WFD implementation
in the Neretva – Trebišnjica River Basin

Toward a River Basin Characterisation
Strategic Guidance

June 2009

Project: Living Neretva Phase III
Authors:
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Glossary and Abbreviations

Adriatic Agency: Agency of the Federation of Bosnia and Herzegovina responsible for the management of the Adriatic Sea Basin, with seat in Mostar¹.

Environmental Quality Standard (EQS): Quantitative and measurable description of the highest acceptable concentration of pollutants in the water column, sediment or biota. An EQS describes the borderline when a pollutant is causing pollution and thus failure to achieve Good Chemical Status. In most cases an EQS is set as a maximum average annual concentration derived from the NOECs (no effect concentration) divided by a safety factor, depending on the level of information and uncertainty. The EU has established legally binding EQS for 33 substances and groups of substances.

Good Status (GS): The normative environmental objective for all bodies of water in the EU as defined by the Water Framework Directive (WFD). In the case of surface water, GS comprises good ecological and chemical status and is measured against a type specific reference condition with no or only very minor human impacts on the Water Status. In the case of groundwater, GS includes good chemical and quantitative status and is measured against natural conditions and whether there is any negative impact on surface water or any legitimate use of that groundwater. In general the GS has to be achieved for all water bodies by 2015. If a number of criteria and conditions are met, the achievement can be postponed twice for a period of six years and alternatively a lower objective can be set.

Good Ecological Status: Ecological status of surface water bodies is described by biological, hydromorphological and general physico-chemical quality elements. Good ecological status is achieved when the biological quality elements (e.g. composition and abundance of fish or benthic invertebrate fauna) and general physico-chemical quality elements (e.g. oxygenation or nutrient condition) are only slightly deviating from the reference conditions (the ones achieved under no or very minor human impacts).

Good Ecological Potential: The default ecological restoration objective for Heavily Modified or Artificial Water Bodies (HMWB), e.g. Water Bodies which are substantially changed in their physical character (e.g. due to dams, dykes). The Good Ecological Potential is defined as a slight deviation of biological quality elements from the ones which would be achieved if all mitigation measures would be carried out which do not have a significant negative impact on the beneficiary of the physical alteration of the water body.

Heavily Modified Water Bodies (HMWB) and Artificial Water Bodies (AWB): can be designated if water bodies are substantially changed in character as a result of human activity and if removing the physical changes (e.g. hydropower dams or flood protection dykes) as would be necessary to restore the Good Status would have a serious negative impacts on the beneficiary of the physical change (e.g. electricity production or human settlement). In addition no alternative that is significantly better from the environmental perspective is available due to technical or cost reasons (e.g. alternative electricity production/energy saving or moving settlement).

Neretva- Trebišnjica River Basin (Basin): The Basin is formed by the two rivers Neretva and Trebišnjica connected by underground flows in a highly karst geology. The Basin extends over 10,292km². The Trebišnjica basin is situated mainly within the Republika Srpska, the Neretva basin within the Federation. The Neretva delta is mainly situated in the territory of Croatia.

Basin Characterisation: includes a general description of the River Basin District and types of waters and reference conditions, an economic analysis of water uses and an assessment of the pressures and impacts and risk of failing to achieve the WFD objectives.

River Basin Management Plans (RBMP): are documents according to the WFD which present a characterisation of a river basin district, assessment of human pressures and

¹ WWF 2008
impacts on the status of bodies of waters, economic analysis of water uses, monitoring networks, list of environmental objectives and justification of derogations from achieving GS by 2015 and programmes of measures to achieve the environmental objectives. Draft plans have to be open for consultation with public and interested parties till June 2009 and be finalised and adopted by December 2009.

**RS Water Directorate**: Directorate for Waters in Bijeljina of the Republic Srpska.²

**Sava Agency**: Agency of the Federation of Bosnia and Herzegovina responsible for the management of the Sava Basin, with seat in Sarajevo.³

**Water Body (WB)**: Distinct element of water, for example a river stretch having distinct natural, ecological and anthropogenic features.


