lead to the dissolution of the rocks and an accumulation of these substances in the environment which can in turn result in changes of pH. Likewise, pH changes can occur in the reservoir where rocks are used containing salt or iron. All these changes could influence the composition of plant and animal communities present.

For instance, changed pH values can affect populations because of low tolerance of sensitive stages (e.g. fish eggs and fry). The amount of sediments and nutrients can also often increase, causing overgrowing of algae and other aquatic weeds. This vegetation then threatens the river plants and animals.[44]

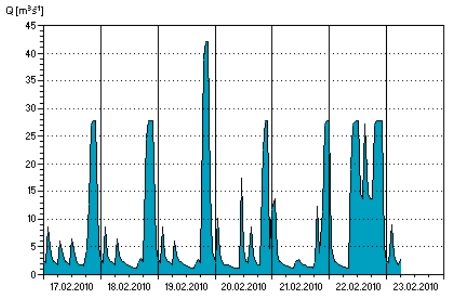
Changes of the flow regime - Derivation hydropower plant



In derivation hydropower plants, the water is supplied to the turbine through an artificial channel. Water is piped directly from the main river flow and discharged from the turbine back into the river. Such watercourses can have an influence over several kilometres along some river stretches. Inadequate flow rates in the original riverbed result in water overheating and insufficient oxygenation, which creates unsuitable living conditions for species such as fish, crayfish and lamprey species, bivalve molluscs, or dragonflies dependent on flowing water habitats.

Among the most affected are the 32xx habitat types of Community importance (codes according to Annex I of the Habitats Directive) and species such as *Cottus gobio*, a species of Community importance, which a typical inhabitant of mountain and foothill streams where these power plants are usually installed.

Changes of the flow regime - Peaking hydropower plant



Another problem causing changes in the hydrological regime of rivers is the peaking of hydropower. This phenomenon is most common in hydropower plants with reservoir water, in particular in the dam plants or run-of-the-river plants with pondage. During the peak demand for electricity the power plant discharges the accumulated water from the reservoir through a

[44] *National Renewable Energy Laboratory (NREL). 2012. Renewable Electricity Futures Study - http://www.nrel.gov/analysis/re_futures/*

turbine, thereby increasing the flow in the hydrological units downstream.

The peaking usually stresses all the organisms living in affected parts of the watercourse, especially those that are unable to handle the increased volumes. These are especially juvenile fish, or other moving organisms that are poorly adapted to fluctuating flows. The peaking regime influence also the behaviour of prey and is of fundamental importance during particularly sensitive periods (e.g. periods of drought or frost).

Changes in seasonal flood cycles

When constructing a hydropower plant, measures are sometimes used to modify streambeds and regulate the water flow in order to be able to control better the flow of water. These are often accompanied by measures to protect the infrastructure of those plants. Interventions in flow control can result in the disruption of the seasonal flood cycles, causing sometimes a complete disappearance of the target habitat types and organisms connected to these cycles from surrounding enclaves.

Examples of such habitats include the periodic ponds and oxbow lakes and rivers and their inhabiting organisms, like e.g. the species of Community interest *Misgurnus fossilis*.

B. Direct impacts on animals

In addition to loss, damage, degradation and fragmentation of their habitats, aquatic species can be affected in other ways.

Migration barriers

Dams and weirs can act as an unsurpassable barrier for upstream migrations and seriously limit downstream movements of fish and lamprey species (not so much for other aquatic animal species but water molluscs or crayfish could be also impacted).

The upstream migration is most important for anadromous fish and lamprey species like *Salmo salar*, sea lampreys *Petromyzon marinus* and *Lampetra fluviatilis* or some sturgeons as *Acipenser sturio*. Downstream migrations are essential for catadromous fish such as the eel *Anguilla anguilla*, which is subject to additional protection through the Eel Regulation[45].

Nowadays investors are often required by law to ensure that migration and the dispersal of native fish species is made possible when such objects are constructed. However, there are still plenty of dams and weirs which were built in the past and are located along important migratory routes of endangered species of fish and lampreys, which are impenetrable and where ensuring of migratory continuum is often technically impossible.

[45] *Council Regulation (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel*

Injuries and killing of individual animals

Fish passing through a hydropower plant can be injured or killed. Mainly fish species are impacted but also other drifting organisms can come into conflict with the turbine, which can injure or kill them.

They can cause [46]:

- injuries through the physical contact with guide vanes, turbine runner or turbine casing
- damage from the pressure fluctuations during the turbine passage
- wedging onto intake screens or injuries caused by their cleaning machines
- mechanical injuries caused by intense flow and constructions of overflow in spillways
- susceptibility to predation downstream due to the disorientation[47]

The degree of mortality can vary from 0 to 100% at a single hydro power plant. Much depends on the type of fish present as well as on the type of hydropower construction and the mitigation measures utilised. Mortality are more often up to 100 % when fish pass through turbines that are mainly in high-pressure plants (with Pelton turbine).

The following table summarises **the main types of habitat change and species impacts that are likely to be encountered when using different types of hydropower plants on a project level**.

Therefore, this table is merely intended to serve as a first orientation for the AA as to the potential likelihood of impacts according to different technologies used but in any case, it does take into account the cumulative impacts particular projects may have in combination with each other or in combination with other plans or projects. This issue is particularly important for small projects likely to have modest impact individually but which could lead to significant impacts in combination with each other although any conclusion regarding the nature of the impacts under the AA procedure needs to be studied on a case-by-case basis. Indeed, the actual impacts will of course vary from site to site and in function of location, habitats and species sensitivity and technical characteristics of the projects themselves.

Potential interactions with other cumulative effects are further developed under chapters 4.5, 5 and 6).

[46] *Arcadis 2011: Hydropower generation in the context of the EU WFD. EC DG Environment.168 pp.*

[47] *Small scale hydropower, Position Paper, The European Anglers Alliance, 2013*

Signs used:

!! – significant effects probable – the impact is known to influence significantly Natura 2000 target features

x – significant effects possible – the impact may influence significantly Natura 2000 target features in some cases or in particular locations or situations

o – significant effects unlikely <u>on individual basis not taking into account cumulative impacts</u>

	Types of hydropower plants												
	generating capacity range					**generating methods**					**head height**		
	pico	*micro*	*mini*	*small*	*large*	*run-of-the-river without pondage*	*run-of-the-river with pondage*	*reservoir*	*pumped-storage*	*underground*	*low-head*	*medium-head*	*high-head*
Habitat changes													
Inundating of habitats	o	o	o	x	!!	o	x	!!	!!	x	x	!!	!!
Disruption of ecological continuity	o	x	x	!!	!!	o	x	!!	!!	x	x	!!	!!
Sediment dynamics	o	o	x	x	!!	o	x	!!	!!	x	x	!!	!!
Water chemical changes	o	o	o	x	x	o	x	x	x	x	x	x	X
Changes of the flow regime – derivations	o	x	x	!!	o	x	x	o	o	!!	x	o	o
Changes of the flow regime - peaking	o	o	o	x	!!	o	x	!!	!!	!!	x	!!	!!
Changes in seasonal flood cycles	o	o	o	o	!!	o	o	!!	x	o	x	!!	X
Direct impacts on animals													
Migration barriers	o	x	x	!!	!!	x	!!	!!	!!	x	x	!!	!!
Injuries and killing	o	o	x	x	!!	x	x	!!	o	!!	x	!!	X

The following table summarises **the level of potential risk certain impacts described above may have on different categories of species**. Its purpose is merely to give a first orientation of the kinds of impacts to study in greater detail when conducting the AA. It does not take into consideration the possible accumulated effects of several impacts operating at once or of cumulative impacts with other plans or projects in the area.

Signs used:

!! – significant effects probable – the impact is known to influence significantly Natura 2000 target features

x – significant effects possible – the impact may influence significantly Natura 2000 target features in some cases or in particular locations or situations

o – significant effects unlikely on individual basis not taking into account cumulative impacts

- – not evaluated

? – insufficient data to evaluate

	A. *Aquatic plants*	***B.*** *River margin´s plants*	***C.*** *Temporary flooded plants*	***D.*** *Mammals*	***E.*** *Turtles*	***F.*** *Lampreys*	***G.*** *Anadromous fish*	***H.*** *Rheophilous fish*	***I.*** *Litophilous + eurytopic fish*	***J.*** *Crayfish*	***K.*** *Dragonflies*	***L.*** *Molluscs*	***M.*** *Cave specialists*	***N.*** *Birds*
Inundating of habitats	x	x	x	x	-	x	x	!!	o	x	x	x	!!	x
Disruption of ecological continuity	x	o	o	x	x	x	x	x	o	x	?	x	-	o
Sediment dynamics	!!	x	o	o	-	!!	x	x	o	?	x	x	-	o
Water chemical changes	!!	x	x	o	?	x	x	x	x	x	x	!!	!!	o
Changes of the flow regime - derivations	x	x	x	x	?	x	x	!!	x	x	x	x	-	o
Changes of the flow regime - peaking	!!	!!	!!	x	x	x	x	!!	!!	x	x	x	-	x
Changes in seasonal flood cycles	x	x	!!	o	o	x	o	?	?	o	?	o	-	o
Migration barriers	-	-	-	x	x	!!	!!	!!	!!	x	o	x	-	o
Injuries and killing	-	-	-	o	o	x	!!	x	x	?	?	o	?	o

Box 10: Examples of impacts on target species

Lampreys are primitive riverine fish that are vulnerable to many potential activities and developments. Juvenile lampreys live in silt beds within the river for several years before maturing (transforming) into adults. Adult sea and river lampreys are only present in the river after transformation from the juvenile stage until they migrate downstream to the sea, and then for several months before spawning when they return to the river. Adult Brook lamprey do not migrate to the sea; they are only present after transformation from the juvenile stage for a short period prior to spawning, after which they die.

Lampreys require two very different types of habitat during their life cycle. The adults breed in pits excavated in gravel beds, often near the tail of a pool, during spring or summer. The gravel should be clean and in faster-flowing reaches where the current is able to supply the eggs with oxygen. The juveniles have very different habitat requirements and live buried in silt beds, usually at the river edge or behind boulders and other obstacles. The distribution of these species is limited by the availability of the above habitat types as well as the need for unimpeded upstream and downstream migration routes for sea and river lampreys.

Lampreys require well-oxygenated water that is low in nutrients and suspended solids. Eutrophication can give rise to increased algal and bacterial production which, as with increased suspended solids, can smother spawning gravels and silt beds containing juveniles. Rivers that support lamprey populations provide the diversity of water depths, flow regress and substrate types necessary to meet the spawning, juvenile and migratory requirements of the three species. The close proximity of these varied river habitats allows lampreys to move easily from one habitat to another during their life cycle.

Developments that widen, deepen and/or straighten the channel reduce the variations in habitat. Lampreys are susceptible to disturbance at any stage during their life cycle. They are most often disturbed during spawning, when the normally nocturnal adults will openly congregate, often in shallow water, and can be vulnerable to a number of natural predators. After spawning the eggs can be disturbed during incubation, and the juveniles in silt beds are also vulnerable to disturbance. All these habitat requirements and life-cycle of the lampreys should be taken in account when planning hydropower activities.

The conservation status of all lamprey species in all biogeographical regions was assessed as unfavourable (or unknown) in 2007 with exception of Lampetra planeri in Boreal region where it was favourable.

Freshwater pearl mussels (*Margaritifera margaritifera*) are long-lived molluscs (over 100 years) that live buried or semi buried in the sand and gravel on river beds. Pearl mussels live in rivers that are low in Calcium and are therefore not found in catchments that comprise extensive limestone or other calcareous rocks. Mature and young Freshwater pearl mussels are often found living together in the same river reach. Freshwater pearl mussels take approximately 10-12 years to become sexually mature. Those populations that contain juveniles, and therefore show signs of recent breeding success, are particularly scarce and are therefore considered to be of the highest conservation value.

Pearl mussels usually lie partly buried in coarse sand or fine gravel, although occasionally they may be found in finer substrates (e.g. peaty), or amongst the roots and stems of aquatic vegetation. Boulder-stabilised refugia, containing enough sand for burrowing, are ideal microhabitats for juvenile mussels. Adults are able to tolerate muddy conditions for unknown lengths of time, but juveniles are never found in this type of habitat. Juvenile pearl mussels tend to live entirely buried within the river substrate and are therefore much more vulnerable to any increases in silt or suspended solids which can smother the gravel bed, preventing the supply of oxygen and organic food particles to the mussels.

The presence of young salmon and trout is essential to the life cycle of pearl mussels. The larvae (glochidia) attach to fish gills in the summer and remain there until the following spring when they drop off and settle into the substrate. Therefore a healthy population of salmonids (salmon, sea trout and brown trout) is important to a freshwater pearl mussel population. All these habitat requirements and life-cycle of the pearl mussels should be taken in account when planning hydropower activities.

Conservation status (in 2007 reporting): Unfavourable bad in all biogeographical regions (Alpine, Atlantic, Boreal, Continental and Mediterranean).

Box 11: Forum Fish Protection and Downstream Migration

Purpose of the case: Open expert forum as advisory body / Germany

The Forum Fish Protection and Downstream Migration is a centrally moderated process on fish protection and downstream bypassing. It is financed by the German Federal Environment Agency (UBA) as a part of a R&D project of the Environmental Research Plan of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety in Germany.

The Forum is aimed at triggering a wide-ranging discussion and information exchange and to develop a common understanding on the latest scientific information and technology on different themes of fish protection and downstream migration. The forum facilitates knowledge transfer among federal and regional water resource management authorities, NGOs, consultancies, water managers, and representatives of the hydropower industry.

The results up to now are:

- The mortality or risk of damage when passing the turbines can be very different between e few percent and 100 percent depending on the type of turbine (hydrodynamic screw turbines vs. Pelton turbines).
- The mortality rate can only be estimated when defining a design fish species and size.
- Discussions are going on, whether the fish individual is important or the fish population.
- Behavioural screens (louvers, electric curtains, subsonic devices, stroboscope light, etc.) expose also a selective efficiency, i.e. the efficiency depends on the fish species and the local conditions.
- A high efficiency can only be expected for fine screens (10 mm).
- Fine screens are available, but only for small and medium-size hydropower plants.
- Currently the design of fish protection means has to be based on a target species.
- There is a big lack of knowledge on the behaviour of fishes in front of screens and bypass intakes.

Source : http://forum-fischschutz.de

Box 12: Hydro-ecological diagnosis and hydropower installations management

Purpose of the case: three year study comparing two different artificial regimes and their biological impacts / France, Rhône river basin

The study showed necessity of scientific surveys and case by case approach when assessing impacts of hydropower development.

The construction of a dam accompanied by a hydropower plant impacted flow dynamics and disrupted biological continuum and the lateral connectivity in La Fontolière (Rhône river basin). Two different hydropeaking regimes were tested and compared to a reference upstream reach. Native fish community was based on trout *Salmo fario* and minnow *Phoxinus phoxinus*. Other species inhabited impacted stretches of the stream – Bullhead *Cottus gobio*, Gudgeon *Gobio gobio*, Loach *Barbatula barbatula* and Eel *Anguilla anguilla*. Also diversity of Macroinvertebrates was reduced in impacted parts of the river. Due to the low residual flow there was an excess of algal and high chlorophyll biomass.

The study on this specific locality demonstrated the importance of maintaining a sufficient residual flow and of an adequate ratio between hydropeaking and residual flow. When the base flow is too low, lentic conditions become a limiting factor and aquatic communities are in poor structure in comparison with the natural reach. In contrast, biological communities (fish, macroinvertebrates and algae) are less impacted when a minimum base flow is maintained and the ratio between hydropeaking and residual flow is reduced.

The study shows that in order to guide hydropower installations management, ecological diagnosis can't only rely on monitoring a monospecific community biomass, but should include a study of the structure and composition of biological communities.

Source: http://www.ecrr.org/Portals/27/Publications/restgeom_doc9.pdf

4.5 Factors influencing the type and degree of impact

Technology used

The degree of negative impact on surrounding ecosystems and the degree of conflict with individual natural elements can be influenced by the choice of technology used for generating water energy.

Ecological quality of region

The degree of impact on EU protected habitats and species is determined also by the quality and sensitivity of the ecosystems surrounding the hydropower plant, as well as the conservation condition and vulnerability of the EU protected species and habitats present.

Completely different impacts can be assessed for a weir placed on the regulated stream with poor ecological conditions compared to a weir with the same parameters placed in a naturally flowing river, which happens also to act as a migration route for species such as *Salmo salar* or *Anguilla anguilla*. In both cases the weir disrupts the natural ecological continuum of the flow, but there are much more serious consequences in the second case and the removal of these impacts is economically and ecologically much more demanding. It is therefore always necessary to assess the broader ecological relations, including in terms of hydromorphology, status of (mainly fish) the local community, presence of migratory species etc.

Similarly a hydropower plant placed in an area that only has relatively common species will not have as significant an effect as one that is placed in a river harbouring an endemic or endangered species like *Proteus anguinus* or *Congeria kusceri*. Any threat to these endangered endemic species (listed in Annex II of the Habitats Directive) could cause serious changes in their local population which will directly influence their conservation status on a regional as well as a global level as well.

Interactions with other plans and projects in the area - cumulative effects?

It is always necessary to anticipate possible cumulative effects as well. The overall effect may end up being significant when the negative impact of hydropower stations is added to other anthropogenic activities on the same stretch of river of if several hydropower plants are placed one after another along the same river. In this case several negative cumulative effects can develop.

The cumulative effect is the combined effect of all activities taken together. It may well be that one hydropower development project, taken on its own, will not have a significant effect, but if these effects are added to those caused by other plans or projects in the area their combined effects could become significant. This influences the planning decision for all project proposals in the area because of potential (or already real) reductions in fish stocks, for example through damage to or loss of habitat or obstructions to migration, or the loss of natural changes to morphology caused by static flows and the flushing of nutrients and sediment at times of low flow.

A typical example of cumulative effects is illustrated by the construction of several migration barriers in the river system. A disruption to migration in a stretch of a river from a single barrier could be assessed as insignificant in terms of its impact on a species population. But if there are more such barriers on the same river, the impact on the species population is likely to be much more significant in terms of the disruption caused to the gene flow and decreased possibilities to find and use suitable habitats. In case of

development of several small projects in the same river catchment, this issue should be taken into consideration in order to ensure that the accumulation of the impacts generated by each project individually will not jeopardise the possibility to achieve the conservation objectives of the surrounding Natura 2000 sites and, in the end, the integrity of the Natura 2000 network.

Box 13: Guidance for run-of-river hydropower

Purpose of the case: Guidance of UK Environment Agency (2013)

The UK Environment Agency issued guidance on run of the river hydropower in 2013. In this it makes a series of recommendations for assessing potential cumulative effects arising from different multiple developments, including the following:

1) Impacts of the particular hydropower scheme should be assessed together with other activities that can reasonably be expected to interact, either in an additive or synergistic way, to adversely affect the environment. This includes activities:

- already authorised;
- for which permission is currently being sought;
- proposed or authorised but not yet fully implemented;
- of a similar and/or different type;
- that may not have a significant effect when considered alone;
- that are regularly exercised and have continuing effects.

Cumulative effects should be considered in relation to:

- the number of existing hydropower schemes in a catchment;
- the number of known proposals for hydropower schemes in a catchment;
- the environmental objectives for the catchment;
- whether the proposed scheme, in combination with other activities, could impact on water body objectives under the Water Framework Directive (namely cause deterioration in ecological status/potential or prevent the achievement of improvements in status);
- whether the proposed scheme, in combination with other activities, could affect a designated site;
- whether there are other impacts, such as impoundment or flow depletion independent of your own scheme.

Source:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/297152/LIT_8848_c3f345.pdf

It is important that cumulative effects are assessed already in the early stages of an environmental assessment rather than merely as an 'afterthought' at the end of the process. The competent public authorities generally have a vision on the whole river and should help to investors with estimation of cumulative effects risk. The assessment of cumulative effects during the AA is described further in the Chapter 6.2.

4.6 Distinguishing between significant and insignificant effects

Identifying the species and habitats that are likely to be affected by a hydropower development plan or project is the first step of any impact assessment. After that, it is necessary to determine whether the impact is significant or not in view of the Natura 2000 site's conservation objectives.

Clearly, the assessment of significance needs to be done **on a case-by-case basis**, in function of the species and habitats present and of the precise characteristics of the project itself. The loss of a few individuals may be insignificant for some species but may

have serious consequences for others. Population size, distribution, range, reproductive strategy and life-span will all influence the significance of the effects and this will vary from one Natura 2000 site to another, even if they are designated for the same species.

The interconnectivity of effects should also be taken into account, for instance land take, on its own, may not be significant for a particular species, but when combined with major disturbances or displacement risks, it may be enough to significantly reduce the fitness, and ultimately the survival rate, of that species.

The assessment of significance should also be considered over an appropriate geographical scale. For migratory species that move over very long distances (such as Atlantic salmon *Salmo salar*), the impact at a specific site may have consequences for the species over a larger geographical area (river basin). Likewise, for resident species with large territories or changing habitat uses, it may still be necessary to consider potential impacts on a regional, rather than a local scale.

The appropriate assessment must also be based on the best available data. This may require dedicated field surveys or monitoring programmes some time in advance of the project. The investor has to be able to anticipate this in their planning and ensure the relevant data from biological and hydrological surveillance includes information on all important aspects (life cycle and seasonal variability). Such studies can sometimes take more than one year in order to be able to capture sufficiently the life cycle of the species and habitat types concerned.

4.7 Identifying potential impacts during different phases of hydropower plant development

When assessing the potential impacts on Natura 2000 sites it is important to bear in mind that impacts may arise not just in relation to the main infrastructure but also in relation to all other associated installations and facilities that accompany the project, such as temporary access roads, equipment storage, spoil heaps etc…These other facilities should be included in the Appropriate Assessment as well.

The impacts may also come into play at different times during the project cycle and must be assessed not just when new hydropower plants are being proposed but also when planning alterations to already existing hydropower facilities (e.g. to renovate or upgrade them or to decommission an remove them) or during the day to day running of the hydropower plant (e.g. in relation to maximum and minimum head heights etc..).

All these factors should also be taken into consideration during the impact assessment and, where necessary, avoidance or mitigation measures should be introduced into the planning agreements and accompanying planning permits to eliminate, or at least minimize, the effects of the proposed plan or project on wildlife.

Potential impacts during the construction phase

The riverbed can be affected by the preparation of the construction area and the construction works can harm water animals, especially fish, lampreys, crayfish and bivalves. For this reason it will be important to perform a field research of the site before the beginning of the construction, followed, if necessary, by relocation of individual specimens to reserve localities.

The timing of ground works must take into account sensitive periods for the species and habitats present, for instance during the period of reproduction. When preparing the terrain, disturbances on the surfaces often create unsuitable places where some animals can stay temporarily. These wet spots can be very attractive especially for amphibians (particularly *Bombina variageta*). It is therefore recommended to prevent these temporary spots from being created in the first place and to make the construction area inaccessible for animals.

Heavy machinery can be a source of oil and other polluting substances when the terrain is being prepared and the riverbed is being modified. For this reason an emergency plan should be in place in case of leakages of these substances. When the machinery and materials are moved from other places (especially from different basins), there is also a danger of transmission of bacterial and viral diseases, or the introduction of a non-native or invasive animal or plant species. When there is such risk, it is necessary to take preventive measures involving for instance the disinfection of the machinery or the use of autochthonous materials during construction.