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² WWF 2008
³ WWF 2008
1. Introduction

WWF Mediterranean Programme Office commissioned *europe, planet earth ltd* (EPE) to provide capacity building and strategic advice to Bosnia and Herzegovina (BiH) administration in carrying out main elements of the River Basin Characterisation as set out in the EU Water Framework Directive (WFD). The economic analysis, which is part of the characterisation, has not been covered. A report about the application of the economic analysis in the Basin has been carried out and published (WWF 2008).

A field visit and two workshops with participants from the Ministry of Water and the Agencies in charge of the Sava and Adriatic Basin were organised in April and June 2009.

This report provides an introduction to the general and specific Basin Characterisation aspects of the WFD and relevant EU experiences, which EPE provided during the workshops. It summarises our findings about the state of play in carrying out the Characterisation of the Basin and our results of a preliminary pressures and impacts screening and assessment of the risk of failing to achieve the WFD objectives.

On the basis of these findings EPE develops a number of recommendations which should help the competent authorities to successfully carry out a Basin Characterisation which supports an effective and robust achievement of WFD objectives.

This work comes at an early stage of the WFD implementation in the Basin – at a time where administrative arrangements are yet to be finalised, coordination and competencies of authorities are still to be arranged and important monitoring to be gathered.

Therefore the findings are general in nature and focussed on aspects relevant at the Basin scale or the river Neretva itself. Information about groundwater and tributaries to the Neretva were not available.

In order to develop more specific guidance for local water management issues it will be necessary to collate more information, as will become available in future through the new monitoring programme, and to ensure the participation of the Water Directorate of Republika Srpska, which was lacking during this work.
2. Basin Characterisation – integrated risk assessment for the aquatic environment

The characterisation is a main step in implementing the WFD. It is part of an iterative management cycle (see Figure 1). It comes after establishing competent authorities for managing the River Basin District. It informs the subsequent management elements including:

- Designing monitoring programmes; and
- Establishing environmental objectives and a programme of measures.

Together these elements are the basis to develop a River Basin Management Plan (RBMP) and to ensure active involvement of the public and stakeholders. The RBMPs and the preparatory elements are to be reviewed every six years. The last management cycle ends 27 years after WFD entering into force and by then the WFD objectives should be fully achieved. The default objectives of the WFD are:

- Protection of the Good Status and restoration of all WBs;
- Prevention of Status deterioration; and
- Efficient and sustainable water use.

NOTE: Environmental objectives, as established by the RBMPs, are the default objectives and possible exemptions. Such exemptions are allowed if a number of criteria are met. In the EU for a high number of WBs an extension of deadlines to achieve the GS is envisaged. In particular, groundwater bodies often require substantial time to recover. Postponing the achievement of GS beyond the last management cycle (ending 27 years after WFD entered into force, i.e. 2027), is only possible for natural reasons. For some WBs lower objectives are likely to be set. Main reasons for lowering the objectives include the lack of environmental better alternatives, technical unfeasibility and disproportional cost of restoration measures. All exemptions have to go through consultation with the public and cannot be granted automatically. Read Policy document endorsed by EU water directors for further information about setting environmental objectives (EC 2005).

Figure 1: Iterative management cycles under the WFD
The timetable for implementing the WFD in BiH is different than set out by the WFD. In specific the deadlines for finalising the RBMPs are 2012 for the (Federation) and 2015 (for Republika Srpska), i.e. shifting the deadlines by 3-6 years. Considering the state of play in BiH, even 2015 as deadline seem to be ambitious.

The main objective of the River Basin Characterisation is to provide an assessment of the risk of failing to achieve the WFD objectives for WBs. This assessment is needed to target monitoring and measures in an environmental and cost effective manner. It identifies the pressures and their drivers as well as the state of the environment in such a way that decision-makers, the public and stakeholders can discuss priorities and environmental ambitions.

The experience in the EU with River Basin Characterisation shows that it is an ongoing process where new information coming from the monitoring programmes will further improve the understanding. With time the uncertainty about which WBs being either in or above or which are below GS should be reduced.