Operation of a hydropower plant

It is recommended to start with a trial phase of operation, according to good practice. This will not only ensure that all the facilities are operating correctly, but also that the measures applied to avoid or minimise impacts (e.g. fish passes) are functioning as expected and not causing any unforeseen damage to habitats and species in the surrounding area. Potential defects or problematic spots should be re-evaluated and rectified.

Depending on the results of the Appropriate Assessment the competent authorities may also consider imposing certain conditions on the permit procedure, for instance to ensure that the flow regime is confirm to the needs to the surrounding river and avoids inappropriate peaks.

Maintenance and renovation

As the river habitat system is very dynamic, maintenance of hydropower installations is an essential part of the hydropower plant operation, especially vis a vis the station's equipment. The fluvial processes in the river system and its disruption by the construction of transverse barriers, which modify the speed of the flowing water, cause a loss of sediments which can accumulate in the weir and still water. These sediments have to be removed in order to maintain the weir and the raceway capacity.

It is, however, necessary to take into account that these sediments can be settled by larvae of lamprey and this is why ichthyologic research is necessary in the basin with presence of these species, followed by a transfer of animals where possible. Biological research of the site should also be realized before the start of other works associated with modifications of the riverbed or movement of the equipment in the stream trough.

When adjustments, renovations or reconstructions are planned of existing hydropower station, it is strongly recommended that more environmentally-friendly innovations of individual parts of the hydropower stations or of the technology are considered. Innovation is desirable especially when changes of the environment cause repeated collisions with nature elements (see below).

There are an increasing number of examples across Europe that illustrate the benefits of renovating or re-constructing existing old hydropower facilities. These can lead to potential win-win situations (or small loss- big gain solutions) that are of benefit both for the hydropower sector in terms of more efficient cost effective energy production and for nature conservation, in terms of restoring the conservation of the EU protected species and habitats present in the site.

End of operation

The last phase of the hydropower station life cycle is its closure. This phase can come for several reasons, for example natural influences, upgrading the energy gaining technology, economic aspects or other unidentified circumstances. In this case, hazardous components and technologies should be removed from the hydropower plant station and permanent passage granted to water animals. All parts of the construction that complicate the passage of flood waves should also be removed. All removed parts should be disposed of properly according to the corresponding type of waste.

Measures may also be needed to renaturalise the streams and their environs, especially in Natura 2000 where there may be a need to restore the damaged habitats and species present in accordance with Article 6.1 and 6.2 of the Habitats Directive.

5. THE BENEFITS OF STRATEGIC PLANNING

5.1 Strategic planning and adopting an integrated approach to the hydropower schemes design

As the previous chapter illustrated, rivers are complex dynamic ecosystems that are used by a wide range of stakeholders. In order to develop sustainable hydropower facilities that aim to minimise negative impacts, it is clear that there are considerable benefits to adopted a strategic approach to planning future developments so that can take account of the requirements of other river users early on in the decision making process.

The old-fashioned way of developing a plan or project, be it for hydropower or for any other sectoral interests, is to first design the plan or project for its purpose and then, later on, to consider wider environmental and other use issues. However, this often results in potential conflicts being taken into consideration at a relatively late stage in the planning process, at a time when there are fewer options. In practice, it also means that project or plan developers have little interaction with experts from the environmental sector before the plan or project is submitted for an appropriate assessment.

When the design concept is already so far progressed, the environmental impact assessment often becomes an exercise in damage limitation and, even though all the rules governing such assessments, including those under the Habitats Directive are followed thoroughly, there is no guarantee of success. This traditional type of approach to project design and planning can also lead to long discussions with planning authorities, other interest groups and NGOs during the public consultation phase which can, in turn, cause significant delays to the planning process and incur additional costs.

Recognising these problems, more and more infrastructure planners are now adopting a more integrated approach to project planning and design, one that considers both the infrastructure and the ecological needs of the site, together with other land uses of the river, at the outset and factors these into the initial project design.

An integrated planning approach has many advantages:

- It promotes a more interactive and transparent planning process and encourages the active assistance and input from ecologists and other stakeholders right from the outset.
- If done correctly, strategic (spatial) planning can help to avoid or reduce the number of potential site-specific conflicts at a later stage in the development process, when financial and legal resources have been committed and there is less room for manoeuvre.
- This can in turn also provide developers with a more transparent and stable regulatory environment and offer them greater certainty over the likely success of their planning application because environmental concerns were taken into account already during the initial project concept.

- It can be more cost effective in the long run. Traditional infrastructure projects often face considerable practical problems (and costs) in trying to incorporate environmental improvements or mitigation measures into an already completed design. When avoidance or mitigation measures are factored in already at an early design or planning stage they will not only be technically easier to implement but also much cheaper;
- It can lead to the development of new, innovative solutions which are unlikely to have been explored under the more classic sectoral approach to project planning.
- It can contribute to an improved public image of the project and the institutions responsible. By informing the public and involving key stakeholders during the entire planning process, and not simply at the impact assessment stage, many of the delays caused during public consultation can be effectively overcome.
- It can highlight the enhanced delivery of multiple ecosystem services, and their monetary and non-monetary values to citizens, compared with a traditional solution.

Whilst it is true that preparing and executing such an integrated planning process generally requires a more substantial initial investment for the public authorities concerned there is strong evidence to show that in the long run it delivers substantial benefits that far exceed the initial extra investment required.

It is for these reasons that the European Commission strongly recommends the use of the integrated approach for planning hydropower projects.

The integrated approach is especially important when dealing with developments that may affect Natura 2000 sites as it will enable the planners to take specific account of the site's conservation objectives at an early stage in the planning process when more options are available. Whilst this may not guarantee the success of the project application it should considerably facilitate its authorisation process. This doesn't mean that there won't be occasions where a project simply cannot be made compatible with the Natura 2000 site's conservation objectives, particularly on relatively unaltered river systems, but at least this conclusion will become evident much earlier on before significant investments are made.

5.2 Determining suitable locations for hydropower plants developments

One of the most effective ways of avoiding potential conflicts with Natura 2000 sites is to consider the location of new hydropower developments at a strategic planning level – for instance through a regional or national development plan or wildlife sensitivity maps. This will help to identify the most suitable locations that provide not only the right conditions for hydropower but also minimise the risk of potential conflicts with Natura 2000 sites.

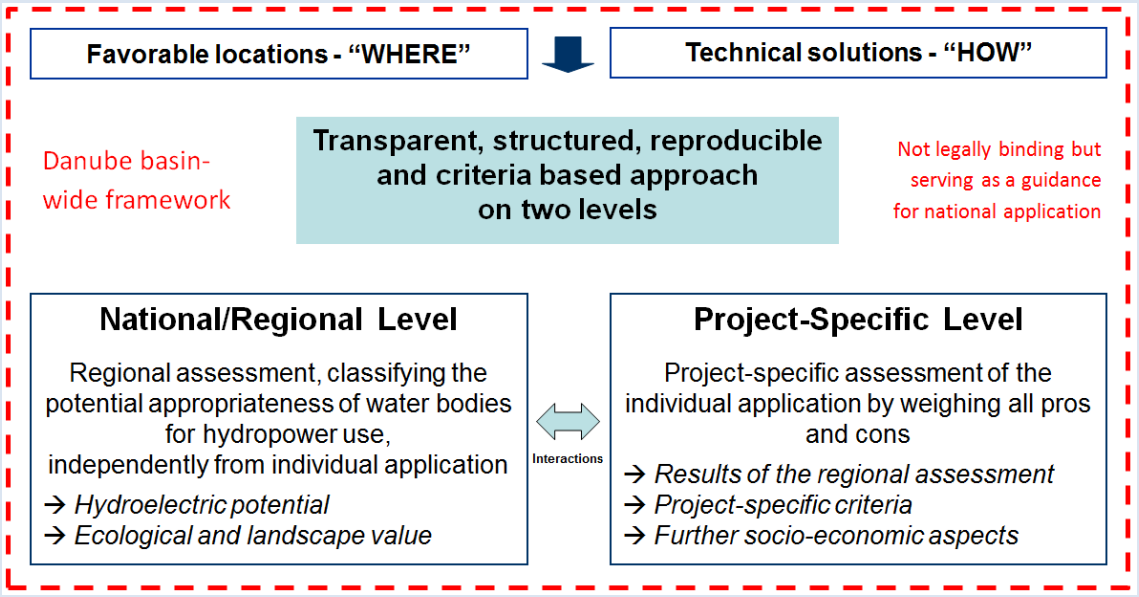
In order to minimize the need for new sites **consideration should be given first and foremost to the potential to modernise and upgrade already existing hydropower plants, which may contribute to the achievement of objectives on renewable energies without entailing an additional impact on the conservation status of the river concerned** (and may even help to improve its status). Pre-planning mechanisms, in which regions and municipalities allocate suitable and "no-go" areas for the development of hydropower is also recommended (European Commission 2006)[48].

[48] *WFD and Hydromorphological pressures. Policy paper. Focus on hydropower, navigation and flood defence activities. Recommendations for better policy integration - http://www.sednet.org/download/Policy_paper_WFD_and_Hydro-morphological_pressures.pdf*

Box 14: Guiding Principles on Sustainable Hydropower Development in the Danube Basin

The International Commission for the Protection of the Danube River recommends focussing on already existing transversal structures (e.g. weirs for river regulation, flood protection or the stabilization of the river bed) instead of on new, untouched sites when placing new installations.

Using the existing structures, which are not planned for removal, can have a strong potential win-win effect, according to the Commission: "*using such structures additionally for hydropower generation can lead to a win-win situation if accompanying ecological restoration measures are applied*".



The strategic planning process includes firstly identifying so called exclusion zones : ie river stretches where hydropower development is acceptable only with difficulty because of national or regional legislation or international commitments; it should be done by national authorities on the national level. For this purpose a set of criteria should be set by the national authorities to make the process clear, transparent and unbiased.

Examples of such criteria are: protected areas, stretches with high ecological status, reference stretches, catchment size. In general the criteria should be set for a basin-wide application. They can be intended for a limited or unlimited period of time, for selected hydropower installations or for all types of installations, etc.

Secondly, the strategic planning should focus on assessment of technical and biological suitability of the remaining river stretches for hydropower utilization.

The document "Guiding Principles on Sustainable Hydropower Development in the Danube Basin" contains a set of national, regional and project-specific criteria with their description as well as user-friendly matrix for a decision support to provide a balanced achievement of energy and environmental objectives.

Source: ICPDR. Guiding Principles on Sustainable Hydropower Development in the Danube Basin

Box 15: Balkan Rivers - The Blue Heart of Europe. Hydromorphological Status and Dam Projects

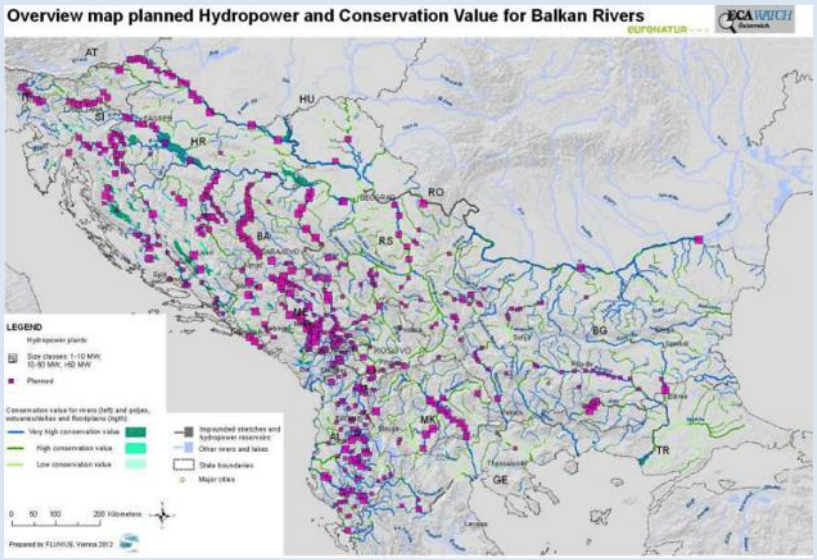
Purpose of the case: providing a reliable information base to exclude ecologically valuable river stretches from harmful hydropower developments and to support the identification of "no-go areas" as demanded by European Water Directors / Balkan incl. Slovenia, Croatia, Greece and Bulgaria

This study carried out a first overview of the most ecologically valuable river stretches in the Balkan region based on the hydromorphological intactness and protected areas as well as on the location of existing and planned hydropower plants. An overlay shows where hydropower planning poses the biggest threat to river ecology.

Regions and catchments of the Balkans have retained many more largely intact river landscapes than in western and central European rivers. About 30% of large rivers are still near-natural and of very high conservation value, in Albania and Montenegro even more than 50%, while in Germany only 10%, in Switzerland 7% and in Austria 6% of the rivers (of comparable size) are in such very good state. The Balkan is one of Europe´s regions with the highest proportion of rivers with high conservation value. The river systems are rich in endemic fish and mollusc species, which makes them globally important in terms of biodiversity conservation.

Extensive hydropower development would significantly impact on the region's freshwater ecology. More than 573 new dams larger than 1 MW are planned, in 70% of cases these would impact on rivers with "very high conservation value" and, in 23% of cases, on rivers with "high conservation value". Only 4% are related to existing dams (improvement or enlargement of existing turbines).

It was recommended therefore that the Balkan´s remaining river stretches with very high conservation value should be kept as far as possible free of new river infrastructure development in order to maintain their significant contribution to Europe´s biodiversity conservation targets and to continue deliver a wealth of important ecosystem goods and services to the region, such as self-purification, flood protection for settlements further downstream, and coastal protection.



Instead, priority should be given to upgrading existing hydropower plants and lowering energy demand by increasing energy efficiency, the potential for which in the Balkan region is huge. Existing dams should mitigate impacts, e.g. by being made passable at least for fish, where feasible also for sediment.

The study can only provide the basis for complex political decisions that need to be reached with stakeholder involvement. But it hopes to provide an important evidence base for the identification of "no-go" areas as suggested by the European Water Directors and to develop hydropower planning strategies that will minimise ecological impacts at lower costs.

Source:
http://www.balkanrivers.net/sites/default/files/BalkanRiverAssessment%20Executive%20Summary29032012.pdf

Box 16: New classification and its particularities

In France the new classifications was introduced by Article 6 of the Water Act (2006) and declined in the Environmental Code and its regulatory part. It make possible to adapt previous devices to the new context. Two complementary lists of streams were prepared.

The first classification list "**Rivers for protection**" aims to protect certain rivers degradation and make their conservation in a long-term possible.

1- Rivers in good ecological status – streams in very good chemical status and in very good biological status, free of significant human disturbance.

2 - Biological sources – streams or their parts identified as biologically very rich with presence of species indicating good functions of the environment. These sections can naturally repopulate disturbed parts of the same river system. To fulfil this role, aquatic organisms must be able to move freely within the river system including the disturbed sections. The first lists of biological sources have been defined for the period 2010-2015 and it is **determined in the RBMP**.

3- The rivers with high importance for diadromous fish - major routes of migratory fish and streams offering them the best potential in terms of breeding and/or growth habitat. These areas are identified in the migratory fish management plans and **included in the RBMP**.

The regulatory consequences of this classification are following:

- New barriers to ecological continuity, regardless of use, shall not be allowed on the classified rivers.
- For existing and licensed constructions, the renewal of their license will be subject to requirements according to the criteria behind the classification of rivers:
  - maintain the good ecological status of water;
  - maintain or achieve good ecological status of rivers in a watershed;
  - protect migratory fish alternately living in freshwater and saltwater.

The second classification list "**Rivers for restoration**" must allow quick compatibility of existing structures with ecological continuity objectives. It involves an obligation to transport of sediments and movement of migratory fish (not only diadromous).

The regulatory consequences of this classification:

- In practice, the existing constructions on rivers, canals or other parts of the river system must be managed, maintained and equipped according to the rules defined by the authority in consultation with the owner or the operator.
- These recommendations may concern technical measures as construction of fish passes and additional devices.
- All constructions have to be put in order the latest within a period of 5 years after the publication of the classification.

Source: http://www.onema.fr/IMG/pdf/revision_classements.pdf

The **French National Agency for Water and Aquatic Environments** offers further useful advice on other relevant aspects. For example:

- the national identification of obstacles to ecological continuity - http://www.onema.fr/Recensement-des-obstacles-sur-les
- information on specific research program on the impacts of hydropower on migratory fish (mainly the eel) - http://www.onema.fr/Programme-de-R-D-Anguilles
- a national technical tool "RefMADI Hydroelec" developed for the assessment of impacts on aquatic environments by hydropower (creation, renewal, modification) - http://www.onema.fr/RefMADI-Hydroelec

Box 17: HY:CON - A strategic tool for balancing hydropower development and conservation needs

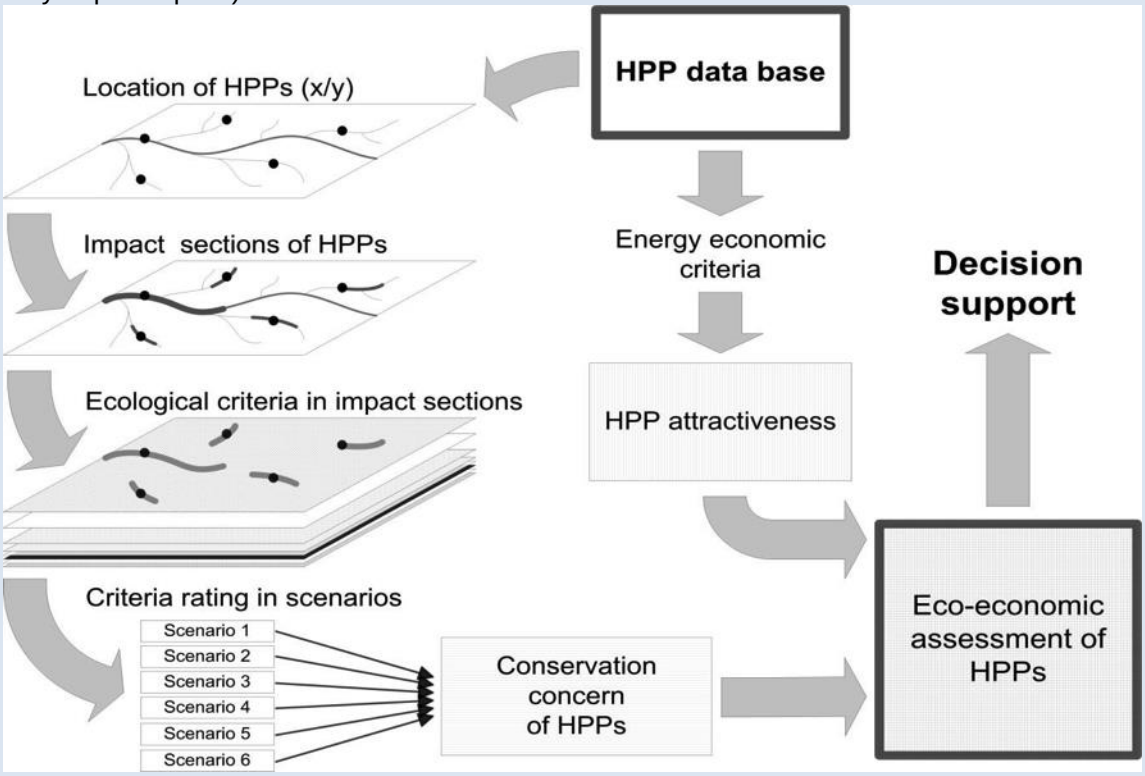
Purpose of the case: strategic instrument assessing the energy economic and conservation needs / Austria

A tool that compares the energy economic characteristics of hydropower plants with potential conservation needs of ecologically sensible river stretches was developed. Based on 199 hydropower plants in Austria Hy:Con identifies projects with the highest electricity system value from an energy economic point of view and least conservation concerns and helps to discard unfavourable projects.

The results show that due to the already achieved high rate of exploitation, only a limited number of new projects are without conservation conflicts. Upgrading of existing hydropower plants is associated with least ecological impacts, while plants with reservoirs are favoured against run-of-the-river plants. Cumulated ecological effects of numerous small hydro plants are significant, while the contribution to overall energy production is comparably small.

Hy:Con represents a strategic instrument that helps decision makers pinpoint the limitations of future hydropower development in heavily exploited areas and avoid conflicts and stranded investments.

The scheme of HY:CON approach at national scale on a catchment area >10 km^2 is following (HPP = hydropower plant)



Source: ; http://www.e3-consult.at/publikationen_vortraege/publikationen/hy_con_a_stratigic_tool_for_balancing_hydropower_development_and_conversation_needs

Land use or sectoral plans usually cover a broad geographical area, be it at the level of a municipality, region or country. This scale, combined with the spatial nature of the plans, enables strategic decisions to be made about the capacity and location of hydropower developments over a broad area, as well as to consult early on with other interested

bodies. The whole process should ideally result in a more integrated and sustainable form of spatial planning which takes on board wider societal concerns at an early stage. This will in turn also provide the industry itself with a more transparent and stable framework for growth and expansion.

A crucial first step in developing a spatial vision for hydropower development that is compatible with nature conservation interests is to determine within a given area both:

- the capacity for hydropower development - for instance in terms of river flow, electricity generation, access to the grid, and other physical or economic constraints – placing particular emphasis on the potential to modernise already existing hydropower facilities rather than installing new facilities in a new stretch of river;
- other land-uses and restrictions and other societal constraints, including nature conservation interests.

With the benefit of geographical Information systems (GIS) data collected on these aspects at a strategic level can be used to develop useful overlay maps which can help authorities to identify, within a given region, potentially low-risk areas – i.e. areas of high value for hydropower development but that also present little or no risk from a nature conservation perspective or potential high-risk areas that are best avoided or where mitigation measures and more substantial impact assessments are likely to be required.

These aspects should be investigated as part of the initial development plan proposal and should also be further developed through the Strategic Environmental Assessment or Appropriate Assessment, where this is required, and/or through consultation with developers and other interested parties. This will not only ensure that the final result is more integrated and acceptable to all concerned but should also reduce the risk of unforeseen difficulties and delays at later stages.

Box 18: LIFE+ project ReStEP – Regional Sustainable Energy Policy based on the Interactive Map of Sources

Purpose of the case: Presentation of LIFE+ project approach

The goal of the project is to make, introduce in practice, test, evaluate and distribute within the framework of the public administration and the business sector a new comprehensive method for urban management and regional planning in the field of proposing and assessing energy projects. The main viewpoint is efficient utilisation of natural resources and the real environmental protection. The new method will use an innovative software tool – an interactive map of conditions for renewable and alternative energy sources including hydropower.

The important part of the project is represented by restrictions defined because of nature conservation and other public interests. All available and relevant geographical data are evaluated from point of view of national legislation, international commitments and measures of non-legislative character. The potential use of renewable energy sources (incl. hydropower plants) is assessed for all types of legislative protection of sites (protected areas incl. Natura 2000, localities of protected species, mainly these for which action plans are carried out etc.) and evaluated as without conflicts, with resolvable conflicts or with conflicts preventing the realisation. The accordance with international commitments (incl. Habitats Directive and WFD) and conservation of non-protected but seriously endangered phenomena are evaluated in a similar way.

The user of IT tool can work with the result showing him as well the potential of using specific type of renewable energy source as location and importance of constraints caused by nature conservation where Natura 2000 plays very important role.
Source: http://www.restep.cz/en

5.3 Wildlife sensitivity maps

Wildlife sensitivity maps are useful tools in helping to place hydropower developments in areas that are compatible with nature conservation requirements. Sensitivity maps can be developed for selected categories of species (e.g. fish species of European importance) or for valuable wildlife in general over a pre-determined area – for instance an entire region.

When wildlife sensitivity maps are super-imposed over the hydropower capacity maps for instance, areas of 'low or no risk' can be identified as well as areas of potential 'higher-risk' where particular species of conservation concern are to be found either year-round or seasonally (e.g. during migration). They can also highlight **potential cumulative impacts** of hydropower developments in a particular region and assist in establishing the likely carrying capacity of that region as regards the number of developments it can sustain.

Box 19: Restoring the Loire: The "Plan Loire Grandeur Nature"

Purpose of the case: strategic planning – impact on stakeholders / France

There are 53 large dams and ca. 10.000 smaller structures on the river basin of Loire. Many of the weirs are abandoned. There is also ca. 1.000 km of dykes on the medium part of the river. This anthropogenic factors caused decrease in migratory fish species, i.e. Eel, Atlantic Salmon, Shad or Lamprey. The Sturgeon disappeared completely. A public body wanted to build four more dams on the basin and was cooperating strongly with the NGOs. The Loire Vivante struggle, between 1986 and 1994, managed to prevent this. Instead an ambitious "Plan Loire Grandeur Nature" was launched in 1994.

Since then a massive restoration programme has been underway to restore the river's continuum through the removal ofa number of obsolete dams. Two large dam projects have been removed, four small dams have been torn down and fish passes have been built where it was impossible to remove the dams.

Almost the whole Loire basin is designated in the Natura 2000 sites. A large restoration programme, Loire Nature (15 million EUR) has been implemented during 2002-2006 with the help of national NGO's. Also a project LOGRAMI (Loire Grands Migrateurs) from the LIFE programme has been implemented in 2000-2004 with costs of around 2.5 million EUR with the aim to help Salmon restoration.

WWF has launched a campaign, together with 30 other organizations, among them professional fishermen, to replace the Poutès-Monistrol dam, on the upper Allier, very destructive for salmon with energy efficiency and other renewable sources (windmills, wood energy, solar). In the city of Brives-Charensac, on the upper Loire basin, three plants (where 250 workers were employed) have been removed and installed in non-floodable parts of the basin to let more room for the floods.

The effects of measures are noticeable. There is for example an increase in Salmon return from 100 in 1992 to 900 in 2006, nevertheless this species is still at high risks. The removal of the Maisons-Rouges dam caused a massive return of Lampreys and Shads. Also other species are returning now because of improvement of water quality connected with replacement of maize fields with pastures in cooperation with farmers.

Very important effect of this kind of strategic planning is that almost every investor is now taking into account the fact that a water body is fragile and that the resource is limited.

Source: http://www.ecrr.org/Portals/27/Publications/restgeom_doc9.pdf

The resources spent for the development of these kinds of maps are likely to be more than compensated for in terms of smoother and less complicated and time-consuming site- related assessments. However, sensitivity maps can only provide a broad orientation of areas of potentially high-, medium- (where mitigation measures may be possible), and low risk areas (where the impact is expected to be limited or low). As such they are not a substitute for Environmental Impact Assessments (EIA) or Appropriate Assessments (AA) at project level. These may still need to be undertaken for individual hydropower development projects.

Comprehensive species surveys within the EIA or AA at individual site level will be able to determine more precisely for each site what the specific nature values and risks of impact are. In this context, the **strategic level maps can already help to indicate the required level of assessment that would be needed for more detailed and stringent baseline studies at individual project leve**l.

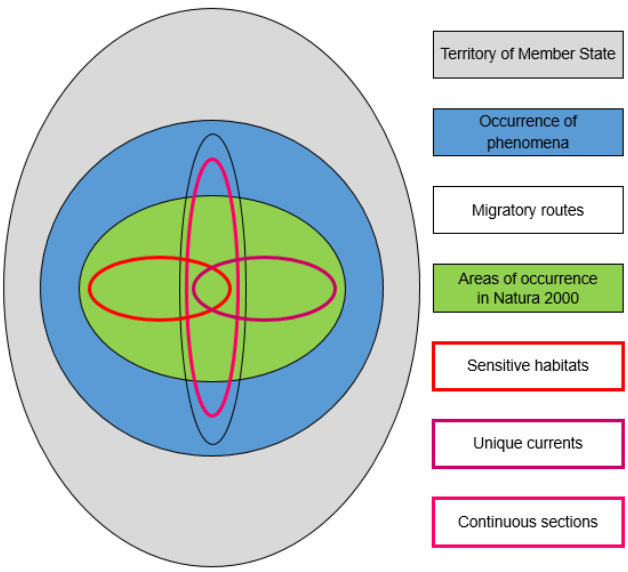
The other significant advantage of wildlife sensitivity maps over larger scales is that they **help pre-empt any potential conflicts with Articles 5 of Birds Directive and 12&13 of Habitats Directive**. As explained in chapter 2, these provisions aim to ensure the protection of species of European Importance across their entire natural range in the EU, i.e. also outside Natura 2000 sites. Hydropower developers or planners must therefore be able to demonstrate that they have taken the necessary precautions to avoid compromising this species protection regime.

Distribution maps of species of EU interest can help planners and developers to avoid areas outside Natura 2000 that are particularly important for these species, such as bottleneck migration routes for migratory fish. However, there is a clear need for more detailed surveys and research into the spatial distribution of vulnerable species across the EU. This could also done at a supranational (or biogeographical) level so that the entire natural range of the species can be covered.

5.3.1. Possible approaches to determining the most suitable locations

Decisions on where to place new hydropower investments should be based on preparation of a comprehensive methodology, detailed mapping and robust evaluation. One possible approach to obtaining a GIS map source is illustrated by the steps described below.

Natura 2000 sensitivity maps should not be based only on GIS analyses. It should also be completed by guidelines regarding the process and technologies for refurbishment and upgrading of hydropower plants. A wide spectrum of different specialisation experts should ideally be involved in the process. Sensitivity map can´t be overly rigid, it should be adapted for calibration based on improved knowledge. It is also important to publish the Natura 2000 sensitivity map, ideally on a webpage of responsible authority. It should be based on description of purpose, methodology



used, results and interactive map outputs.

First, it is necessary to know the distribution data of relevant EU protected species and habitat types and to determine their areas of occurrence in Natura 2000. For anadromous fish and lamprey' species the migratory routes are best defined in collaboration with neighbouring states (if needed).

Identifying migratory routes

As a part of sensitivity mapping for hydropower development it is important to take account of all routes serving as corridors connecting marine areas with spawning sites of target anadromous species. This map should be based on map of the favourable reference range (available through the Article 17 Habitats Directive reporting[49]).

Identifying areas of occurrence in Natura 2000

It can be difficult to describe the occurrence of species inhabiting small streams in large sites. In such cases, the following procedure could be used if no exact geographical data are available.

1) Prepare a list of potentially affected target features in the Member State
2) Map Natura 2000 sites with each selected target feature (one shape for each target feature)
3) Specification of occurrence of each target feature inside Natura 2000 sites - map of potential habitats ecologically interconnected with its proved occurrence
4) Enlargement of a map to surrounding areas directly connected in sense of population or habitat structure and functions

With all this data it will then be possible to identify the most important areas (=key zones) for the species/habitat types concerned.

[49] *The map of actual range for a number of EU protected species (EU-25, 2001-2006) is described in the Annex 2 - http://bd.eionet.europa.eu/article17/speciessummary*

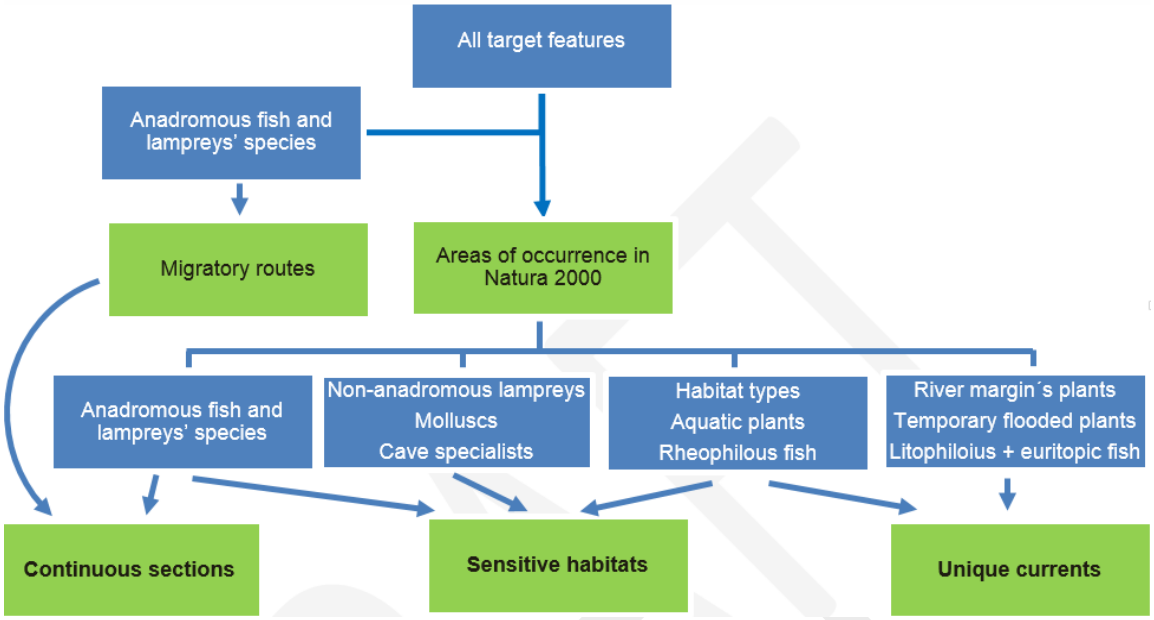


Fig. 6: Framework scheme of the process of the key zones determination

Identifying different zones

Key zones will indicate those areas that are the most vulnerable to hydropower development and are best avoided. Outside these one can also distinguish further between non –favourable areas; less favourable areas and suitable areas.

A) <u>Key zones</u>

Key zones could help to divide the territory of the Member State into **areas usable for hydropower development planning, including the potential for modernising and upgrading existing facilities**. Although the number of categories and their strictness can be variable, using of three categories is still recommended because of its simplicity of application.

⇒ ***Sensitive habitats –*** places which could be harmed easily by minor changes of the habitat. Described for:

- Running water habitat types – mainly habitats potentially influenced by inundations and changes in sediment dynamics
- Aquatic plants – habitats of species influenced mainly by changes in sediment dynamics
- Non-migratory lampreys – places of most abundant occurrence of streams with frequent deposits inhabited by larvae
- Mostly rheophilous fish species – spawning places for important part of population, could be connected in continuous parts of river basin to make communication of individuals living in or around streams possible
- Bivalve molluscs – inhabited habitats which could be mostly changed by hydropower construction and operation
- *Proteus anguinus* + *Congeria kusceri* – practically all known localities of these species

⇒ ***Unique currents –*** irreplaceable places in broad area reliant on natural conditions of flow regime – rare habitats of rheophilous species e.g. rapids in slowly flowing

streams, specific sediment loads etc. Described for running water habitat types, plants connected with running water habitats, non-anadromous fish species.

⇒ ***Continuous sections*** – specified as migratory routes of anadromous fish and lampreys connecting spawning areas with sea in river basins where Natura 2000 sites for these species are designated, can't be disjointed between sites. Also sections for other fish and lampreys' species (as well as mammals directly connected with water habitat, aquatic turtles, crayfish and bivalve molluscs) should be defined where necessary to connect parts of population co make communication of individuals living in or around streams possible.

It can also help identify areas that are more or less sensitive or entirely suitable for hydropower development:

A) Non-favourable areas – relevant conflict with conservation of target features – influence on sensitive areas, modification of unique habitats or barriers on stretches with need of continuous integrity.

B) Less favourable areas – possible conflict with Natura 2000 conservation – interfering in areas of occurrence in Natura 2000 of selected species and habitats and adjoined areas of their occurrence.

C) Suitable areas – probably no connection with Natura 2000 conservation – no specific restrictions. Authorisation may be granted (from Natura 2000 conservation point of view) if all provisions of the Habitats Directive are met (see the Chapter 6).

The following table summarizes the evaluation process for areas usable for hydropower development planning (A – non-favourable areas; B – less favourable areas; C – suitable areas) for specific groups of EU protected species or habitats.

	A. *Habitat types*	***B.*** *Aquatic plants*	***C.*** *River margin´s plants*	***D.*** *Temporary flooded plants*	***E.*** *Mammals*	***F.*** *Turtles*	***G.*** *Lampreys*	***H.*** *Anadromous fish*	***I.*** *Rheophilous fish*	***J.*** *Litophilous + eurytopic*	***K.*** *Crayfish*	***L.*** *Dragonflies*	***M.*** *Molluscs*	***N.*** *Cave specialists*	***O.*** *Birds*
Modification of habitat structure															
Sensitive habitats	A	A	-	-	-	-	A	A	A	-	-	-	A	A	-
Areas of occurrence in Natura 2000	B	B	B	B	B	B	B	B	B	C	B	B	B	-	B
Influence of flow regime															
Unique currents	A	A	A	A	-	-	-	-	A	A	-	-	-	-	-
Areas of occurrence in Natura 2000	B	B	B	B	B	B	B	B	B	B	B	B	B	C	B
Migration barriers															
Continuous sections	-	-	-	-	-	-	-	A	-	-	-	-	-	-	-
Areas of occurrence in Natura 2000	C	C	C	C	B	B	B	-	B	B	B	C	B	C	B

For evaluation of a specific plan or project it is also important to give a value for:

- making migration impossible or limited (exploiting the hydraulic power on existing weirs should be always preferred before construction of new barriers)
- influencing of the flow regime
- habitat structure modification

Areas usable for hydropower development should be defined also only for specific impacts of hydropower development. The simplified table below shows the links between key zones and the main categories of impact.

		Migration barriers	Influence of flow regime	Modification of habitat structure
Key zones	Sensitive	B	A	A
	Unique	B	B	A
	Continuous	A	B	B
Other areas of occurrence		B/C	B	B
Other localities		C	C	C

5.4 Streamlining the environmental permitting procedures

Another benefit of adopting a more strategic approach to energy transmission planning is that it helps to organise the various permit procedures and environmental impact assessments in a more efficient way.

This streamlining process has been formalised in the case of Projects of Community Interest (PCIs) under the Ten-T Regulation and specific Commission guidance[50] has been produced on how to implement such streamlining mechanisms in practice whilst at the same time ensuring the maximum level of environmental protection in accordance with EU environmental law.

The Commission guidance makes a series of recommendations which, although designed with PCIs in mind, are also relevant for all energy plans or projects, including hydropower developments. They are therefore summarised below.

The recommendations focus in particular on:

- Early planning, "roadmapping" and scoping of assessments;
- Early and effective integration of environmental assessments and of other environmental requirements;
- Procedural co-ordination and time limits;
- Data collection, data sharing and quality control;
- Cross-border co-operation, and
- Early and effective public participation.

5.4.1. "Roadmapping" and scoping of assessments

[50] *Guidance Document "Streamlining environmental assessment procedures for energy infrastructure 'Projects of Common Interest' (PCIs)" - http://ec.europa.eu/energy/infrastructure/pci/doc/20130724_pci_guidance.pdf*

As stated earlier in this chapter, an early planning and "**roadmapping**" of the different assessments and other environmental requirements to be met is vital for a successful streamlining of environmental assessment procedures. Ideally, this planning should happen at the very early concept stage of a project and should lead to a concise assessment roadmap, indicating which type of assessment should take place at what point in the overall assessment / permit procedure. This roadmapping should be the main responsibility of the project promoter, in close co-operation with the co-ordinating authority.

In case of a staged assessment, the roadmap should also indicate which aspects should be assessed at what stage in the process to ensure complementarity, and to avoid both non- consideration of certain elements and reduce the risk of repetitive assessments. The roadmap should also set out how and at what point in the process other environmental requirements should be met.

In order to adequately roadmap the different assessments required and other environmental requirements at stake, a **very early scoping of all potential environmental effects** of a project is recommended already at the conceptual stage. More detailed scoping should happen in line with the further development of the project, e.g. at the pre-application phase or as part of the EIA/AA process.

Scoping stimulates early dialogue, helps identify relevant legislation or necessary assessments and regulatory controls, or potential impacts that may be relevant to the project but not immediately perceived by the project promoter. It also helps to identify relevant data, possible alternatives, information gathering methods and their scope and level of detail, and issues of particular concern to affected stakeholders and the public. By agreeing on the expectations of the assessment with the relevant authorities at the start, the project promoter can confidently and effectively plan the collection of environmental information well in advance.

5.4.2. Early and effective integration of environmental assessments and of other environmental requirements

Environmental assessments should be performed as early as possible, and to the level of detail possible, at an early stage in the overall process. **Effective tiering** should be applied to ensure that different assessments required under different pieces of EU legislation, or in different phases of the process, build on, and complement each other. Environmental requirements other than assessments (e.g. as regards the strict species protection regime under the two Nature Directives) should also be integrated as early as possible, in the overall process to identify and remedy problems at an early stage, and to avoid delays and public acceptance problems in the run-up to project permitting.

As for early integration of environmental assessments, **it is strongly recommended that SEAs and, where applicable, AAs[51], are made mandatory already at the planning stage for national energy plans and programmes.** This allows the environmental suitability of different types of energy sources as well as different locations for energy projects to be assessed from the start.

[51] *see European Court of Justice Ruling C-177/11*

It also ensures that the level of assessment always matches the level of planning/decision-making and avoids that *faits accomplis* are created by inclusion of projects in national energy plans, for which no relevant assessments have been carried out. This will lead to fewer conflicts at the individual project level, both in substance and in terms of public acceptance.

5.4.3. Procedural coordination, 'one stop shop' and time limits

According to the new EIA Directive, in the case of projects for which the obligation to carry out assessments of the effects on the environment arises simultaneously from this Directive and from the two EU nature directives, Member States shall, where appropriate, ensure that coordinated and/or joint procedures are provided for. Under the coordinated procedure, Member States must endeavour to coordinate the various individual environmental assessments of a particular project by designating an authority for this purpose and providing, wherever possible, for a single assessment of the environmental impact of a particular project.

A further powerful tool to streamline environmental assessment procedures is to **set time limits** for parts or all of the environmental assessment procedures. The EIA Directive, revised by Directive 2014/52/EU, has introduced specific obligations as regards the introduction of time-frames and of "one-stop shop" procedures. According to Article 4.6 Member States shall ensure that the competent authority makes its decision as regards the EIA permit as soon as possible and within a period of time not exceeding 90 days from the date on which the developer has submitted all the information required.

However, in exceptional cases, the competent authority may extend the deadline, for instance relating to the nature, complexity, location or size of the project. This is especially relevant for projects falling also under the scope of the Habitats Directive. In view of the very specific scientific and technical surveys required for Appropriate Assessments, time limits should be set on a case by case basis depending, for instance, on the nature and duration of the field surveys required for the EU protected species and habitat types present.

The introduction of time limits aims to reduce unnecessary delays in assessment procedures and encourage the creation of synergies between assessments where possible, but should in no way lower the quality of the environmental assessments performed.

5.4.4. Transboundary Environmental evaluations

The Directive 2001/42/EC (SEA Directive) and Directive 2011/92/EU (EIA Directive) require that a Member State in whose territory a plan, programme or project is being prepared, or intended to be carried out, shall before its adoption, and as soon as possible, inform any other Member States that are likely to be significantly affected by such plans, programmes or projects.

Member States can, for instance, co-operate and coordinate on the EIA/AA procedures, especially regarding the definition of the scope and level of detail of the information to be submitted by the project promoter and the schedule for the permit granting procedure. In

2013 the Commission produced guidance on the application of the environmental impact assessment procedure for large-scale transboundary projects, aiming to facilitate the authorisation and efficient implementation of such projects in the future[52] [53].

5.4.5. Early and effective public participation

One major path of progress to ensure a better integration between the different sectors is an increase in transparency and public involvement in decision-making. The EU environmental assessment legislation (e.g. the EIA and SEA Directives) and other relevant EU and international instruments (Aarhus Convention) place strong emphasis on establishing open and transparent procedures and providing ample opportunities for public consultation. In the case of the Habitats Directive, public consultation is not obligatory but it is strongly recommended, if appropriate.

Early consultation with environmental stakeholders, and indeed all stakeholders, is important in ensuring that acceptable and sustainable solutions are found. It is important to reach a common understanding of the issues at stake and to foster a cooperative search for solutions. Evidence has shown time and again that most conflicts in the past stemmed from failure to involve environmental stakeholders early enough in project planning. Expensive procedures were required to seek compromises after lengthy and costly delays.

Ideally stakeholders and the wider public should participate in all stages of project development. Participation is especially important in the project definition phase and in the process of working out realistic alternative solutions for problematic projects. Project developers should consider developing a road map for public consultation as early on as possible in the project's development.

Box 20: Added value of public participation in addressing the hydropeaking challenges

Purpose of the case: Example from Adour- Garonne district of France

The key environmental issue in the « Hydro peaking challenge » of the French Adour-Garonne District Water Agency is the protection of salmonid spawning areas and the improvement in reproduction conditions for migratory species like salmon in the Dordogne basin. At first, Electricité de France (EDF) was asked to considerably limit the variations in the discharges on two important hydro-energetic chains on Dordogne and Garonne rivers. However, because of strong constraints and losses imposed by this demand, the measures were rejected as they were considered to be too high to be borne by EDF or by the Water Agency or other rivers users.

In order to find new solutions to better reconcile salmonid protection and electricity demand it was decided in 1997 to create a working group bringing together the Water Agency, a public establishment EPIDOR (*Etablissement Public Interdépartemental de la DORdogne*), Government representatives, fishermen federation, environmental associations, experts (MIGADO) and EDF.

Thanks to the dialogue and the collaboration between the different actors on the basis of their competences in the fields of energy, biology and economics, alternative solutions began to

[52] *Guidance on the Application of the Environmental Impact Assessment Procedure for Large-scale Transboudary Projects - http://ec.europa.eu/environment/eia/pdf/Transboundry%20EIA%20Guide.pdf*

[53] *The EU is also party to the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) and the Protocol on Strategic Environmental Assessment (SEA Protocol) Council Decision of 27 June 1997*

emerge. The solution finally adopted was considered acceptable by the community and the various actors. Instead of very strong hydroelectricity generation restrictions, it consisted of a mix of complementary measures concerning, on the one hand, flow regulation, but with less stringent constraints for hydroelectricity, and on the other hand, the aquatic environment itself, with the moving of spawning areas.