An assessment of 25 Characterisation reports in the EU in the year 2006 revealed that around 50% of WBs are at risk of failing GS (see Figure 2). After 30 years of EU water protection policies in place this is a rather sobering finding and shows that the WFD tackles environmental problems, which were not looked at in the past.

In specific the deterioration of hydromorphological quality elements (see Figure 3) causes many WBs to fail the GS. In plain language this means that those WBs have insufficient space and lost the connection with their floodplains or groundwater and / or have insufficient or inadequately distributed water flows to support functioning aquatic ecosystems. New sectors and human activities are therefore identified as drivers for deterioration of water status, including navigation, hydropower and flood control (see Figure 4).

**Figure 2:** Risk of failing objectives by 2015, based on 25 River Basin Characterisation Reports (EEB, WWF 2006)
**Figure 3:** Number of River Basin Characterisation reports (out of 25) identifying main reasons for failure in achieving GS (multiple identification is possible) (EEB, WWF 2006)

**Figure 4:** Number of River Basin Characterisation reports (out of 25) identifying specific sectors causing the failure in achieving GS (multiple identification possible), (EEB, WWF 2006)
3. The main steps for a River Basin Characterisation

The characterisation includes four main steps, which are described in this chapter except for the economic analysis of water uses. Those steps are closely interrelated and should be carried out in close coordination.

3.1. Typology and reference conditions

The purpose of a typology is to set reference conditions as precisely as possible and thus arrive at an ecological, meaningful and workable classification system.

Types can be established using the System A or B as outline in the WFD Annexes. It does not really matter which one is used as long as the result is ensuring that precise reference conditions can be set. In the EU most commonly a top-down approach has been applied whereby abiotic parameters are used to develop a first set of types, which have to be further refined or merged using biotic data and expert judgement in order to make them biologically meaningful (see Figure 5).

Figure 5: Approaches for typology, courtesy of Ulrich Irmer, Umweltbundesamt Germany

Reference conditions have to be established for all water types. Ideally a ‘real site’ for each type is found in the Basin, which has no or minor human impacts and from which the values of indicative parameters describing the ecological status can be derived. In order to assess whether the site is suitable a screening of pressures should be carried out using the criteria as laid down in Annex 1 of this report.

Note: Water bodies which changed their category due to human activities (e.g. river turned into a lake by a dam) cannot be used as reference sites.

In case sites without or with very minor human impact are not available one should check availability of sites in neighbouring or similar river basins. If that is not successful either historical data, models and expert judgement is to be used as appropriate. See flowchart in Annex 2 for further information.

3.2. Water body delineation

WBs serve are the smallest management unit in a river basin, which should allow the accurate description of the water status, now and in future, and the environmental objectives.

The delineation of WBs should be:

- **Complete** - covering all water and all relevant hydromorphological elements (flow, water channel, riparian zone/wetlands if clearly connected with a surface water);
- **Meaningful** - representing ecological and chemical status;
- **Manageable** - aggregate when possible; and
- **Flexible** - to adjust to changing conditions.
The main criteria to delineate WBs are:

- Water category (river, lake, coastal water) and significant natural features (see Figure 6);
- Typology (altitude, geology, size, depth etc... and additional biotic parameters) (see Figure 7);
- Significant human impacts to ensure that changes in Status are visible (see Figure 8); and
- Public Participation, WBs will be the closest link to individual citizens.

**Figure 6:** Water categories and significant natural features used for delineation (CIS Nr 2)

**Figure 7:** Typology used to delineate WBs (CIS Nr 2)
Figure 8: Pressures used for delineation and consequences of misclassification (CIS Nr 2)
3.3. Pressures and impacts assessment – the risk assessment

The WFD’s pressures and impacts assessment step of the River Basin Characterisation can be described as a risk assessment. Risk assessments are common for all policy and decision-making processes. Some are based on very formalised technical procedures delivering quantified results, like chemical risk assessments, others are done at a personal judgement call with qualified results, like street crime in your neighbourhood.