The analysis of the environmental and economic impacts shows that these measures lead to:

- A very small loss in environmental performances compared to the objective that was to protect all the spawning areas and that probably could not have been achieved even with the constraints initially imposed;
- A very large gain in terms of cost of measures and a cost that may be shared between EDF and the Water Agency.

Such results prove the usefulness of the dialogue between actors and of the involvement of the stakeholders as early as possible.

The objectives of any communication and active involvement strategy should be to:

- ensure a transparent planning and decision-making process of the infrastructure project and an openness as regarding all relevant information and data;
- raise awareness about the overall project objectives and related issues of the project;
- gain public support for the planning process and project implementation;
- integrate key stakeholders in the planning phase to create an atmosphere of mutual trust and respect, and thus facilitate the public acceptance and successful implementation of the project.

In practice the following are particularly important for ensuring a successful stakeholder consultation and participation process:

- *Timing of public participation*: Public involvement should begin in the earliest stages of a project so that environmental information can be used in the consideration of alternatives for design, location and financial arrangements. Public involvement should continue throughout the environmental assessment process and project cycle. Identifying relevant interest groups:
- *Identification of the relevant interest groups or stakeholders* is critical to successful public involvement, whether it concerns a policy, plan, programme (e.g. sectoral or regional) or project. Analysis of the social composition of the society in which the project is planned will also help ensure that all relevant social actors or stakeholders are identified and included in consultation. In addition, social analysis will identify local values, organizational structures and approaches to communication, negotiation and decision making.
- *Choosing the right form of communication and consultation:* Public involvement can range from simple dissemination of information to consultation and through to full participation in decision making:
    - *Informing:* one-way flow of information from proponent to public.
    - *Consulting:* two-way flow of information between proponent and public, giving the latter an opportunity to express views.
    - *Participating:* two-way flow of information and ideas in which the proponent and the public are involved in shared analysis and agenda setting and the public is voluntarily involved in decision making on project design and management through consensus on the main elements. It should be noted that good public participation processes go beyond simply introducing formal consultation

procedures. They enable stakeholders who are participating to also provide technically qualified and relevant contributions.

The level of public involvement required for a specific project will vary according to the social and political context. A participation matrix can be drawn up for each of the main stakeholder groups to help determine the appropriate degree of participation. The matrix also can be used as a systematic tool for defining roles and responsibilities of a stakeholder and identifying areas of potential disagreement between groups.

- *"Ownership" and commitment:* Early consultations with potentially affected groups can improve the environmental information supplied to decision makers (e.g. through identification of environmental impacts or the design of suitable mitigation measures), thus minimizing conflict and delay. In addition, genuine efforts to provide the public with information and respond to suggestions or concerns helps prevent miss understandings and can result in more widely accepted projects with a greater sense of local ownership.

Undoubtedly, public consultation and participation can be time-consuming and demanding, but when used positively they will improve the plan or project, reduce antagonism and enhance the potential for long-term success.

6. THE PERMIT PROCEDURE UNDER THE HABITATS DIRECTIVE

As stated before, EU nature legislation does not exclude development activities in and around Natura 2000 sites. Instead, it requires that any plan or project that is likely to have a significant negative effect on one or more Natura 2000 sites undergoes an appropriate assessment (AA) in accordance with Article 6.3 of the Habitats Directive in order to assess the implications of that plan or project on the site(s).

This chapter provides a step-by-step guide on undertaking the Natura 2000 permit procedure in the context of hydropower plans and projects in particular. Because Natura 2000 concerns Europe's most valuable and endangered habitats and species, it is logical that the procedures for approving developments that are likely to have a significant negative effect on these sites are sufficiently rigorous to avoid undermining the overall objectives of the Birds and Habitats Directives.

Particular attention is therefore given to the need for decisions to be taken on the basis of sound scientific information and expertise. Delays in the approval process are very often caused by poor quality AA that does not allow the competent authorities to make a clear judgement on the impacts of the plan or project.

It is also important to avoid confusion over the environmental assessments carried out under the EIA and SEA Directives and the AA carried out under Article 6.3 of the Habitats Directive. Whilst these assessments are very often carried out together, as part of an coordinated procedure, each assessment has a different purpose and assesses impacts on different aspects of the environment. **An SEA or an EIA cannot therefore replace, or be a substitute for, an AA.**

Article 6.3
Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.

Article 6.4
If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted.

The focus of the AA is on species and habitat types protected by the Birds and Habitats Directives, and in particular those species and habitats for which the Natura 2000 site has been designated. The AA does not have to assess the impact on other fauna and flora unless they are ecologically relevant for the EU protected species and habitats present on this site. An AA under Article 6.3 is therefore narrower in scope than an assessment under EIA and SEA Directives, being confined to implications for Natura 2000 sites in view of their conservation objectives.

The outcome of each assessment procedure is also different. In the case of the EIA or SEA assessment, the authorities have to take the impacts into account. For the AA, **the outcome is legally binding** for the competent authority and conditions its final decision. Thus, if the AA has ascertained that there will be an adverse effect on the integrity of the Natura 2000 site, despite the introduction of mitigation measures, then the plan or project can only be approved if the conditions in the derogation procedure foreseen under Article 6.4 are met.

6.1 When is the Article 6 procedure required?

The procedural and substantive safeguards that must be applied to any plan and project likely to have a significant effect on a Natura 2000 site(s) are laid down in Article 6 of the Habitats Directive.

This procedure is designed to:

- Assess the implications of a plan or project that is likely to have a significant effect on a Natura 2000 in view of the site's conservation objectives;
- Ascertain whether these implications will not adversely affect the integrity of the site;
- Provide a mechanism for approving plans and projects that have an adverse effect if they are considered to be necessary for imperative reasons of overriding public interest and if no less damaging alternative solutions exist. In such case compensatory measures must be taken to ensure the overall coherence of Natura 2000 is protected.

As regards its geographical scope, the provisions of Article 6.3 are not restricted to plans and projects carried out exclusively in a Natura 2000 site; they also target developments situated outside Natura 2000 sites but which are likely to have a significant effect thereon. The trigger for such an assessment is not based on whether the project is located inside the Natura 2000 or not but on whether it is likely to have a significant effect on a Natura 2000 site and its conservation objectives.

As stated above the effects need to be determined in function of the species and habitat types for which a particular site has been designated. This will influence how far from the project area one should look for possible effects. For instance, a rare plant which only occurs in specialised habitat conditions may only be affected by projects in the immediate vicinity whereas a migratory species which has wider habitat requirements may be affected by plans or projects further afield.

For hydropower development the following should be taken into account when carrying out the AA:

a) If maintenance activities are directly connected with or necessary for the management of a Natura 2000 site (and as such integrated into its management plan, if relevant),

they have to be designed in such a way that they do not adversely affect the integrity of the site. As a consequence, such activities can be authorized without AA.

b) Strategic documents may come into play when evaluation of "overriding public interest" of the (especially if these strategies are set by a legislative act – e.g. Law on Water). Nevertheless, any such decision must be carried out on a case-by-case basis.

c) River impoundment affects the downstream environment, so dams built in the same catchment, either in a series (i.e., along the same river) or in parallel (i.e. on different tributaries) will inevitably result in **cumulative impacts** on the water environment and, hence, likelihood of such cumulative impacts on some of Natura 2000 sites, too. The total impact on a river ecosystem of cumulative effects may be bigger than the mere sum of individual impacts. The most frequently mentioned type of cumulative impact is the combined effects of multiple dams on river discharge and water quality, as well as on species migration.

d) There are differences between administrative procedures approving on one hand newly designed hydropower installations and already existing facilities on the other. Newly built installations may have wider and more variable spectrum of possible impacts (during both building and operation stages) and thus one may expect that overall assessment will be more demanding. Effective and accurate determination of the extent to which a project may have adverse effects on one or more Natura 2000 sites generally requires precise data gathering and its careful analysis[54].

6.2 A step-by-step procedure for carrying out appropriate assessments

The procedure laid out in Articles 6.3 must be carried out in sequential order. Every step determines whether a further step in the process is required. For instance if, after the screening, it is concluded that there will be no negative effects on the Natura 2000 site, then the plan or project can be approved without the need for further assessment.

The steps are as follows (see diagram):

- **Step one: screening** – this initial step is to determine whether a plan or project has to undergo an appropriate assessment or not. If it is likely to have a significant negative effect on a Natura 2000 site, then an appropriate assessment is required.

- **Step two: appropriate assessment** – once it has been decided that an AA is required, a detailed analysis must be undertaken of the potential impacts of the plan or project, alone or in combination with other plans or projects, on the integrity of Natura 2000 site(s) in view of its conservation objectives.

- **Step three**: **decision making** - If the appropriate assessment concludes that there is an adverse effect on integrity of the site and these cannot be mitigated against then the competent authorities will need to refuse the plan or project.

Article 6.4 provide for certain derogations to this general rule. Thus, if it is concluded that the plan or project will have an adverse effect on a Natura 2000 site, it can still be approved under exceptional circumstances provided the conditions of Article 6.4 are met.

[54] *Eliantonio, M., Lammerant, J., McGuinn, J. and Volckaert, A., 2013: Support to develop guidance for streamlining environmental assessment procedures of energy infrastructure 'projects of common interest', Millieu, ARCADIS.*

It is clear from the above that this decision-making process is underpinned by the precautionary principle. The emphasis is on objectively demonstrating, with reliable supporting evidence, that there will be no adverse effects on the Natura 2000 site.

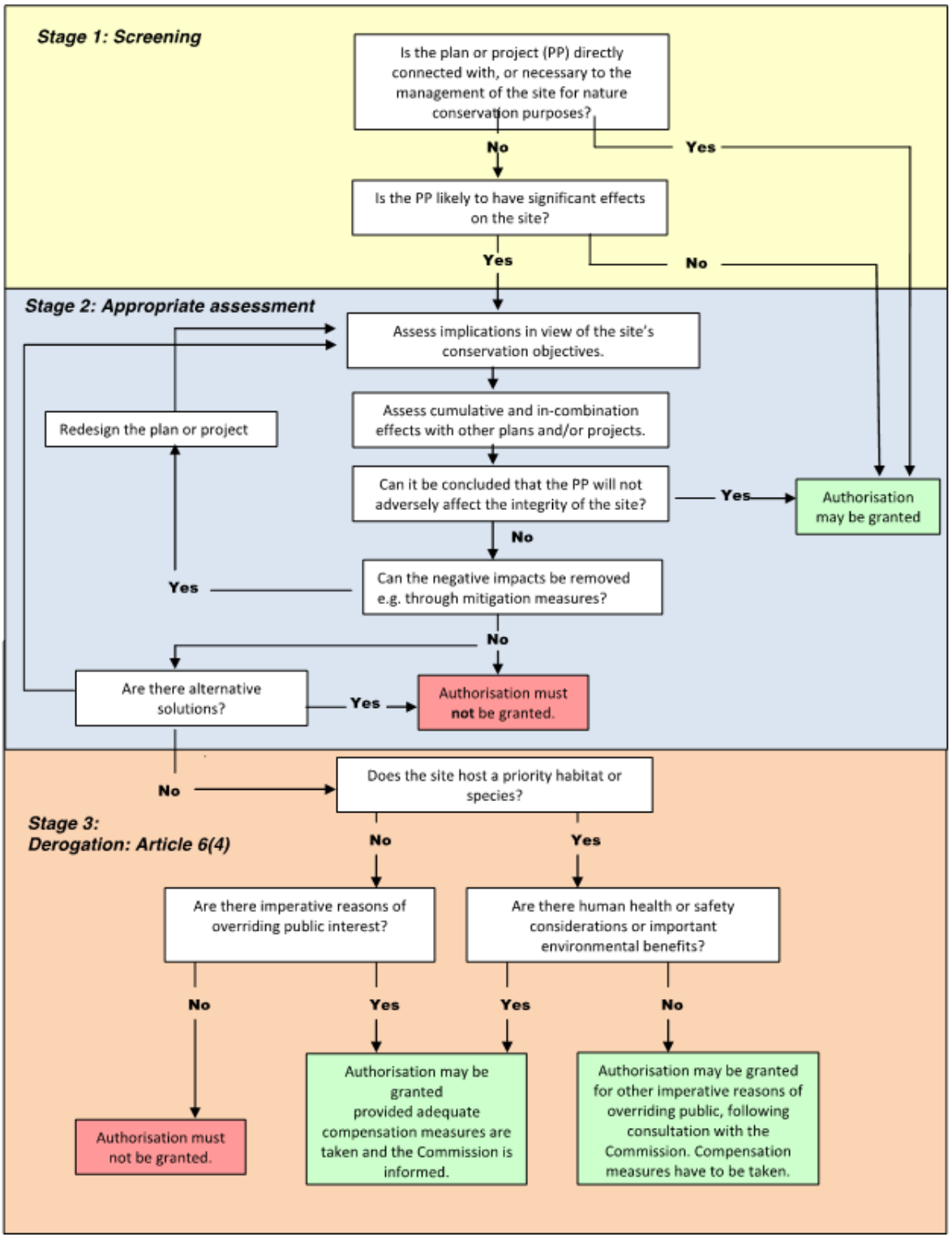


Figure 6: Flow chart of Article 6.3 and 6.4 procedure (based on European Commission methodological guide)

6.2.1. Step one: Screening

The first step in the Article 6.3 procedure is to determine whether or not an AA is actually needed, i.e. if a plan or project is likely to have a significant effect on a Natura 2000 site. If it can be determined with sufficient certainty that the plan or project is **not** likely to have a significant effect, either individually or in combination with other plans or projects, then it can be approved without further assessment.

However, if there is any doubt, an AA must be undertaken so that these effects can be studied in full. This was confirmed by the ECJ in the Waddensea ruling (C- 127/02) in which the Court concluded that: "*the environmental protection mechanism provided for in Article 6.3 does not presume that the plan or project considered definitely has significant effects on the site concerned but follows from the mere probability that such an effect attaches to that plan or project. In case of doubt as to the absence of significant effects such an assessment must be carried out, this makes it possible to ensure effectively that plans or projects which adversely affect the integrity of the site concerned are not authorised, and thereby contributes to achieving, the overall objectives of the Habitats Directive.*"

Box 21: Environmental Permit for Hydropower Scheme

Purpose of the case: pre-application and environmental site audit checklist by the Environmental Agency / Great Britain

During the so called “pre-planning process” there is an electronic application form to be filled in (“Environmental site audit checklist for hydropower schemes”) in order to gather information about various environmental aspects of planned hydropower scheme.

Applicant should fill in the checklist consisting of following issues:

1. Water abstraction and flow management
2. Conservation
3. Water quality
4. Biodiversity and fisheries
5. Managing flood risk
6. Navigation

Application can identify whether the applicant could provide all information needed for decision making in the permitting procedure, can help with providing relevant information to the applicant (e.g. links to a map with Natura 2000 sites, list of protected species in England, etc.) and condenses various requirements into single application form.

	Yes	No
Is the scheme within, or likely to affect, a Site of Special Scientific Interest (SSSI)? (See note 2a)		
Is the scheme within, or likely to affect, a Special Area of Conservation (SAC)? (See note 2b)		
Is the scheme within, or likely to affect, a Special Protected Area (SPA)? (See note 2c)		
Is the scheme within, or likely to affect, a national nature reserve? (See note 2d)		
Is the scheme within, or likely to affect, a local nature reserve? (See note 2d)		
Is the scheme within an Area of Outstanding Natural Beauty (AONB)? (See note 2e)		
Is the scheme within a national park? (See note 2f)		
Is the scheme likely to affect any waterfall, public footpath, heritage feature or conservation area? (See note 2g)		
Have formal ecological surveys been carried out on the site? (See note 2h)		
Does the scheme take account of protected species that may live at the site or nearby? (See note 2i)		

Data can be then more easily shared between different competent authorities. Afterwards, proposal is assessed by the Agency which at the same time offers initial advice. Additional data could be required or in some cases the Agency may advise the applicant against making a formal application, based on the information he has provided. This initial checking phase can avoid inappropriate projects at the really beginning.

Source:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/304977/WR325_391be9.pdf

The reasons for the final decision as to whether or not to carry out an AA should be recorded and sufficient information should be given to justify the conclusion that has been reached.

Box 22: Program for Annual Water Maintenance Works in Croatia

Purpose of the case: Example of cooperation between field engineers and conservationists

Good illustrative example of cooperation between field engineers familiar with standard water management practices on one hand and conservationists on the other can be found in Croatia. According to the Water Act, an annual national "Programme for maintenance works for protection against harmful effects of water" (hereinafter "Programme") for the whole country needs to be prepared and implemented.

Because the Programme includes also various preventive maintenance activities related to safety of flood defence dykes and structures, inundation areas as well as maintenance of drainage capacity along small watercourses, it is (in relevant cases) necessary to deal with potential impacts within the AA procedure. Thus, information exchange between the water and nature sectors was improved and intensified and early communication about the Programme became a part of planned preparatory activities.

Cooperation at all levels from national to regional was established, starting with two key bodies at the central level: special state water management agency "Croatian Waters" (HV) responsible for planning, implementing and coordination of the Programme and the "State Institute for Nature Protection" (SINP) responsible for all expert tasks of nature conservation in Croatia, including Natura 2000 network and the AA.

A permanent joint working group was established. HV provided standardized descriptions of particular interventions and their geographical location on maps, while SINP provided GIS layers related to nature protection assets and developed standardized types of measures connected with mitigation of impacts on biodiversity, landscape or particular habitats and species.

Subsequently, local working groups were established and local nature protection together with water management practitioners jointly assessed each planned intervention in the field. Indeed, new level of cooperation between conservationists and water managers at all levels of management from the field staff to the policy makers has been established in this way. It opens opportunity for e.g. joint planning of conservation measures on particularly valuable watercourses.

Source: Ecosystems LTD, 2013: Compilation of case studies on the Article 6.3 permit procedure under the Habitats Directive. Case Study 7: Adopting a strategic approach to AA for the National Program for Annual Water Maintenance Works (Croatia)

6.2.2. Step two: Appropriate Assessment

Once it has been decided that an AA is required, such an assessment will need to be carried out before the competent authority makes its decision on whether or not to authorise the plan or project (according to the Judgment of the Court C-127/02[55]). As stated above the purpose of the AA is to assess the implications of the plan or project on

[55] *Judgment of the Court C-127/02 - Waddenvereniging and Vogelsbeschermingvereniging*

the site in view of its conservation objectives, either individually or in combination with other plans or projects.

The term "appropriate" essentially means that the assessment needs to be appropriate to its purpose under the Birds and Habitats Directives, i.e. that of safeguarding species and habitat types listed under the two directives. "Appropriate" also means that the assessment has to be a reasoned decision. If the report does not include a sufficiently detailed assessment of the effects of the Natura 2000 site or does not provide enough evidence to draw clear conclusions as to whether or not the site's integrity is adversely affected then the assessment does not fulfil its purpose and cannot be considered "appropriate" for the purposes of Article 6.3.

This has been confirmed by the European Court of Justice which has ruled that "*the appropriate assessment should contain complete, precise and definitive conclusions capable of removing all reasonable scientific doubt as to the effects of the works proposed on the site concerned*" (Commission/Italy, C-304/05).

The Court also emphasised the importance of using **best scientific knowledge** when carrying out the AA in order to enable the competent authorities to conclude with a sufficient degree of certainty that there will be no adverse effects on the site's integrity. In this respect it considered that "*all the aspects of the plan or project which can, either individually or in combination with other plans or projects, affect those objectives must be identified in the light of the best scientific knowledge in the field*." (C-127/02, Para 54).

Because of the specialised nature of the AA, it is strongly recommended that the assessment be based on analyses carried out by suitably qualified ecologists.

The appropriate assessment report should in particular:

- describe the project or plan in sufficient detail for members of the public to understand its size, scale and objectives;
- describe the baseline conditions and conservation objectives of the Natura 2000 site;
- identify the adverse effects of the project or plan on the Natura 2000 site;
- explain how those effects will be avoided through mitigation;
- set out a timescale and identify the mechanisms through which the mitigation measures will be secured, implemented and monitored;
- contain sources of information.

Finally, it should be noted that, whilst it may be the project proponent who undertakes or commissions the AA, it is the competent authorities' responsibility to ensure that the AA has been carried out correctly and is capable of objectively demonstrating, with supporting evidence, that there will not be any adverse effects on the integrity of the Natura 2000 site, in light of its conservation objectives.

Assessing effects in light of the site's conservation objectives

As stated above, the assessment should assess the possible implications for the site of the plan or project in view of the site's conservation objectives. To understand what conservation objectives are, it is necessary to look back at how Natura 2000 sites are selected. As explained earlier each site is included in the Natura 2000 network because it is of conservation value for one or more of the habitat types listed in Annex I or species

listed in Annex II of the Habitats Directive, or species listed in Annex I of the Birds Directive as well as regularly occurring migratory bird species.

The conservation value of the site at the time of designation is recorded in a **Standard Data Form** (SDF). This provides the site's formal identification code, its name, location and size, and detailed map. It also records the ecological characteristics of the site which led to its designation as a Natura 2000 site and provides a broad assessment of the conservation condition of each species or habitat type on that site (scored A to D).

The SDF is therefore the reference base of a status of a site for setting conservation objectives for the site, in line with the overall objectives of the Habitats Directive (Article 6.1). At a minimum, the sites' conservation objective will be to maintain the species and habitats for which it was designated in the same condition (as recorded in the Standard Data Form). This means ensuring that they will not deteriorate below that level.

However, the overall objectives of the Habitats and Birds Directives go beyond simply preventing further deterioration. They aim to ensure that EU protected species and habitat types reach a favourable conservation state across their natural range in the EU. Thus more ambitious conservation objectives may be required to *restore* and *improve* the conservation condition of the EU protected species and habitat types present on that site (under Article 6.1).

If more ambitious conservation objectives have been set, then the impacts of the plan or project must be measured against these more ambitious objectives. For instance, if the objective is to restore the population of kingfisher to a certain population level within 8 years, it has to be assessed if the plan or project will or will not prevent this conservation objective from being realised, and not merely whether the kingfisher population will remain stable. If no specific conservation objectives have been set then it can be taken that the conservation objective for the Natura 2000 site is to maintain the conservation conditions of the species and habitat types for which the site has been designated (as recorded in the SDF) and to avoid any deterioration of that condition.

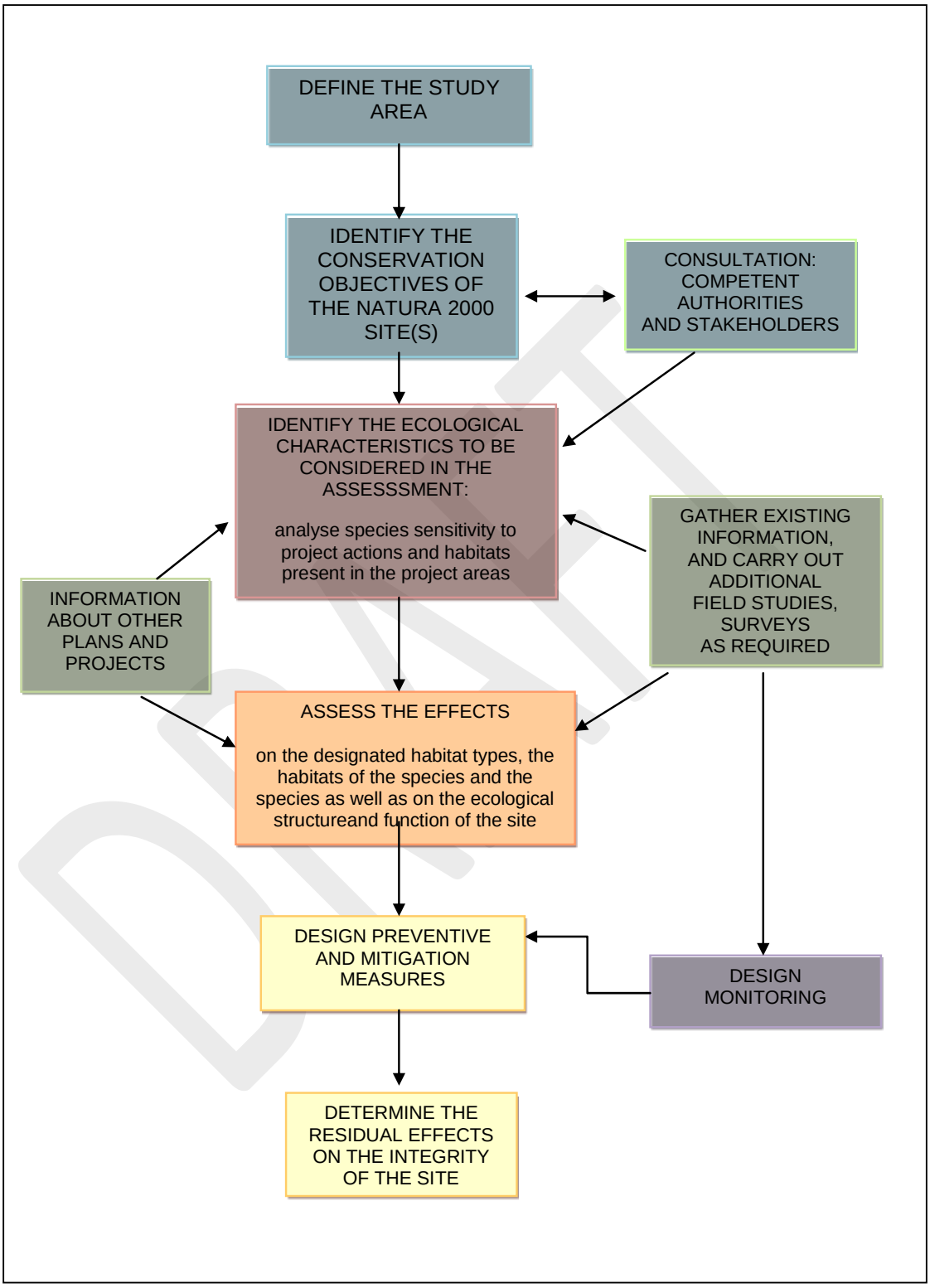
It is recommended that the project planner consults with the competent authorities responsible for the Natura 2000 sites as early as possible to find out about the Natura 2000 site, its conservation objectives and the conservation condition of the habitat types and species for which it is designated. They will also be to indicate if there are more detailed sources of information available on this – for instance a management plan adopted for the site or monitoring reports and studies about the conservation condition of the species and habitat types concerned within that region, or country.

Box 23: Examples of national methodologies on AA

Efficiency and transparency of AA procedure can be substantially improved by developing national guidelines which define information necessary for decision making, provide criteria for AA, explain the procedure or provide a template for AA documentation.

Scottish Natural Heritage – National guidance for Competent Authorities when dealing with proposals affecting freshwater SAC sites. Guidance is focused on definition of what is likely significant effect. The first part provides information about administrative aspects, responsible authorities and legislation. The second part summarizes detailed ecological requirements of water dependent qualifying habitats and species (population characteristics, distribution, supporting habitats, disturbances, etc.). The third part presents significance of activities likely to affect qualifying features. Deciding about impacts has a form of checking questions for easier identification of significance. These questions should be answered for all presented features of related site(s) – if the answer to any question is “yes” or “I don’t know”, further investigation of the proposal and its effects should be undertaken.

Steps to be undertaken as part of the appropriate assessment



Collecting the necessary information for the AA

Basic information sources for an AA include:

- Natura 2000 Standard Data Forms
- Natura 2000 management plans
- Technical and scientific literature
- Nature conservation authorities, experts and specialists (incl. local experts)
- Reporting on conservation status according to the Article 17 at national and biogeographical level.

Gathering all the necessary information on both the project and the Natura 2000 site is an important first step of the AA. This is usually an iterative process. If the first identification and analysis reveals that there are important gaps in knowledge, then further baseline ecological and survey field work may be necessary to supplement existing data. As stated before it is important that the AA is **based on the best scientific knowledge in the field** and is capable of removing all reasonable scientific doubt as to the effects of the works proposed on the site concerned.

Detailed surveys and fieldwork should focus on those target features that are sensitive to the project actions. Sensitivity should be analysed taking into account the possible interactions between the project activities (nature, extent, methods, etc.) and the habitats and species concerned (location, ecological requirements, vital areas, behaviour, etc.).

Any field studies must be sufficiently robust and long-lasting to take account of the fact that ecological conditions may vary significantly according to the seasons. For instance, undertaking a field survey on a species for a few days in winter will not capture their habitat usage during other more important periods of the year (e.g. during migration or breeding).

Consulting with nature authorities, other scientific experts and conservation organisations early on will help ensure that as complete a picture as possible is built up about the site, the species/habitats present and the type of effects to be analysed. They can also offer advice on the updated scientific information that is available on the site and its EU protected species and habitat types (including Natura 2000 management plans) and on what additional baseline studies and field surveys may be needed in order to assess the likely impacts of the project. Other stakeholders such as conservation NGOs, research institutions or local organisations may also be able to provide further local knowledge and ecological information useful for the AA.

Identifying negative impacts

Once all of the necessary baseline data has been gathered, the assessment of the implications of the plan or project on the Natura site can be undertaken. The description of potential negative impacts of hydropower facility projects as described in Chapter 4 should help to identify the type of effects to look out for.

It is evident that the effects of each project will be unique and must be evaluated on a case-by-case basis. This is in line with the ECJ Waddensea ruling: "*in assessing the potential effects of a plan or project, their significance must be established in the light, inter alia, of the characteristics and specific environmental conditions of the site concerned by that plan or project*."

The first step is to identify which target features within each site could be potentially affected and should be subject to further assessment. This is important as every species and habitat type has its own ecological lifecycle and conservation requirements. The impacts on each will also vary from one site to another depending on their conservation state and the underlying ecological conditions of that particular site. For each effect identified, the assessment should also look at the magnitude of the impact, type of impact, extent, duration, intensity and timing.

The AA also involves looking at all aspects of the plan or project that could have implications for the site. Each element of the plan or project should be examined in turn and the potential effects of that element should be considered in relation to each of the species or habitat types for which the site has been designated Thereafter, the effects of the different features should be looked at together, and in relation to one another, so that the interactions between them can be identified.

Whilst the focus should be on the species and habitats of EU interest that have justified the site designation, it should not be forgotten that these target features also interact with other species and habitats, as well as with the physical environment in complex ways. It is therefore important that all the elements considered essential for the structure, functioning, and dynamics of the river ecosystem are examined as any alteration could also have a negative effect on the habitat types and species present.

Impacts should be predicted as precisely as possible, and the basis of these predictions should be made clear and recorded in the AA (this means also including some explanation of the degree of certainty in the prediction of effects). As with all impact assessments, the AA should be undertaken within a structured framework to ensure that the predictions can be made as objectively as possible, using quantifiable criteria wherever possible. This will also greatly facilitate the task of designing mitigation measures that can help remove the predicted effects or reduce them to a non- significant level.

Predicting the likely impacts can be difficult as one needs a good understanding of ecological processes and conservation requirements of particular species or habitat types likely to be affected. It is therefore recommended that the necessary expert advice and scientific support is secured when carrying out the AA.

Box 24: Commonly used methods for predicting impacts:

The AA should also apply the best available techniques and methods to estimate the extent of the effects.

- Direct measurements, for example of areas of habitat lost or affected, proportionate losses from species populations, habitats and communities.
- Flow charts, networks and systems diagrams to identify chains of impacts resulting from direct impacts; indirect impacts are termed secondary, tertiary, etc. impacts in line with how they are caused. Systems diagrams are more flexible than networks in illustrating interrelationships and
- Quantitative predictive models to provide mathematically derived predictions based on data and assumptions about the force and direction of impacts. Models may extrapolate predictions that are consistent with past and present data (trend analysis, scenarios, analogies which transfer information from other relevant locations) and intuitive forecasting. Normative approaches to modelling work backwards from a desired outcome to assess whether the proposed project will achieve these aims. Predictive modelling often plays an important role as the main impacts often follow from changing in hydromorphological structures resulting in changes in sedimentation regime with serious consequences for the underwater biota.

- Population level studies are potentially beneficial for determining population level effects of impacts to bird or bat or marine mammal species, for instance.
- Geographical information systems (GIS) used to produce models of spatial relationships, such as constraint overlays, or to map sensitive areas and locations of habitat loss. GIS are a combination of computerised cartography, storing map data, and a database-management system storing attributes such as land use or slope. GIS enable the variables stored to be displayed, combined, and analysed speedily.
- Information from previous similar projects may be useful, especially if quantitative predictions were made and have been monitored in operation.
- Expert opinion and judgment derived from previous experience and consultations on similar inland waterway development projects.
- Description and correlation: physical factors (e.g. water regime, current, substrate) may be directly related to distribution and abundance of species. If future physical conditions can be predicted then it may be possible to predict future developments of habitats and populations or responses of species and habitats on this basis.
- Capacity analyses involve identifying the threshold of stress below which populations and ecosystem functions can be sustained. It involves the identification of potentially limiting factors, and mathematical equations are developed to describe the capacity of the resource or system in terms of the threshold imposed by each limiting factor.

Adapted from: Methodological guidance on the provisions of Article 6.3 and 6.4 of the Habitats Directive

Assessing potential cumulative effects

As mentioned above, the cumulative effects must not be overlooked during the assessment; not only is this a legal requirement but it can also have major implications for the plan or project, as well as other subsequent plans or projects which are put forward in the same area.

A series of individually modest impacts may on their own be insignificant but when seen together they can lead to a significant impact. Article 6.3 addresses this by taking into account the combination of effects from other plans or projects. Article 6.3 does not explicitly define which other plans and projects are within the scope of the combination provision but it is clear that the underlying intention is to take account of cumulative impacts that may occur over time. In that context, one should consider plans or projects which are completed, approved but uncompleted, or actually proposed.

It should be understood that, in considering a proposed plan or project, Member States do not create a presumption in favour of other similar, but as yet not proposed, plans or projects in the future. On the contrary, if one or more projects have already been approved in an area, this may lower the ecological threshold as regards the significance of the impacts for future plans or projects in that area.

For instance, if a hydropower facility within or around a series of Natura 2000 sites are submitted one after another, it could well be that the assessment of the first or second projects concludes that the projects will not adversely affect the Natura 2000, but then later projects may not be approved because their effects when combined with those of the previous projects becomes significant enough that the site's integrity will be adversely affected.

In this context, it is important for hydropower projects are looked at strategically and in combination with each other over a reasonably larger geographical area, and not simply viewed as individual isolated projects.

Determining the significance of the effects

Once the effects have been identified (see also the Chapter 4.7), there needs to be an appraisal of their significance for the site and its target features. The following parameters can be considered when assessing significance:

- Quantitative parameters of the target feature: for instance, how much habitat is lost for that species or habitat type. For some the loss of even single units or small percentage areas of occurrence within a given Natura 2000 site (e.g. for priority habitat types and species) should be taken as being a significant impact. For others the significance threshold may be higher. Again it depends on the species and habitat types, their state of conservation in that site as well as their future prospects.
- Qualitative parameters of the target feature: independent of these quantitative parameters, the significance of the impacts should also take account of the quality of occurrence of the target feature, for instance it may be:
  - the only site in a particular region/ country where the target features is present (i.e. the target feature may be rather abundant in a given site but this is the only place where it occurs and is protected);
  - a site with an important occurrence of the species (e.g. a core area for the occurrence, larger areas of representative stands, etc.);
  - a site where the species is at the limit of its existing distribution range.
- Importance of the site from the point of view of the species´ biology e.g. site of reproduction (nesting places, spawning area, etc.); feeding habitat; sheltering possibilities; migration pathways.
- Ecological functions necessary for maintenance of target features as well as site integrity.

Where there is doubt or differences of opinion over the degree of significance, it is best to find a broader agreement amongst relevant experts, e.g. regional and/or national specialists in the affected target feature so that a consensus be built up over this.

Box 25: Assessing significance of impacts

Purpose of the case: Example from Germany

In Germany, experts have attempted to set scientifically underpinned criteria for decision making on the significance of impact on Birds and Habitats Directive species and habitats[56]. Following several years of research, guidelines setting mutually interlinked criteria for each habitat type and species from the said directives was developed and since its publishing has become a routinely used tool for AA practitioners, officially recognized also by German courts. As its recommendations fit to German natural conditions this guidelines cannot be directly used in countries with different natural circumstances but may be useful as a source of inspiration and initial orientation.

[56] *Lambrecht H., Trautner J. (2007) Fachinformationssystem und Fachkonventionen zur Bestimmung der Erheblichkeit im Rahmen der FFH-VP – Endbericht zum Teil Fachkonventionen, Schlussstand Juni 2007. - R&D Project of the Federal Ministry for Environment, Nature Protection and Nuclear Safety deputed to Federal Agency for Nature Protection, FKZ 804 82 004, Hannover, Filderstadt. (Expert information system and expert rules for significance assessment within the framework of Appropriate Assessment – Final report part Expert rules, final status June 2007. In German.) -*

http://www.mugv.brandenburg.de/cms/media.php/lbm1.a.2318.de/fue_ffh.pdf

Box 26: Scale used by experts licensed for AA

Purpose of the case: Example from the Czech Republic

A practical issue is the scale used for evaluation of the significance of impacts during the AA. There is no prescription but based on long-lasting practical experience, the following scale can be recommended[57]: Assessment of impact significance is to be carried out against each target feature of the given site. If the impact on even a single target feature is marked with "-2" it automatically means the site integrity is adversely affected and such a project must not be granted permit within the Article 6.3 procedure.

Value	Term	Description	Examples
-2	Significant adverse impact	**Significant adverse impact. Excludes plan/project implementation** Significant disturbance or destructive impact on habitat or species population or its substantial part; significant disturbance of ecological demands of the habitat or species; significant impact on the habitat or natural development of a species. Under certain conditions, the impact can be lowered by mitigation measures.	Disruption of migration routes to spawning places of anadromous species Destruction of habitat by inundation because of new dam Hydrological changes because of derivation significantly influencing population
-1	Moderately adverse impact	Limited/moderate/non-significant adverse impact **Plan/project implementation is not excluded.** Moderate troublesome impact to habitat or species population; moderate disruption of ecological demands of habitat or species; marginal impact on habitat or natural development of a species. Its elimination through mitigation measures is possible but application of mitigation measures cannot be enforced, unless national legislation asks differently.	Modernization – using fish-friendly technology, building fish passes on existing barriers Impact on margin parts of population Influence on habitat common in surrounding area
0	Zero impact	The plan/project has no demonstrable impact.	Outside area of occurrence
+1	Moderately positive impact	Moderate favourable impact on habitat or species population; moderate improvement of ecological demands of the habitat or a species; moderate favourable impact on the habitat or on the natural development of a species.	Reconstruction of peaking hydropower to run-of-river hydropower without weir or dam
+2	Significantly positive impact	Significant favourable impact on habitat or species population; significant improvement of ecological demands of habitat or a species, significant favourable impact on the habitat or natural development of a species.	Demolition of hydropower plant

[57] *This scale has been recommended to and used by experts licensed for AA by law in the Czech Republic since 2007 - http://www.mzp.cz/cz/hodnoceni_vyznamnosti_vlivu_koncepci*

Introducing mitigation measures to remove adverse effects

Once the negative effects have been identified it will be possible to consider whether mitigation measures can be introduced to remove or reduce these effects to a non-significant level (see chapter 5 for suggestions on different types of mitigation measures that could be used for hydropower projects). When exploring suitable mitigation measures it is important to consider first those that can remove impacts at source and, only if these are not possible, should other mitigation measures be examined that can at least significantly reduce or abate the negative effects of the project.

Mitigation measures must be specifically designed to eliminate or reduce negative effects identified during the AA. They must not be confused with compensation measures which are intended to compensate for the damage caused. Compensation measures can only be considered if the plan or project has been accepted as being necessary for imperative reasons of overriding public interest and where no alternatives exist (under Article 6.4 – see below).

These mitigation measures should contain:

- details of each of the measures proposed and an explanation of how it will eliminate or reduce the adverse impacts which have been identified;
- evidence of how they will be implemented and by whom;
- a timetable for implementation relative to the plan or project (some may need to be put in
- place before the development can proceed);
- details of how the measure will be monitored and how the results will be fed back into the day to day operation of the IWT project (adaptive management – see below).

This will enable the competent authority to evaluate the mitigation measures and determine whether or not they are sufficient or suitable for eliminating or removing the negative effects which have been identified (and do not inadvertently cause other adverse effects on the species and habitat types in question). If the mitigation measures are deemed sufficient, they will become an integral part of the specification of the final plan or project or may be listed as a condition for the approval of the project.

Determining whether the site's integrity is affected

Once the effects of the project have been predicted as accurately as possible, their level of significance assessed and all possible mitigation measures have been explored, the AA must reach a final conclusion as to whether they will adversely affect the integrity of the Natura 2000 site.

The term "integrity" clearly relates to **ecological integrity**. The "integrity of the site" can be usefully defined as the coherent sum of the site's ecological structure, function and ecological processes, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is designated. A site can be described as having a high degree of integrity where the inherent potential for meeting site conservation

objectives is realised, the capacity for self-repair and self-renewal under dynamic conditions is maintained, and a minimum of external management support is required.

If a plan or project adversely affects the integrity of a site only in a visual sense or causes significant effects to habitat types or species other than those for which the site was designated as Natura 2000, this is not an adverse effect for purposes of Article 6.3. On the other hand, if one of the species or habitat types for which the site has been designated is significantly affected then the site integrity is necessarily also adversely affected.

The expression “integrity of the site” shows that the focus is on the specific site. Thus, an argumentation that damage to a site or part of it can be justified on the basis that the conservation status of the habitat types and species it hosts will anyway remain favourable within the European territory of the Member State cannot be accepted.

In practice the assessment of site integrity should focus in particular on identifying whether the project:

- causes changes to significant ecological functions necessary for the target features;
- significantly reduces the area of occurrence of habitat types (even of those of lower quality) or viability of species populations in the given site which are target features;
- reduces the site diversity;
- leads to the site fragmentation;
- leads to a loss or reduction of the key site characteristics (e.g. tree cover, regular annual flooding) which the status of the target feature depends on;
- prevents meeting the site conservation objectives.

If one of the conservation objectives of a Natura 2000 site is e.g. “ban to reduce the area of any habitat of species within the site” then any impact leading to reduction of habitat of any species, regardless if it is listed in Annex II of the Habitats Directive, is inacceptable; any impact on those habitats would automatically mean an adverse impact on site integrity, excluding granting the permit for such the intervention in question.

Conclusions of the appropriate assessment

It lies with the competent national authorities, in the light of the conclusions of the AA, to approve the plan or project. This can be done only after having ascertained that it will not adversely affect the integrity of that site. If the conclusions are positive, in the sense that no reasonable scientific doubt remains as to the absence of effects on the site, the competent authorities can give their consent to the plan or project.

The onus is therefore on proving the absence of effects rather than their presence, reflecting the precautionary principle (Case C-157/96). This has been confirmed by several ECJ rulings. In the Waddensea case (C-127/02) the Court confirmed that "a plan or project [...] may be granted authorisation only on the condition that the competent national authorities are convinced that it will not adversely affect the integrity of the site concerned.

Where doubt remains as to the absence of adverse effects on the integrity of the site linked to the plan or project being considered, the competent authority will have to refuse authorization.[...] the competent national authorities are to authorise (a plan or project) only if they have made certain that it will not adversely affect the integrity of that site. That

is the case where no reasonable scientific doubt remains as to the absence of such effects."

The AA and its conclusions should be clearly recorded. In this respect, the AA report should be sufficiently detailed to demonstrate how the final decision was reached, and on what scientific grounds the decision was made.

European funding

Projects on hydropower development could be a subject of various national operational programmes co-financed by the EU Funds. The infrastructural projects seeking EU co-financing must demonstrate full compliance with the EU law, in particular Habitats Directive, EIA, SEA and WFD. There are mechanisms at EU level (for major projects) and at national level (for non-major projects) to ensure the selection of projects that are fully compliant with the EU law. In case of non-compliance of the project which already benefited from the EU Funds, the European Commission reserves the right to make financial corrections.

Cooperation among responsible authorities and methodological guidance can help eliminate the administrative obstacles related to the AA procedure at minimum. Competent authorities may help investors by providing them with the rules of the funding schemes and explain the relevant consequences and requirements necessary for successful application.

6.2.3. The derogation procedure under Article 6.4

Article 6.4 provides for exceptions to the general rule of Article 6.3. This is not an automatic process, it is up to the project or plan proponent to decide whether they wish to apply for a derogation. Article 6.4 lays down the conditions that need to be respected in such cases and the steps that need to be followed before a competent national authority can authorise a plan or project that has been assessed as adversely affecting the integrity of a site under Article 6.3.

Article 6.4 requires that the competent authorities ensure the following conditions are respected before a decision can be taken on whether or not to authorise a plan or project that may adversely affect a site:

- The **alternative** put forward for approval is the least damaging for habitats, for species and for the integrity of a Natura 2000 site, and no other feasible alternative exists that would not affect the integrity of the site.
- There are **imperative reasons of overriding public interest** that justify the authorisation of the plan or project, including those of a social or economic nature.
- All **compensatory measures** required to ensure the protection of the overall coherence of the Natura 2000 network have been taken.

The order in which these conditions are examined is important as each step determines whether the next step is required. If, for instance, it is found that there is an alternative to the plan or project in question, then there is not point in examining whether the original plan or project is of overriding public interest or to develop suitable compensation measures since that plan or project could not, in any case, be authorised if a viable alternative exists.