EU water policy, as it was in the past mainly a policy to address chemical pollution, is influenced by the sophisticated chemical risk assessment procedures, which in principle describe the risk as the potential adverse effect of a chemical (its toxicity) times the estimated exposure (i.e. environmental concentration or daily human intake). The problem is that often the exposure is unknown (complex substances transport mechanisms) or there is no clear relation between the risk and the exposure (for example hormone mimicking substances, where lower concentration can have higher negative impacts, or several substances develop synergistic negative effects).

When applying risk assessment procedures to non-chemical pressures, like changes of water flow and levels and morphology this should be kept in mind.

The risk assessment proposed by the CIS guidance documents (CIS Guidance Nr 3) suggests the following approach:

- Assess driving forces and pressures, for example agriculture using water for irrigation and thus abstracting water from a river (see Figure 9 for a list of relevant pressure under the WFD)
- Identify potential significant pressures, for example abstractions from river at low flow more than 20% of flow
- Assess impacts, for example loss of macrophytes due to lack of water
- Establish likelihood of failing GS, for example moderate deviation of general composition of macrophytes from reference conditions resulting in Moderate Status only. Often three categories of risk are provided: At risk, Insufficient Data and Not at Risk. Sometimes more risk categories are used

See Annex 3 for examples of the results of a risk assessment.

NOTE: In establishing the Status of a water body the one out – all out principle applies, which means that if one indicative parameter for a quality element, e.g. oxygenation condition or hydrological regime, is deviating significantly from reference condition, the overall Status of that water body is below Good no matter how good other quality elements are.

Figure 9: List of WFD relevant pressures

- Hydrology
  - Abstraction and flow regulations
- Morphology
  - Embankments and dykes
  - River maintenance / dredging
  - Drainage
- Water pollution
  - Discharges or losses of nutrients, priority substances and other toxic substances or alien species from industrial, urban or agricultural activities
- Groundwater abstraction
Figure 10: List of WFD relevant impacts

- Hydrology
  - Flow regime
  - River – groundwater connectivity
  - Reservoir/lakes size and volumes

- Morphology
  - Structure and substrate of river or lake bed
  - Structure of lake shore or riparian zone
  - Lake depth

- Surface water quality
  - Transparency
  - Nutrients/Pesticides
  - Industrial pollutants
  - General physico-chemical condition
  - Biological parameters

- Groundwater Quality
  - Nitrates and ammonium
  - General physico-chemical condition
  - Pesticides
  - Industrial pollutants

- Groundwater quantity
  - Levels and flow

The experience with the pressures and impacts assessment in the EU was that quite good data and information about drivers and pressures is available. The understanding of impacts was often incomplete and data were lacking to achieve a high confidence in the risk assessments at water body level. The interaction of many parameters, like chemical and hydromorphological conditions with biological quality elements is not understood sufficiently.

Therefore the results of the risk assessment were often broken down for each group of quality elements and the category of “insufficient data” or “probably at risk or not at risk” became very large.

NOTE: According to the CIS guidance Nr 3 it is best practice to designate WBs at risk if data are insufficient to assess the risk but there is a clear sign of a significant pressure. The reason for this is that WBs at risk should become part of the operational monitoring which should help to reduce uncertainties.

The work to reducing uncertainties could go on forever and paralyse decision-making. Therefore it is necessary to provide information about the suspected impact, in specific whether it involves long-term or irreversible negative effects (for example loss of endemic species, negative effects on reproductive systems, pollution of drinking water resources, or loss of sediments). Decision-makers must be aware of the costs of inaction when waiting for further data to reduce uncertainties.
4. Situation in the Neretva basin and recommendations for next steps

The findings in the following chapters are based on a field visit carried out on 15 April 2009, 2 workshops (15-16 April and 1-2 June 2009) and the presentations and feedback received from representatives of Adriatic and Sava Agencies.

4.1. Typology and reference conditions

The work on typology and establishing reference conditions has not yet started, partly because of coordination and competency sharing problems. The Adriatic Agency has the competencies for water courses of 1st category, which are laid down in the respective regulations. 1st category courses cover the Neretva and some tributaries, but insufficient to start the typology exercise.