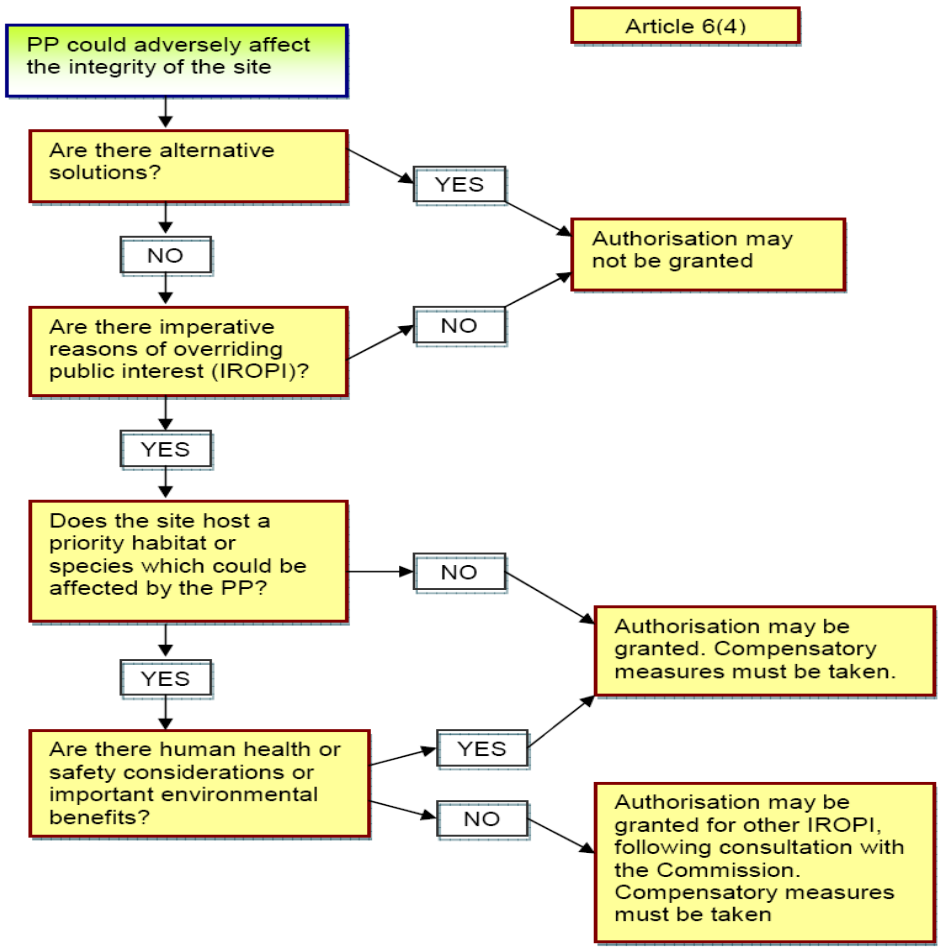
Demonstrating the absence of alternative solutions

The search for alternatives can be quite broad and should be linked to the public interest objectives of the plan or project. It could involve alternative locations, different scales or designs of development, different methods of construction or alternative processes and approaches.

Although the requirement to search for alternatives falls within the scope of Article 6.4, in practice it is useful for the planner to consider all possible alternatives as early as possible when initially planning their development project. If an appropriate alternative is found at this stage which is not likely to have a significant effect on a Natura 2000 site, then it can be approved immediately and an appropriate assessment will not be required.

However, in the case where the project has gone through an AA which has concluded that there will be an adverse effect on the integrity of the site, it is then for the competent authority to determine whether alternative solutions exist. All feasible alternatives, in particular, their relative performance with regard to the conservation objectives of the Natura 2000 site and the site's integrity should be analysed.

Flow chart of the Article 6(4) conditions



The alternative solutions chosen should also be subject to a new appropriate assessment if it is likely to have a significant effect on the same or another Natura 2000 site. Usually, if the alternative is similar to the original proposal, the new assessment may be able to draw a lot of the information needed from the first appropriate assessment.

Imperative reasons of overriding public interest

In the absence of alternative solutions, or in the presence of solutions having even more negative effects on the conservation objectives or integrity of the site concerned, the competent authorities must examine whether there are imperative reasons of overriding public interest which justify the authorisation of the plan or project in spite of that fact that it may adversely affect the integrity of a Natura 2000 site(s).

The concept of "imperative reason of overriding public interest" is not defined in the directive. However it is clear from the wording that, for a plan or project to be authorised in the context of Article 6.4, it must meet all three of the following conditions:

- there must be **imperative** reasons for undertaking the plan or project – imperative in this sense clearly means that the project is essential for society, rather than merely desirable or useful;
- the plan or project must be of **overriding interest** – in other words it must be demonstrated that implementing the plan or project is even more important than fulfilling the objectives of the Birds and Habitats Directives. It is clear that not every kind of public interest of a social or economic nature is sufficient, in particular when seen against the particular weight of the interests protected by the directive (see e.g. its 4th recital stating "Community's natural heritage"). It seems also reasonable to assume that the public interest can only be overriding if it is a long-term interest; short term economic interests or other interests which would only yield short-term benefits for the society would not be sufficient to outweigh the long-term conservation interests protected by the directive.
- be of **public interest** - it is clear from the wording that only public interests, can be balanced against the conservation aims of the directive. Thus, projects developed by private bodies can only be considered where such public interests are served and demonstrated.

Article 6.4 second subparagraph mentions human health, public safety and beneficial consequences of primary importance for the environment as examples of such imperative reasons of overriding public interests. It also refers to "other imperative reasons of overriding public interest" of social or economic nature.

It should be noted that the conditions of overriding public interest are even stricter when it comes to the realisation of a plan or project likely to adversely affect the integrity of a Natura 2000 site that hosts priority habitat types and/or species, where those habitat types and/or species are affected.

These can only be justified if the imperative reasons of overriding public interest concern:

- human health and public safety or;
- overriding beneficial consequences for the environment, or;
- for other imperative reasons if, before granting approval to the plan or project, the opinion of the Commission has been given.

The opinions delivered by the Commission in the framework of Article 6.4 illustrate the kind of projects that have been considered of imperative reasons of overriding public interest[58].

Compensatory measures

If the above two conditions are met then the authorities must also ensure that compensatory measures are adopted and put in place before the project can begin. Compensatory measures therefore constitute the "last resort" and are used only when the decision has been taken to proceed with a plan or project because it has been demonstrated that there are no alternative solutions and that the project is necessary for imperative reasons of overriding public interest under the conditions described above.

Compensatory measures under Article 6.4 are clearly distinct from the mitigation measures introduced through Article 6.3. Mitigation measures are those measures which aim to minimise, or even cancel, the negative impacts on a site that are likely to arise as a result of the implementation of a plan or project. Compensatory measures on the other hand are *sensu stricto* independent of the project.

They are intended to make up for or offset the residual negative effects of the plan or project (after all possible mitigation measures have been introduced to the plan or project) so that the overall ecological coherence of the Natura 2000 network is maintained. The compensatory measures must be able to compensate fully for the damaged caused to the site and to its target features and must be sufficient to ensure that the overall coherence of Natura 2000 is protected.

To ensure that the overall coherence of Natura 2000 is protected, the compensatory measures proposed for a plan or project should in particular:

- contribute to the conservation of affected habitat types and species within the biogeographical region concerned or within the same range, migration route or wintering area for species in the Member State concerned;
- provide functions comparable to those which had justified the selection of the original site, particularly regarding the adequate geographical distribution;
- have to be additional to the normal duties under the directive, i.e. they cannot substitute existing commitments, such as the implementation of Natura 2000 management plans.

According to existing Commission guidance, compensatory measures under Article 6.4 can consist of one or more of the following:

- the recreation of a comparable habitat or the biological improvement of a substandard habitat within an existing designated site provided this goes beyond the site's conservation objectives;
- the addition to the Natura 2000 network of a new site of comparable or better quality and condition to the original site;
- the recreation of a comparable habitat or the biological improvement of a substandard habitat outside a designated site which is then included in the Natura 2000 network.

[58] *EC web page on Management of Natura 2000 Sites*
- *http://ec.europa.eu/environment/nature/natura2000/management/opinion_en.htm*

The habitat types and species negatively affected must as a minimum be compensated for in comparable proportions, but, considering the high risks and scientific uncertainty involved in attempting to recreate or restore substandard habitats it is strongly recommended that ratios well above 1:1 or more are applied to be sure that the measures really do deliver the necessary compensation.

It is considered good practice to adopt compensatory measures as close as possible to the affected area in order to maximise chances of protecting the overall coherence of the Natura 2000 network. Therefore, locating compensation within or nearby the Natura 2000 site concerned in a location showing suitable conditions for the measures to be successful is the most preferred option. However, this is not always possible and it is necessary to set a range of priorities to be applied when searching locations that meet the requirements of the Habitats Directive. Under these circumstances, the likelihood of long-term success is best evaluated by peer-reviewed scientific studies of trends.

Member States should pay particular attention when the negative effects of a plan or project are produced in rare natural habitats or in natural habitats that need a long period of time to provide the same ecological functionality. For some habitats and species it may simply not be possible to compensate for any loss within a reasonable time frame as their development may take decades.

Finally, the compensatory measures should be in place and fully functional before the work on the plan or project has begun. This is to help buffer the damaging effects of the project on the species and habitats by offering them suitable alternative locations in the compensation area. If this is not fully achievable, the competent authorities should require extra compensation for the interim losses that would occur in the meantime.

The information on the compensatory measures should be submitted to the Commission before they are implemented and before the realisation of the plan or project concerned. It is therefore advised that information on compensatory measures should be submitted to the Commission as soon as they have been adopted in the planning process in order to allow the Commission, within its competence of guardian of the treaty, to assess whether the provisions of the directive are being correctly applied.

6.3 Position of competent authorities at the national level

The EU environmental legislation establishes general obligations which need to be transposed into national law in a form of much more detailed provisions. The way of transposition, following the subsidiarity principle, differs among the EU Member States, as do the administrative procedures and implementation practices. As regards the AA, its procedural regimes are strictly dependent on the national legislation framework and distribution of roles and responsibilities among various “competent authorities”.

Obligations set out by Article 6.3 of the Habitats Directive relate to any “competent authority” to be further specified in national protection regulations and can include e.g. any ministry, government department, public, statutory or self-governmental body, both from the sector of nature protection or any other sector.

Within the EU tere are two main “models” of competent authorities for AA: either they are represented solely by nature protection authorities, or there is a shared responsibility among the governmental sectors. In the latter model, responsibility for AA lies with the particular economic sector in charge of given branch of industry or other economic development.

In such a case, nature protection authorities or agencies are obliged to provide their opinions to the competent authorities from economic sectors, which can place higher demands on mutual coordination. In some countries, advisory nature protection bodies (at central or provincial level) exist opinion of which is obligatory to all plans and projects likely to affect Natura 2000 sites.

A good model of how to minimize possible conflicts and facilitate consistent enforcement practices could be illustrated by Swiss example of strategic planning guidelines for cantons developed jointly by the Federal Office for the Environment, the Federal Office for Energy and the Federal Office for Spatial Development[59].

Recommendations for decision making process by competent authorities:

A) **Identification of all competent authorities** according to the national legislation framework and setting an effective cooperation after defining roles and responsibilities

B) **Involvement of advisory/consultation body** into the AA process (relevant governmental agency or institution if they exist)

C) **Establishment of advisory board** (only for strategic planning of big projects) comprising representatives of relevant competent authorities responsible for environment and landscape protection, nature conservation (especially Natura 2000 network), energy sector, spatial development, protection of freshwater, central policy makers, self-governmental bodies, etc.

D) **Developing national guidelines** for competent authorities

E) **Sharing the information on responsibilities** concerning AA procedure on the official websites of all competent authorities, provide a contact point for applicants with FAQ scheme or hotline (for example see Natural England's site: https://www.gov.uk/environmental-impact-assessments)

F) **Informing** investors, developers, planners and other interested groups of possible national or regional strategies and criteria to be applied

G) **Developing a publicly available register of plans or projects** with link to AA documents

[59] *FOEN, SFOE, ARE (eds.), 2011: Recommendations for developing cantonal conservation and exploitation strategies for small hydropower plants. Bern, 28 p.*

7. A REVIEW OF POTENTIAL MITIGATION MEASURES

7.1 What are mitigation measures?

When the assessment of a hydropower development plan or project undertaken under Article 6 of the Habitats Directive identifies a number of negative effects on a Natura 2000 site, the plan or project is not automatically rejected. Depending on the severity of the potential impacts, it may be possible to introduce mitigation measures that will eliminate, or at least minimise to an insignificant level, the potential negative impacts of a plan or project.

In order to decide which mitigation measures are required, it is essential first to assess the effects of the plan or project on the EU protected species and habitat types present in the Natura 2000 site (alone or in combination with other projects or plans). This will identify the nature and extent of the negative effects and provide a baseline against which to determine the type of mitigation measures required to remove each of these negative effects, or at least reduce them to an insignificant level.

In short, effective mitigation of adverse effects on Natura 2000 sites can only take place once the potential negative effects have been fully recognised, assessed and reported. The identification of mitigation measures, like the impact assessment itself, must be based on a sound understanding of the species/ habitats concerned.

Mitigation measures can involve modifications to the size, location, design and technology used by the hydropower plan or project (e.g. avoid formation of migration barrier and/or injuries of fish caused by turbines). Or they can take the form of temporal adjustments during the construction and operational phases (e.g. avoiding water pollution if sensitive parts or populations of target species are located downstream).

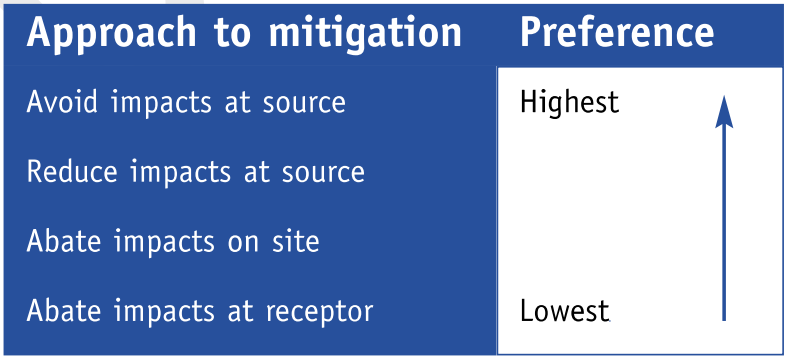


Figure 7: Hierarchical approach to adopting mitigation measures. Mitigation should always aspire to the top of the mitigation hierarchy (i.e. avoiding impacts at source)

For each mitigation measure proposed, it is important to:

- explain how the measures will avoid or reduce to a non-significant level the identified adverse impacts on the site;
- provide evidence of how they will be secured and implemented and by whom;
- provide evidence of the degree of confidence in their likely success;
- provide a timescale, relative to the project or plan, when they will be implemented;
- provide evidence of how the measures will be monitored and how additional measures will be introduced if the mitigation proves not to be sufficient.

Once suitable mitigation measures have been identified and worked out in detail, the plan or project may be approved under the Article 6 Habitats Directive permit procedure on condition that these mitigation measures ensure that the impacts are not significant in view of the conservation objectives of the site, and the mitigation measures are implemented in accordance with the instructions given by the competent authority.

If however there is still a significant residual effect on the site, even after the introduction of mitigation measures[60], then alternative solutions will need to be examined instead (e.g. different location of the project, different scales or designs of development, or alternative processes. If these do not exist then the plan or project may still be approved in exceptional cases, provided that the conditions of Article 6.4 are respected and suitable compensation measures are approved that will compensate for the remaining negative significant effects (see the Chapter 6.2 for details) so that the Natura 2000 network is not compromised.

7.2 Potential measures to mitigate negative effects of hydropower development

The remainder of this chapter looks at the range of potential mitigation measures that can be used for hydropower development plans and projects in relation to impacted species and habitat types of EU importance in particular. Mitigation measures can be introduced at the level of a plan or at various stages in the project cycle to remove or reduce the impacts to a non-significant level. Mitigation measures must always be focused on mitigating specific negative impacts.

At the project level, it is recommended that the following aspects are taken into consideration during different phases of the project implementation.

<u>Phase I. Pre-construction</u>

- Investigate different options to avoid potential conflicts with Natura 2000 sites.
- Determine suitable ecological flows to provide suitable conditions for survival, development and reproduction of the living organisms in the flow; this includes adaptation of hydropeaking (limitation in intensity and frequency) where relevant.
- Plan solutions enabling migrations (fish passes, solutions without barriers) where technically and financially feasible, but especially in areas of high relevance to target fish and lampreys species.
- Minimize inundations by size of dams and weirs with respect to the protection of EU protected species (their presence and demands).
- Restore or improve the management of EU protected habitats (mainly by renaturalisation of convenient adjacent parts of the stream) in order to improve its ecological functioning and resilience to future changes and to mitigate the potential

[60] *Mitigation measures are not the same a compensatory measures – see chapter 6 for details.*

impact of the new hydropower project on those habitats and species for which the site was designated.
- Ensure that new installed technologies are as safe for animals as possible (and especially for fish and lampreys) by design (fish-friendly screens and turbines – see following points below).
- Plan Before-After Control-Impact (BACI) assessment and supporting monitoring.

Phase II. Construction of new hydropower plants
- Mitigate pollution of water and environment.
- Build new dams and weirs in accordance with demands of target features.
- Consult construction of fish passes with experts during all stages of construction.

Phase III. Operation - maintenance, modernisation, re-construction of existing plants
- Conduct standardised monitoring of the impacts of hydropower plant on fish and lampreys and monitoring to evaluate the effectiveness of mitigation measures.
- Realize renaturalisation of directly impacted and adjoining parts of stream (where possible).
- Ensure sediment transport by management of gravel when the sediments are mined from above the transverse structure, which leads to their accumulation, and transport to the stream below the dam.
- Artificially simulate floods (where appropriate) in cooperation with river basin managers taking into account interests of other influenced stakeholders.
- Eliminate spreading weeds by manual harvesting or by introducing fish feeding on these plants.
- Prepare report regularly on the results of monitoring and mitigation activities and share it with key stakeholders.

Phase IV. Decommissioning
- Demolish migration barriers where possible.
- Taking cost-effectiveness into account, restore conditions for an effective renaturalisation of area impacted by former hydropower plant and restoration of the EU protected habitats and species present.

Box 27: Weir removal on the Mirna River

Purpose of the case: Removing of obsolete weir and construction of rocky glide / Slovenia

An obsolete weir on the river Mirna wasn´t used anymore. The construction caused a loss of river continuum. It interrupted migration way for cyprinids (e.g. Nase carp *Chondrostoma nasus*, Barbel *Barbus barbus*, Danube roach *Rutilus pigus*) and salmonids (Danube salmon *Hucho hucho*).

For this reason the weir was reconstructed to the rocky glide (Institute for Water of the Republic of Slovenia). The measure was accompanied by improvement of flow conditions, namely by (re)creation of natural hydromorphological structures (e. g. pools, rapids, riffles, sand bars and fords).

Measures taken ensured the improvement of river continuum between the Sava and Mirna rivers and initiated development of dynamic riverine habitat, typical for the Sava river reaches in the area. Migratory fish species gain migration possibility in order to use more spawning areas in the catchment area. Migration of Brown trout upstream and downstream river towards the proper spawning places in different parts of the river are possible now. Revitalised habitats support autochthonous fish communities and species as well as macroinvertebrates.

Costs of restoration works are estimated on 175,000 € (monitoring and maintenance not included).

Source: http://www.ecrr.org/Portals/27/Publications/restgeom_doc9.pdf

Box 28: Fish compensation measures in the regulated River Klarälven

Purpose of the case: fish stocking and fish passes in tributaries as a mitigation measure / Sweden

In Sweden, there are 8 hydropower plants on the river Klarälven (built in 1906-1962). The annual production of these plants is 1.3 TWh. There is a refurbishment program ongoing. The upper dam in Höljes has a regulation amplitude of 34,5 m, the other plants have small water reservoirs. The degree of regulation is 9 %. Due to the short-term regulation at Höljes the flow varies daily and weekly. There are requirements of a minimum discharge in the licensed plants and also funding of part of the income for environmental measures. There is a habitat restoration program for creating spawning areas after dredging has removed them. This project was partly financed by the Hydro Power Company and the municipality of Torsby, and it was carried out during the summer of 2005 and 2006.

Damming has interrupted the migration of fish such as salmon and trout. Damming and dredging have also reduced the spawning and breeding areas. There is a stretch in the river between Höljes and Edsforsen where there are still some rapids and good spawning grounds. There are two freshwater salmon species populations (and two trout) that migrate in Klarälven.

The lowermost power plant Forshaga has a fish trap which is used during the season of fish migration. Fish captured in the trap are used as parent fish for stocking, both salmon of both types and trout, all according to the permit of the power plant. After two years of fish stocking the fry are ready to leave for a life in lake Vänern (the largest lake in Sweden). Some fish trapped at Forshaga are just let out on the upper side of the dam, they are of the Gullspång type and it must not breed in the river Klarälven. That measure is just for leisure-fishing. Klarälven salmon captured at the Forshaga are transported upstream in the river. They are transported to spawning grounds upstream the Edsforsen Hydro Power Plant. All is done with full control from fishery authorities.

According to fishery authorities, **fish passes would not be efficient when fish have to pass several dams to reach spawning areas**. The loss would be high and only a small percentage would be able to pass. That is why all **fish are actively transported to their breeding areas** without losses caused by fishing or difficulties in passing several fish passes. In addition, parent fish are caught for stocking purposes which helps maintaining the unique populations of lake salmons and trout. Measures can be adapted according to the fish disease situation in Lake Vänern.

Annual salmon and trout amounts have varied between 2300 and 4500. Among the trapped fish the portion of trout from natural life cycle is 7 % and salmon from natural life cycle 35 % due to the transportation to the upper breeding areas. The result from 2005 showed that the portion of salmon from natural life cycle was more than 50 %.

The measure is suitable for places with several migration obstructions. Ecological efficiency can be gained without major fishing restrictions.

Source: http://www.ecrr.org/Portals/27/Publications/restgeom_doc9.pdf

7.2.1. A review of potential constructions enabling migrations

Building of bypasses at weirs and dams enabling migratory fish species to navigate through the river, especially for spawning, can be a highly effective mitigation measure but it is not without technical problems and must therefore be fully investigated beforehand to ensure that the investment will give the desired results for that particular stretch of river.

The planning of fish passes construction should be dependent on evaluation of cumulative impact of barrier in wide river system. Isolated constructions are much less effective than those connected to a systematic plan taking ecological characteristics of present fish species into consideration.

The newly constructed fish passes usually have appropriate slopes surmountable for all types of fish and lampreys inhabiting the streams. Care should be taken however not to locate fish passes next to the mouth of the corridor, which makes it difficult for fish to find. The most important parameters of fish passes are therefore the slope, flow and mouth localization.

As the construction of fish passes is quite costly an initial ichthyologic survey to determine the parameters of the fish pass according to the composition of the local ichthyofauna and potentially migrating species of fish and lampreys for which the fish pass is intended, is highly recommended. A convenient supplement to a fish pass is a monitoring device verifying effectiveness of the fish pass; the results can help to address gaps in the fish pass functionality in the future.

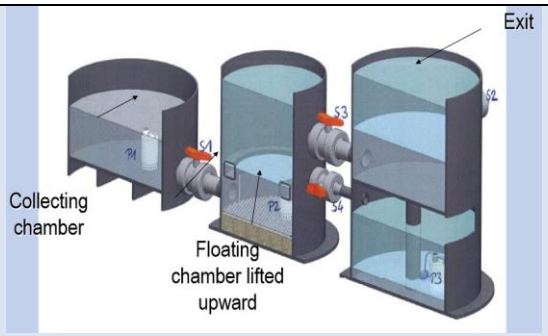
Concentrating on the upstream migration and dispersal of fish and lampreys, it is important to keep in mind also the downstream migration and dispersal. The downstream dispersal is typical for different fish species and other species of aquatic animals expanding downstream, whether active or passive motion carried by the stream. The downstream migration is particularly common for the catadromous fish species like the Eel *Anguilla anguilla*.

Finally it is essential that a sound maintenance plan is established for new constructions. Many fish passes are not effective on a long-term basis because of insufficient maintenance.

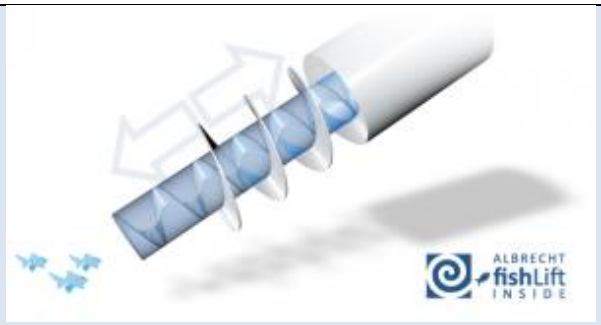
Box 29: New fish-friendly technologies

Purpose of the case: Examples of new technologies

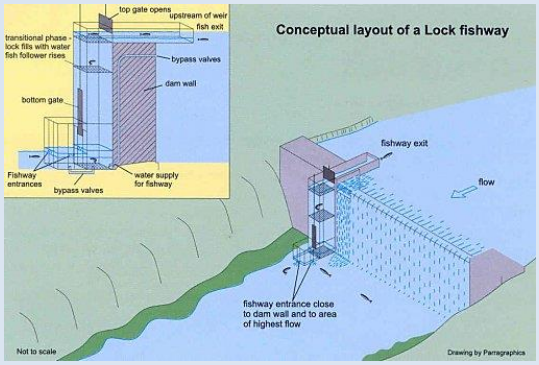
Innovations propose a broad range of new technologies. It is highly recommended to use only those tested by scientific institutions confirming expected effectiveness. Among new interesting technologies it is possible to count following examples:



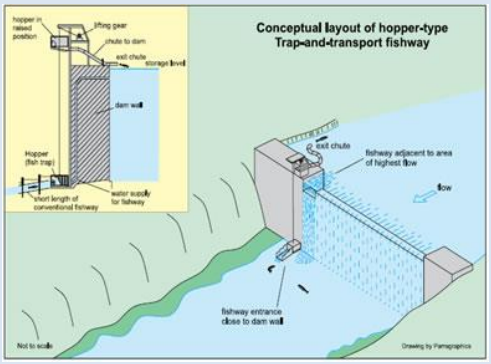
Fish-lift-lock-system



Albrecht fishLift inside



Lock fishway



Fish Elevator

Sources: http://www.der-wasserwirt.at, http://www.hydroconnect.at, http://www.dpi.nsw.gov.au/fisheries/habitat/rehabilitating/fishways, http://cw-environment.usace.army.mil/restore/fishpassage/types.cfm?Option=UpstreamStructuralTech&CoP=Restore&Id=fishpassage

7.2.2. Examples of fish-friendly turbines

To prevent injuries, fish-friendly turbines are recommended in combination with measures preventing the animals from entering the water pipe leading to the turbine using a fish-friendly intake in the form of a screen and repellent device of bottom sill.

It is assumed that all turbines impact fish to a certain degree. However, the adaptation of the turbine geometry, the operational mode and management of hydropower plant with regard to key species are possible solutions. As a result, some turbines promise to be fish-friendly by causing no or reduced damage to fish passing the turbine. Fish-friendly turbines are designed to reduce or eliminate the factors injuring the fish like blade strikes, getting fish stuck between the blades and the housing, flow shear, velocity and pressure gradients[61].

In the preferred (from the Natura 2000 conservation point of view) low-pressure plants the mortality or damage rate depends on the diameter of the rotor and the distance between the rotor blades, rotation speed and pressure differences during turbine passage. To avoid clamping of fish, the International Commission for the Protection of the Danube

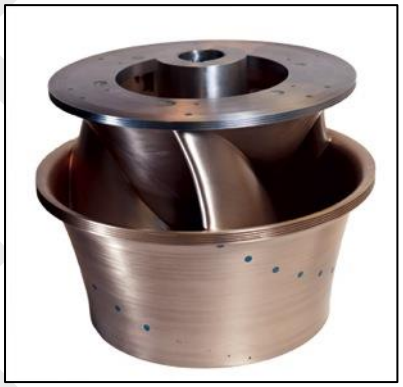
[61] *Management plan to save the eel - Optimizing the design and management of installations, Philippe Baran and Laurent Basilico, 2011*

River recommend the distance between the blades and the turbine coat should be less than 3 mm.[62]

Very low head turbine

Very low head turbo generator can generate relatively moderate output (on the order of hundreds kW) under heads lower than 2 m (from 1,4-3,2 m) where turbine flow rates can exceed 10 m^3/s (optimum 10-26 m^3/s). This type of turbine is being used for example in France, Italy and Poland. The results of tests on large eels and salmon smolts confirmed excellent fish-friendly characteristics of the system, the percentage of injuries was minor[63,64].

Alden turbine



Another specially developed fish-friendly turbine is the Alden turbine. It is equipped with three helicoidally blades and designed for high heads from 6 to 37 m, mostly 20-30 m, and flows above 30 m^3/s. The big turbine with three blades rotates slowly. It incorporates elements to reduce fish injury and mortality associated with damaging shear and pressures as well as blade strikes. The survival rate of the fish incl. medium-sized eels, extrapolated to a full-scale turbine, was calculated at between 97-100%[65,66]. Despite the positive results, extrapolation of the results to the large eels migrating downstream was considered as uncertain.[67]

Gorlov helical turbine

The Gorlov helical turbine is proposed for low-head micro hydro installations when construction of a dam is undesirable. The technology may potentially offer cost and environmental benefits over dam-based micro-hydro systems. It eliminates the initial cost of dam engineering, construction and maintenance, reduces the environmental and ecological complications, and potentially simplifies the regulatory issues put into law specifically to mitigate the problems with dams[68].

It spins so slowly that fish can see it early enough to swim around it. In the preliminary tests it was claimed that when a fish swims between slowly moving turbine blades it would not be harmed. It would also be unlikely for a fish to get stuck in the turbine, because the open spaces between the blades are larger than even the largest fish living in a small river. A fish would also not be tumbled through the vortex, because the Gorlov helical

[62] *Measures for ensuring fish migration at transversal structures, Technical Paper, International Commission for the Protection of the Danube River, 2012*
[63] *http://www.vlh-turbine.com/EN/html/FishFriendlinessTest.htm*
[64] *http://www.power-technology.com/features/feature115301/*
[65] *Management plan to save the eel - Optimizing the design and management of installations, Philippe Baran and Laurent Basilico, 2011*
[66] *Measures for ensuring fish migration at transversal structures, Technical Paper, International Commission for the Protection of the Danube River, 2012*
[67] *http://www.onema.fr/IMG/EV/meetings/management-plan-to-save-the-eel.pdf*
[68] *http://en.wikipedia.org/wiki/Gorlov_helical_turbine*

turbine does not produce enough turbulence, so small objects would be harmlessly swept through.[69]

Archimedes hydrodynamic screw turbine

Hydrodynamic screws generate energy from water resources by taking advantage of natural water fall (up to 10 m). With hydrodynamic screws, even minimum hydrodynamic potentials at powers starting from 1 kW can be exploited economically.[70] The rotor of the machine spins slowly (in most cases 28-30 rpm) and sits in a trough or tube with a small 3-5mm gap between the rotating and stationary parts.

The machine takes in large blocks of water which travel slowly down the machine before emerging at the bottom. These pockets of water are large enough to hold large fish. Even when a fish gets in the way of an arriving blade, it tends to be washed aside rather than hit by the blade. There is no significant shear forces or pressure changes. In most of such installations a compressible rubber strip is added to the leading edge of the turbine rotor as a precaution. Fish can therefore travel through the turbine physically unharmed.[71]

According to several studies, the rate of fish harmed by this type is quite low. Schmalz[72] shows in a case study that three species remained unharmed (roach, tench and bream) and 92 % of all remaining specimens were unharmed. However large gaps between the turbine and its case may cause injuries to fish and sharp edges of blades should be avoided. This issue should be solved by adding soft rubber bumpers to the leading edge of the rotor, and by ensuring that there is a very narrow gap between the tip of the leading edge of the rotor, and the stationary part. [73, 74]

7.2.3. Accessory fish-friendly technologies

Behaviour barriers are facilities that produce a stimulus for fish (repulsive or attractive), which are usually used to prevent the fish from entering the turbines: electrical screens, bubble screens, sound screens, fixed/mobile screens, light screens, surface guide walls, Louvre screens. However, **in Europe the experiences are not convincing and these technologies has not proven efficient yet**.

Sufficiently fine screens can protect the majority of fish species (at least adults). But it is important to note that the density of screens also affects the water flow to the turbine which can significantly reduce the efficiency of the turbine and generation of electricity. Along with the screens, the redirection of the downstream migrating animals to a fish passage allowing them to overcome safely the transverse barrier can be considered.

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[69] http://www.cobscook.org/pdf/tidalPower/ORPC%20First%20Annual%20Cobscook%20Bay%20Conference.pdf
[70] http://www.andritz.com/products-and-services/pf-detail.htm?productid=8775
[71] http://nehydropower.drupalgardens.com/sites/nehydropower.drupalgardens.com/files/201304/Fish%20Damage%20and%20Hydro-screws.pdf
[72] *Schmalz 2010: Untersuchungen zum Fischabstieg und Kontrolle möglicher Fischschäden durch die Wasserkraftschnecke an der Wasserkraftanlage Walkmühle an der Werra in Meiningen. Fischökologische & Limnologische UntersuchungsStelle Spdthpringen. Im Auftrag der Thüringer Landesanstalt für Umwelt und Geologie.*
[73] *ICPDR : Measures of ensuring fish migration at transversal structures. Technical paper.*
[74] *Hutton Roger 2012: Damage to fish by hydroturbines. A new fish-friendly approach using the Archimedean Screw Generator. New England Hydropower.*

Fish electric guidance and deterrence could be also used. For example acoustic deterrence water guns offer a method to deter aquatic species using underwater sound/pressure waves. The water gun technology can be operated both in static and mobile applications, depending on the fisheries´ needs and resource settings. Sound source and output pressure can vary and is determined by the water gun chamber size and the applied air pressure.

7.3 Monitoring of mitigation measures effectiveness

The proposed approach is based on the precondition that a monitoring of effects on the population level, research, evaluation and reporting system for progress of implementation is realized by state administration.

In this respect it is necessary to:

- Assess progress against objectives, milestones and timeframe of strategic plans.
- Evaluate lessons learnt to improve the future operation.
- Prepare implementation reports for key stakeholders.
- Support international exchange of experience.
- Collaborate in efforts to save threatened long-distance migratory species from the negative effects of hydropower development.
- Initiate and support relevant research projects regarding prevention and mitigation measures and the development of environmentally-friendly devices.
- Develop a set of monitoring protocols standardised for different conditions.

8. DEALING WITH EXISTING HYDROPOWER FACILITIES

8.1 Dealing with existing hydropower stations having a negative effect on a Natura 2000 site

Old hydropower facilities in Natura 2000 sites that have been in place for many years are known, on occasion, to cause the decline or degradation of the EU protected species and habitat types present within the site.

The Natura 2000 permit procedure under Article 6.3 of the Habitats Directive does not in principle apply in such circumstances, unless there is a proposal for plan or project to modernise or renovate the existing facilities. If this renovation work is likely to have a significant negative impact on the Natura 2000 site then it will need to go through an appropriate assessment before it can be approved.

But, more often than not in such cases, the renovation or modernisation work can lead instead to significant positive effects for the Natura 2000 site as impacting facilities are removed and replaced with more environmentally sensitive structures that will be significantly less damaging for the habitats and species present.

However, existing hydropower facilities located within Natura 2000 sites must still conform to the provisions of Article 6.1 and Article 6.2 of the Habitats Directive.

This means there is a legal obligation for Member States to investigate the threats and pressures brought about by the presence of the hydropower facilities on the species and habitat types for which the site has been designated and, if they are deemed to be causing the further decline or degradation of the conservation condition of the EU protected species and habitats present below the level when the site was designated, then necessary remedial measures will need to be implemented to stop this decline or degradation.

More specifically, Article 6.2 imposes **an obligation of non-deterioration** of the site as compared to the state it was in when it was first designated. This article should be interpreted as **requiring Member States to take all the appropriate actions** which it may be reasonably expected to take, to ensure that no deterioration or significant disturbance occurs. It requires both man-caused as well as natural deterioration of natural habitats and the habitats of species to be avoided.

Article 6.2 is applicable to the performance of activities which do not require prior authorisation. Thus, if an already existing activity in an SAC causes deterioration of natural habitats or disturbance of species for which the area has been designated, it must be covered by the implementation of the necessary conservation measures foreseen in article 6.1.

This may require, if appropriate, bringing the negative impact to an end either by stopping the activity or by taking mitigating measures. This can include economic compensation.

This is supported by the *Owenduff* Case (C-117/00)[75] where the Court of Justice ruled that Article 6.2 was infringed because measures had not been adopted to prevent deterioration, in an SPA, of the habitats of the species for which the SPA was designated. Several CJEU Cases[76] have further clarified the type of legal protection regime that needs to be put in place for the purposes of Articles 4.1 and 4.2 of the Birds Directive and Article 6.2 of the Habitats Directive. They stress in particular the need for the legal regime to **be specific, coherent and complete,** capable of ensuring the sustainable management and the effective protection of the sites concerned (C-293/07).

The Court also identified infringements in cases where the regime in place was *'too general and did not concern specifically the SPA or the species that live in it'* (C-166/04), measures taken were *'too partial, isolated measures, only some of which promote conservation of the bird populations concerned, and so did not constitute a coherent whole'* (C-418/04), or SPAs were submitted to *'heterogeneous legal regimes which did not confer on the SPAs a sufficient protection'* (C-93/07). The Court also considered that purely administrative measures or voluntary measures were not sufficient for the purposes of Article 6.2 (C-98/06).

Article 6.1 further requires Member States to **take positive conservation and remedial measures that are necessary to maintain or restore habitat types and species for which the site has been designated**.

Although not obligatory, the Habitats Directive encourages nature authorities to elaborate Natura 2000 management plans in close cooperation with local stakeholders and land owners concerned to identify the threats and pressures on each Natura 2000 site and to determine the necessary conservation measures that need to be implemented.

The conservation measures including mitigation measures for existing hydropower plants should be integrated into the Programme of Measures within the RBMP. The deadline for achieving "good ecological status" in 2015 enable potentially early implementation of measures for the species and habitat types of Community interest.

For sites where existing hydropower plants are degrading or deteriorating the condition of the site management plans are a useful tool for analysing the exact nature and magnitude of the problems caused by the hydropower facility and for identifying the right kind of conservation measures that are needed to remedy these.

As regards the content of management plans, in relation to hydropower plants, there could be conservation measures connected with water restoration and water management, modification of water regime or mitigation measures, some of them being likely to affect operation of even already existing hydropower installations.

Good communication of hydropower operators with authorities and/or bodies in charge of management planning may prevent useless conflicts and lead to inclusion into the plans of such measures which both benefit the conservation objectives and do not adversely affect the hydropower operation.

[75] *see also C-75/01, C-418/04, C-508/04*
[76] *See also Cases C-166/97, C-96/98, C-57/89, C-44/95, C-75/01, C-415/01, C-6/04, C-508/04, , C-241/08, C-491/08, C-90/10*

Box 30: Examples from Danube basin

Enabling fish migration
In the Danube River Basin, a special attention should be given to the highly endangered anadromous Danube sturgeons, as pointed out in the Danube Sturgeon Action Plan. For upstream migration, many solutions are available (e.g. bypass streams, technical fish passes, fish lifts etc.) to mitigate the negative impact of migration barriers to a certain degree. These fish migration facilities are state of the art and enable migration of fish species to their spawning grounds, although their effectiveness varies and depends greatly on how site specific fish migration behaviour has been taken into account.

Downstream migration is of great importance but cannot be adequately ensured up to now, even though certain possibilities exist to minimize negative effects on ecology. Fish friendly turbines and other technical solutions are indicated as means to achieve downstream migration. Intensive research leading to technical innovations has still to be undertaken or is currently on-going.

Ensuring ecological flow
The methods for determination of ecological flow can be categorised into four groups, reflecting the main attributes of the approach, including hydrological and hydraulic rating, habitat simulation and holistic approaches. The development of methods is dynamic and new research provides a better understanding of the relationships between flow requirements and biological, physico-chemical and hydro-morphological elements of riverine ecosystems.

Ensuring sediment transport
At present the sediment balance of most large rivers within the Danube River Basin can be characterized as disturbed or severely altered. Morphological changes during the last 150 years due to river engineering works, flood and torrent control, hydropower development and dredging, as well as the reduction of adjacent floodplains by nearly 90%, are the most significant causes of impacts. Availability of sufficient and reliable data on sediment transport is a prerequisite for any future decisions on sediment management in the Danube River Basin.

Attention should be given to ensuring the sediment continuum. Reservoir flushing must respect fish spawning periods and critical suspended sediment concentration downstream for not silting up the river bed and not harming fish gills and benthos, thus flushing should be done in a controlled and planned way. If the accumulated sediments are polluted they must not be flushed but should be dredged out and technically treated as special solid waste according to Best Available Techniques (BAT).

Mitigating effects of artificial flow / water level fluctuations (hydropeaking)
Hydropeaking is a pressure type that occurs in the Danube River Basin District by the generation of peak energy supply by hydropower stations. The Danube country-specific recommendations and/or standards on hydropeaking mitigation include several specific requirements: reduction of amplitude of flow fluctuation, reduction of frequency of hydropeaking, change of ramping time, building of compensation basins, improvement of hydromorphological structures of the river and coordination of different plants' operation. However, results of ongoing research projects aiming at most cost- effective measures as well as also ensuring security of electricity supply should be taken into account.

Mitigating the effects of hydropeaking demands the definition of the variation range for relevant ecological parameters such as discharge, water temperature, fish habitats sediment/suspension load, etc. Special emphasis is needed to be given to sediment transport and river morphology since hydropeaking can foster colmation/siltation of the river bed sediments.

Source: ICPDR. Guiding Principles on Sustainable Hydropower Development in the Danube Basin

8.2 Creating win-win solutions through modernising and upgrading hydropower facilities

Modernising and upgrading already existing hydropower plants not only offers potential ecological benefits but also sometimes win-wins solutions for the investors as well. The possibilities for technical upgrading of hydropower plants and conservation measures have to be evaluated on a case by case basis, ownership rights are a key issue to be considered.

This technical upgrading should increase the energy production (e.g. by the installation of new turbines or generators, modification of the control systems, etc.). It can be also accompanied by measures which increase the installed capacity and electricity production by expanding the existing use of water.

It should be ideally linked to ecological criteria for the protection and improvement of the water status. In particular, in areas of high ecological importance, such as Natura 2000 sites, it is highly recommended to examine all potential restoration measures that could not only mitigate the existing impacts of the plant on the river, but also improve the conservation status of the EU protected species and habitats present.

Incentive schemes can be a helpful tool in energy strategies and instruments. These win-win solutions should be promoted as well as financially supported by investment incentives or guaranteed feed-in tariffs etc. On the other hand water pricing policies can establish the requirement that the polluter pays and removing or replacing of environmentally harmful subsidies can be economically attractive.

Two examples of win-wins are presented below. They are amongst many other examples eg from German river Neckar where a hydropower plant using the derivation canal with non-functional fish pass was replaced by new plant on the weir 3-4x more efficient. Also in Upper Austria the funding program was prepared for upgrading and ecological restoration of more than 100 plants and an increase in hydropower generation of ca. 150 GWh.

Box 31: KW Agonitz Refurbishment - Optimizing energy generation and ecological measures

Purpose of the case: establishing technical type of a fish pass on Steyr river / Austria

The small hydropower plant Agonitz is situated on the river Steyr at km 32.00 in Upper Austria. It was built in 1924 with gross head 7 m and maximum discharge 20 m³/s with installed capacity 990 kW producing annually about 6,4 GWh. The dam disrupted continuum for fish migration. Due to bad condition a refurbishment was necessary. It was based on expanding discharge from 20 m³/s to 45 m³/s, alteration of bottom weir gate and raising hydraulic head to 8,3 m by 1,3 m bed excavation downstream. Total costs were € 7,600,000, new annual production was assessed to 15,8 GWh.

Ecological measures were performed by limnology professionals who also assisted in the construction works. Fish migration were made possible because of establishing a fish pass (bypass) designed as combination of natural-like-rivulet and vertical-slot-fish-ladder. Costs of this measure were € 380,000 and have been compensated by increasing power generation.

Source: http://www.ecrr.org/Portals/27/Publications/restgeom_doc9.pdf

Box 32: Hydropower plant Albbruck-Dogern

Purpose of the case: installation of dynamic minimum water flow, creation of a fish pass / Germany

The hydropower plant Albbruck-Dogern was built on Rhein River in 1933. It is a run-of-river facility with long derivation. The intake canal is 3.5 km long. There was no power plant on the weir. The residual water flow (3-8 m^3/s) was assessed as insufficient due to the diversion section. Also the river continuum was interrupted as well as fish migration. It is reflected in low population of fish and other aquatic species.

Mitigation measures were implemented on the grounds of the need of a new concession for the hydropower plant and the building of an additional hydropower plant by the weir. The aim was an increase of power generation together with improvement of the ecosystem.

The measures implemented were based on increase of the residual water flow and construction of a fish pass and complementary measures. Immediate increase of the residual flow to 40 m^3/s, followed by increase up to 70-100 m^3/s from 2008 and up to 200 m^3/s when the new weir-power plant is commissioned and in operation (2009-2010). Other measures are represented by construction of a nature like fish pass, creation of a nature like bed structure in the diversion with gravel bars, revitalisation of former gravel islands and elevation of a bird-island.

The improvement of the ecological conditions in the whole area of the river is in effect connected with increase of the annual energy output of about 87 GWh/year. Costs for hydropower development were about 51 million EUR, the ecological measures cost 4 million EUR.

Source: http://www.ecrr.org/Portals/27/Publications/restgeom_doc9.pdf

Acronyms

AA	Appropriate assessment according to the Article 6.3 of the Habitats Directive
EEA	European Environment Agency (http://www.eea.europa.eu/)
EIA	Environmental Impact Assessment of projects
EU	European Union (EU 28)
FCS	Favourable Conservation Status – main objective of measures according to the Habitats Directive
NGOs	non-governmental organizations
PCIs	Projects of Community Interest
pSCI	proposed Site of Community Importance to the Commission
RBMP	River Basin Management Plan according to the Water Framework Directive
SAC	Special Area of Conservation with necessary conservation measures applied
SCI	Site of Community Importance approved by the Commission
SDF	Standard Data Form of Natura 2000 site
SEA	Strategic Environmental Assessment of plans and programmes
SPA	Special Protection Area designated in accordance with the Birds Directive
WFD	Water Framework Directive

Annexes

Annex 1: List of Annex I habitat types and Annex II species sensitive to hydropower

A. Running water habitat types. Hydropower is impacting mainly sections of water courses with natural or semi-natural dynamics (minor, average and major beds) where the water quality shows no significant deterioration.

Significant impacts are caused mainly by large hydropower plants because of vast inundations. Some habitat types are also very sensitive for changes in flow regime and limitations of natural flooding.

Natura 2000 code	***Name of habitat type***
3210	Fennoscandian natural rivers
3220	Alpine rivers and the herbaceous vegetation along their banks
3230	Alpine rivers and their ligneous vegetation with *Myricaria germanica*
3240	Alpine rivers and their ligneous vegetation with *Salix elaeagnos*
3250	Constantly flowing Mediterranean rivers with *Glaucium flavum*
3260	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation
3270	Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation
3280	Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of *Salix* and *Populus alba*
3290	Intermittently flowing Mediterranean rivers of the Paspalo-Agrostidion

Plants connected with running water habitats. For plants, main pressure is connected with habitat changes influencing quality of substrate and flow changes. In this realm, we distinguish three groups:

B. Aquatic plants growing in streams and rivers. These species are common in low-speed flowing waters. From the point of view of hydropower, they are endangered by changes of flow force caused by peaking during the day that can change low-speed flow into the faster one creating damaging pressure on plant body. Another physical harm to the plants can be generated by sediment dynamics. It creates physical damage on the plant body or it can cause movement of river bed and losing of rooting area. Also change of water chemistry can lead to a weakening of the population.

Natura 2000 code	***Latin name mentioned in the Annex II of the Habitat directive***
1832	*Caldesia parnassifolia*
1831	*Luronium natans*
1516	*Aldrovanda vesiculosa*
1960	*Hippuris tetraphylla*
1966	*Persicaria foliosa*
1602	*Petagnia saniculifolia*
1383	*Dichelyma capillaceum*
1985	*Hygrohypnum montanum*

C. Species bound to margin of watercourses that are influenced by flooding and peaking of the flow regime. These species are specialists on early succession stages of river banks that are created by more intensive flooding. However, they need some time to grow undisturbed so peaking during the day can be serious obstacle in plant development.

Natura 2000 code	***Latin name mentioned in the Annex II of the Habitat directive***
1669	*Myosotis lusitanica*
1673	*Myosotis retusifolia*
2109	*Cochlearia polonica*
4090	*Cochlearia tatrae*
1897	*Carex panormitana*
1658	*Centaurium somedanum*
1434	*Salix salvifolia*

D. Species needing temporary flooding. These species need temporary inundation but in defined period of time, mainly during spring. Changing of natural flow regime, during the day as well as season, can caused serious damage to the population.

Natura 2000 code	***Latin name mentioned in the Annex II of the Habitat directive***
1427	*Marsilea batardae*
1670	*Myosotis rehsteineri*
1619	*Apium bermejoi*

E. Mammals directly connected with water habitat. Two charismatic species - the otter and the beaver – are classed into this group.

Both of them do not belong to the most impacted features but mainly constructions of large hydropower have impacts on their habitats.

Natura 2000 code	***Latin name mentioned in the Annex II of the Habitat Directive***
1355	*Lutra lutra*
1337	*Castor fiber*

F. Aquatic turtles. Species from family Emydidae listed in the Annex II of the Habitats Directive belong to this group.

Their occurrence is mostly outside areas important for hydropower development but also these turtles could be impacted, mainly by construction of large hydropower plants and conjoined with changes of the habitat and also with peaking of river flow under the dam.

Natura 2000 code	***Latin name mentioned in the Annex II of the Habitat Directive***	***Natura 2000 code + valid Latin name corresponding to taxonomy / or other notes***	
1220	*Emys orbicularis*	1220	*Emys orbicularis*
		5370	*Emys trinacris*
1221	*Mauremys leprosa*		
1222	*Mauremys caspica*	1222	*Mauremys caspica*
		2373	*Mauremys rivulata*

G. Non-migratory lampreys. Group of species living entire life in streams and rivers. Larvae inhabit fine alluvial deposits of organic material, spawning substrate is represented mainly by gravel bars.

Lampreys are impacted very frequently by small hydropower because of barriers and reduction of the flow in case of derivations. The value of residual flow has to ensure hydrologic regime influencing habitat structure (deposits inhabited by larvae and spawning sites) as little as possible. Dams of large hydropower change a lot sediment dynamics and represent total migration barrier.

Representatives:

Natura 2000 code	***Latin name mentioned in the Annex II of the Habitat Directive***	***Natura 2000 code + valid Latin name corresponding to taxonomy / or other notes***	
1096	*Lampetra planeri*	except the Estonian, Finnish, and Swedish populations	
1097	*Lethenteron zanandreai*		
1098	*Eudontomyzon* spp.	2483	*Caspiomyzon (Eudontomyzon) hellenicus*
		2484	*Eudontomyzon mariae*
		2485	*Eudontomyzon vladykovi*
		4123	*Eudontomyzon danfordi*
		5260	*Caspiomyzon (Eudontomyzon) graecus*

H. Anadromous fish and lampreys' species. Species dependent on spawning in freshwater and living also in marine habitat. They carry out long-distances migrations to spawning sites and juveniles to the sea.

They are logically endangered mainly by all types of barriers preventing to return to spawning streams and by injuries caused also on route to sea. Fish passes should be built preferably on their migratory ways and no new barriers constructed. Large hydropower plants have ordinarily more significant impact but many small hydropower plants could be equally fatal.

Natura 2000 code	***Latin name mentioned in the Annex II of the Habitat Directive***	***Natura 2000 code + valid Latin name corresponding to taxonomy / or other notes***	
1095	*Petromyzon marinus*	except the Swedish populations	
1099	*Lampetra fluviatilis*	except the Estonian, Finnish, and Swedish populations	
1100	*Acipenser naccarii*		
1101	*Acipenser sturio*	1101	*Acipenser sturio*
		5042	*Acipenser oxyrinchus*
------	*Alosa* spp. (only some species)	1102	*Alosa alosa*
		1103	*Alosa fallax*
		2491	*Alosa pontica*
		4120	*Alosa caspia nordmanni*
		4125	*Alosa immaculata*
		4127	*Alosa tanaica*
1106	*Salmo salar*	except the Finnish populations	
1113	*Coregonus oxyrhynchus*	anadromous populations in certain sectors of the North Sea, taxonomy still not clarified	

I. Mostly rheophilous fish species. All species are dependent on flow sections of streams and/or on local gravel or sandy substrate. Very heterogeneous group associating species requiring various habitats according to different life stages but always connected with flowing streams or rivers. They need hard substrate in most cases to complete their reproductive cycle.

For these reasons they are endangered by hydropower mainly because of potential inundations of habitats represented by stony-gravel sections, changes of the flow regime and migration barriers.

Natura 2000 code	***Latin name mentioned in the Annex II of the Habitat Directive***	***Natura 2000 code + valid Latin name corresponding to taxonomy / or other notes***	
1105	*Hucho hucho*	natural populations	
1107	*Salmo marmoratus*		
1108	*Salmo macrostigma*	5349	*Salmo cetti*
		5350	*Salmo farioides*
		5351	*Salmo dentex*
		5352	*Salmo louroensis*
		5353	*Salmo macedonicus*
		5354	*Salmo pelagonicus*
		5355	*Salmo peristericus*
1115	*Parachondrostoma (Chondrostoma) genei*		
1116	*Parachondrostoma (Chondrostoma) polylepis*	1116	*Parachondrostoma (Chondrostoma) polylepis*
		2510	*Parachondrostoma (Chondrostoma) willkommii*
		5182	*Parachondrostoma (Chondrostoma)* duriense
1118	*Iberocypris palaciosi*		
1122	*Romanogobio (Gobio) uranoscopus*	1122	*Romanogobio (Gobio) uranoscopus*
		6159	*Romanogobio (Gobio) elimeius*
1124	*Romanogobio (Gobio) albipinnatus*	6157	*Romanogobio (Gobio) belingi*
		6158	*Romanogobio (Gobio) vladykovi*
1126	*Parachondrostoma (Chondrostoma) toxostoma*	1126	*Parachondrostoma (Chondrostoma) toxostoma*
		5270	*Parachondrostoma (Chondrostoma) turiense*
		5271	*Parachondrostoma (Chondrostoma) arrigonis*
		5272	*Parachondrostoma (Chondrostoma) miegii*
1128	*Iberochondrostoma (Chondrostoma) lusitanicum*	1128	*Iberochondrostoma (Chondrostoma) lusitanicum*
		5181	*Iberochondrostoma (Chondrostoma) almacai*
1130	*Aspius aspius*	except the Finnish populations	
1131	*Leuciscus souffia*	1131	*Leuciscus souffia*
		6193	*Squalius (Leuciscus) keadicus*
			Telestes (Leuciscus) muticellus
1132	*Leuciscus lucumonis*		
1137	*Barbus plebejus*	1137	*Barbus plebejus*
		5088	*Barbus cyclolepis*
		5089	*Barbus euboicus*
		5095	*Barbus prespensis*
		5254	*Barbus pergamonensis*
		5256	*Barbus sperchiensis*
		5263	*Barbus strumicae*
		5265	*Barbus bergi*
1138	*Barbus meridionalis*	taxonomy still not clarified	

1140	*Chondrostoma soetta*		
1141	*Chalcalburnus chalcoides*	5268	*Alburnus volviticus*
		5269	*Alburnus vistonicus*
		5288	*Alburnus mandrensis*
		5289	*Alburnus mento*
		5290	*Alburnus schischkovi*
		5291	*Alburnus sarmaticus*
1142	*Barbus comizo*		
1144	*Cobitis trichonica*		
1146	*Sabanejewia aurata*	taxonomy still not clarified	
1149	*Cobitis taenia*	except the Finnish populations	
		1149	*Cobitis taenia*
		5299	*Cobitis strumicae*
		5300	*Cobitis pontica*
		5301	*Cobitis vettonica*
		5302	*Cobitis paludica*
		5303	*Cobitis calderoni*
		5304	*Cobitis bilineata*
		5305	*Cobitis zanandreai*
		5306	*Cobitis punctilineata*
		5307	*Cobitis stephanidisi*
		5308	*Cobitis ohridana*
		5309	*Cobitis vardarensis*
		5310	*Cobitis meridionalis*
		5311	*Cobitis puncticulata*
		5312	*Cobitis arachthosensis*
		5313	*Cobitis hellenica*
1156	*Padogobius nigricans*		
------	*Zingel* spp.	1160	*Zingel streber*
		5356	*Zingel balcanicus*
1162	*Cottus petiti*		
1163	*Cottus gobio*	except the Finnish populations, taxonomy still not clarified	
1998	*Romanichthys valsanicola*		
2511	*Gobio kessleri*		
2533	*Cobitis elongata*		

J. Litophilous and eurytopic fish species. A group collecting species without special linkage to flowing sections of streams. They often inhabit native alluvial habitats.

In general these species are less endangered by hydropower development then previous groups of fish and lampreys. Nevertheless they are frequently seriously impacted by hydropower in cases of peaking and building migration barriers (more likely in eventuality of large hydropower plants).

Natura 2000 code	***Latin name mentioned in the Annex II of the Habitat Directive***	***Natura 2000 code + valid Latin name corresponding to taxonomy / or other notes***	
------	*Alosa* spp. (only some species)	1989	*Alosa caspia vistonica*
		2490	*Alosa macedonica*
		4124	*Alosa agone*

		4126	*Alosa maeotica*
		5046	*Alosa killarnensis*
		5048	*Alosa vistonica*
1114	*Rutilus pigus*	1114	*Rutilus pigus*
		5345	*Rutilus virgo*
1117	*Ladigesocypris ghigii*		
1120	*Alburnus albidus*	1119	*Alburnus vulturius*
		1120	*Alburnus albidus*
1121	*Scardinius graecus*		
1123	*Rutilus alburnoides*	5341	*Tropidophoxinellus hellenicus*
1125	*Rutilus lemmingii*		
1127	*Rutilus arcasii*		
1129	*Phoxinellus* spp.	5279	*Pelasgus thesproticus*
		5333	*Pelasgus stymphalicus*
		5334	*Telestes pleurobipunctatus*
		5335	*Telestes beoticus*
		5336	*Pelasgus marathonicus*
		6263	*Pelasgus epiroticus*
		6264	*Pelasgus prespensis*
		6291	*Pelasgus laconicus*
1133	*Anaecypris hispanica*		
1134	*Rhodeus sericeus amarus*	1134	*Rhodeus sericeus amarus*
		2528	*Rhodeus sericeus*
1135	*Rutilus macrolepidotus*		
1136	*Rutilus rubilio*	1136	*Rutilus rubilio*
		5342	*Rutilus prespensis*
		5343	*Rutilus ylikiensis*
		5344	*Rutilus panosi*
1139	*Rutilus frisii meidingeri*		
1145	*Misgurnus fossilis*		
------	*Sabanejewia larvata*	1147	*Cobitis conspersa*
		1148	*Cobitis larvata*
1150	*Silurus aristotelis*		
1151	*Aphanius iberus*	1151	*Aphanius iberus*
		5196	*Aphanius baeticus*
1152	*Aphanius fasciatus*	1152	*Aphanius fasciatus*
		5276	*Aphanius almiriensis*
1153	*Valencia hispanica*		
1154	*Pomatoschistus canestrinii*	taxonomy still not clarified	
1155	*Knipowitschia panizzae*	taxonomy still not clarified	
1157	*Gymnocephalus schraetzer*		
1992	*Valencia letourneuxi*		
2011	*Umbra krameri*		
2522	*Pelecus cultratus*		
2555	*Gymnocephalus baloni*		
4009	*Phoxinus percnurus*		

K. Crayfish species. Both Annex II crayfish species are connected with streams and rivers and mainly with hard substrate sections.

Mainly a development of small hydropower plants is influencing their populations but there are more serious threats and pressures caused by humans. Besides changes in habitat caused by installation and operation of hydropower plants the crayfish are also impacted by migration barriers nevertheless they are able to get over lower weirs.

Natura 2000 code	***Latin name mentioned in the Annex II of the Habitat Directive***
1092	*Austropotamobius pallipes*
1093	*Austropotamobius torrentium*

L. Bivalve molluscs. Species of this group belong to the order Unionoida and inhabit freshwater habitats (not caves as *Congeria kusceri* – see point N. Cave specialists). They are dependent on fish populations.

They are more than other species sensitive to chemical changes and hydropower development could be in conflict with their protection also for many other reasons (see evaluation table below).

Natura 2000 code	***Latin name mentioned in the Annex II of the Habitat Directive***	***Natura 2000 code + valid Latin name corresponding to taxonomy / or other notes***	
1029	*Margaritifera margaritifera*		
1032	*Unio crassus*	1032	*Unio crassus*
		5382	*Unio tumidiformis*
1990	*Margaritifera durrovensis*		

M. Dragonflies connected with running water habitats. These species are habitat specialists sensitive for deteriorations of inhabited streams and rivers.

For this reason they are also impacted by hydropower development although bad practice examples are not frequent. Main pressures are connected with habitat changes influencing quality of substrate and flow changes.

Natura 2000 code	***Latin name mentioned in the Annex II of the Habitat directive***
1037	*Ophiogomphus cecilia*
1044	*Coenagrion mercuriale*
1046	*Gomphus graslinii*
1047	*Cordulegaster trinacriae*
4045	*Coenagrion ornatum*
4046	*Cordulegaster heros*

N. Cave specialists. Group contains two species – *Proteus anguinus and Congeria kusceri*. Ecological demands of these species are very specific because of its underground life.

Problems are directly connected with development of underground hydropower plants influencing unique habitats of the species. If the site of species is impacted, it is most likely very significant and has to be assessed with maximal prudence taking into account the precautionary principle.

Natura 2000	***Latin name mentioned in the Annex II of the Habitat***

code	*Directive*
1186	*Proteus anguinus*
4065	*Congeria kusceri*

O. Piscivorous bird species connected with streams. Only two piscivorous species from Annex I of the Birds Directive are selected as potentially significantly impacted by hydropower development.

The primary impact is represented by loss of habitat because of inundations and disturbances caused by peaking of large hydropower plants. Both species could be more (secondary) influenced by changes of population structure of prey (fish species).

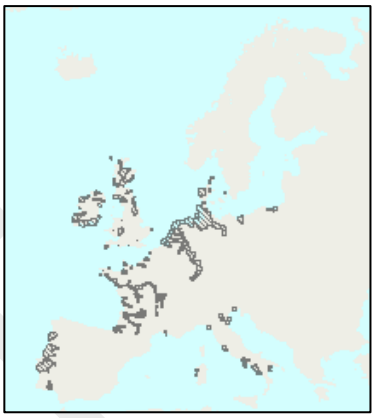
Natura 2000 code	*Latin name mentioned in the Annex I of the Birds Directive*
A030	*Ciconia nigra*
A229	*Alcedo atthis*

Annex 2: List of anadromous fish species from Annex II

Reporting according to the Article 17 of the Habitats Directive have indicated the current distribution of anadromous species in EU territory and there might be a high probability to find them in these areas. However some species might occur also outside the illustrative maps.

Petromyzon marinus

The sea lamprey is an anadromous species that is very rare in the Baltic region, widely distributed in the Atlantic and Continental regions, and in the western and central Mediterranean basin. Adults migrate into rivers during the spawning season.
The conservation status is 'unfavourable-bad' in the Atlantic, Mediterranean and Continental region.

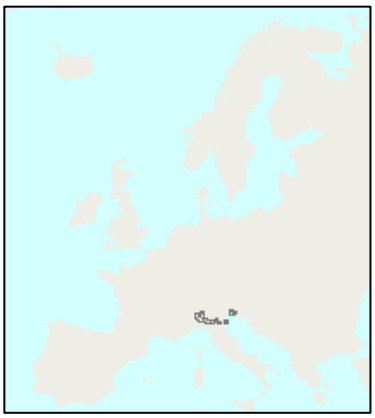


Lampetra fluviatilis

The European river lamprey is a demersal and anadromous species found in a wide range of riverine and coastal habitats of the Baltic Sea and Atlantic countries while in the Mediterranean region it is found along the French and western Italian coasts. Spain did not report on this species which is believed to be possibly extinct due to the building of the Cedillo dam (Caceres) in the 1970's.
The conservation status is considered 'unfavourable-inadequate' in the Atlantic, Boreal and Mediterranean regions.

Acipenser naccarii

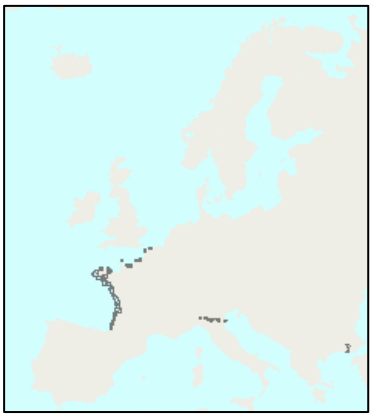
The Adriatic sturgeon is a demersal and diadromous fish species inhabiting the Adriatic region. It spawns in fresh water after a marine period of growth during which it remains near the shore, at the mouths of rivers, between 10 to 40 meters.
The conservation status is 'unfavourable-bad' in the Continental region where a large decline has occurred in the Italian rivers during the last decades among others due to construction of dams that block the rivers where sturgeons spawn. No overall assessment was made for the Mediterranean region because the assessment from Greece stated that no recent information is available.



Acipenser sturio

The Atlantic sturgeon is a demersal and diadromous species inhabiting the Atlantic and Mediterranean regions. Most of its life is spent at sea, relatively close to the coast, it enters rivers to spawn. Previously abundant along all European coasts, today very little is known about its current distribution. Moreover, it is a long-lived and slow-growing fish which is therefore vulnerable to exploitation. The species is exposed to overfishing, construction of dams, water pollution and habitat destruction.

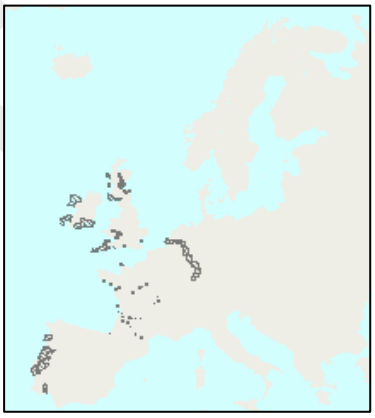
The conservation status is s 'unfavourable-bad' in the Atlantic, Continental and Mediterranean regions.



Alosa alosa

The allis shad is a pelagic and anadromous species spending most of its life cycle in the marine environment. It is rare and declining throughout its range which includes the western coasts of Europe, from southern Norway to Spain, and in the Mediterranean eastwards to northern Italy. Overfishing, pollution and dam constructions (cutting off access to spawning sites) are the major threats to the species.

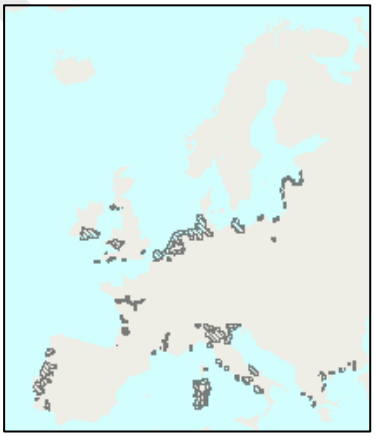
The species is extinct in the Atlantic region of Denmark and Continental region of Denmark and Poland. The overall conservation status is 'unfavourable-bad' in the Atlantic, Continental and Mediterranean regions.



Alosa fallax

The twaite shad is a pelagic and anadromous fish species spending the vast majority of its life in marine waters. It is found along western Europe, from southern Norway to Morocco and along to the eastern Mediterranean, but has declined substantially throughout Europe. Population declines in many parts of Europe have been attributed to pollution, overfishing and migratory route obstructions.

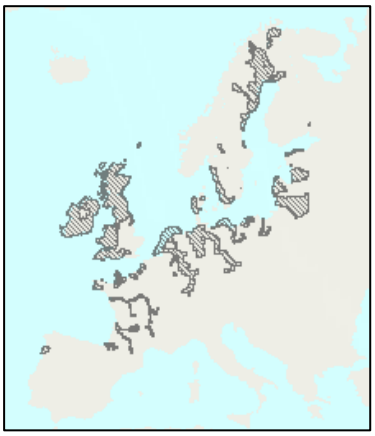
The overall assessment is 'unknown' in the Boreal region, 'unfavourable-bad' in the Atlantic and Continental region and 'unfavourable-inadequate' in the Mediterranean region.



Salmo salar

The Atlantic salmon appears in the northern Atlantic Ocean and waters flowing into the northern Atlantic Ocean. All European countries, except most Mediterranean countries, with rivers flowing into the sea host this species.

In all geographical regions (Alpine, Atlantic, Boreal and Continental) the status of this species is assessed as 'unfavourable-bad'.



Coregonus oxyrhynchus

The houting is an anadromous whitefish which spawns in large rivers from which the young migrate to the sea to develop and grow to maturity. They then return to their natal rivers to breed. The original distribution of the houting was in the Baltic Sea and eastern parts of the North Sea and several large rivers (e.g. Elbe, Rhine, Weser) into which adults migrated to spawn. The stocks of this species have greatly declined during the second half of the 20th century and several populations have disappeared. Species is recorded from Atlantic region only from northern DK. Its overall assessment is 'unfavourable-bad'.