For the Sava basin a preliminary typology has been undertaken resulting in 42 river types based on abiotic indicators.

In view of this experience in the northern BiH basin, it is recommended to apply biotic parameters and use the expert judgement of biologists in order to avoid a too large number of types and to ensure they are indeed biologically meaningful. In addition, one should keep in mind that for each water type specific reference conditions have to be established.

The work on reference conditions has not yet started. The agency reports that for the upper and middle parts of the Neretva it is likely that natural sites with minor human impact exist. It is recommended to apply the criteria as outlined in Annex 1 Error! Reference source not found. to select potential reference sites followed by monitoring of their biological parameters, either as part of the surveillance or operational monitoring.

NOTE: Reference conditions should not be adapted to existing human pressures, no matter how important they are. Human needs will be taken care off during the setting of environmental objectives and designation of heavily modified or artificial Water Bodies.

For the lower parts of the Neretva it is advisable to look for reference sites in neighbouring regions, otherwise historic data, models and expert judgment are the last option. In the specific case of the Neretva, this should include estimating natural sediment structure and nutrient conditions before hydropower impacts. The abundance of the three endemic trout species, Neretvanska Mekousna, Glavatica and Zubatak, could play an important role of defining reference conditions for the Neretva River (see Annex 4).

Concerning the artificial lakes, as created by hydropower dams in the Neretva basin, it is advisable to assume the reference condition as established by the appropriate natural river type, until a decision about the designation as artificial or heavily modified WBs is made in the later phases of the River Basin Management Planning.

NOTE: The WFD does not make a practical difference in the designation of artificial or heavily modified WBs. In both cases a number of criteria are to be met, including the lack of significantly better environmental alternatives (for example wind power or energy saving replacing a hydropower station) due to technical feasibility or disproportionate costs. The designation must be open to public consultation.

If those waters are designated as HMWB or AWB the specific ecological reference conditions will be provided by the Maximum Ecological Potential. This potential is set by estimating the values of indicative biological parameters if all mitigation measures are taken which do not have a significant adverse effect on the respective water use. For example the abundance and composition of macrophytes and migratory fish to be expected if a fish by-pass is constructed (see Figure 11), flows are managed to mimic natural flows and sediment transport ensured in such a way that those measures do not have a significant impact on the electricity production (for example 50% reduced output).
Figure 11: Two types of functioning fish passes – the more natural-like bypass channel is more costly in this case but provides useful additional spawning ground (CIS Technical Report on Hydromorphology).

4.2. Water body delineation
Work has not yet started and would be premature until the typology has been carried out and more information from the pressures and impacts assessment and monitoring has become available.
4.3. Results of a preliminary screening of pressures and impacts

A preliminary screening of pressures and impacts was carried out in order to identify risks of failing to achieve WFD objective in the Neretva basin. A distinction was made between basin scale and water body scale. At this stage only indicative statements about the impacts and risk of failure at local scale were possible.

The information we used includes a field visit along the middle part of the Neretva River as well as monitoring data made available and feedback provided by the Adriatic Agency on a questionnaire which was distributed in April 2009. In addition information about human activities at basin scale is available in the WWF 2008 report on the economic analysis and could be used for the risk assessment.

More information is expected to be available soon: The Adriatic Agency has established a new monitoring programme for 2009-11. This will cover many indicative parameters for relevant quality elements at 51 monitoring stations. Quality elements not covered by this programme and identified as important by the preliminary pressures and impacts screening are fish, macrophytes, and sediment structure.

Table 1 shows the main elements of the pressures and impacts screening and preliminary risk assessment. The main findings are the following:

4.3.1. Hydromorphological degradation caused by hydropower

10 hydropower stations in the Basin are very likely having a significant negative impact at river basin scale and causing large parts of the river system failing to achieve a Good Ecological Status. The main impacts include: loss of river connectivity and barrier for migrating species, increased erosion and sedimentation downstream of dams due to rapid and significant daily water level changes (see
Figure 12). Those impacts have already triggered the installation of rip-rap and river embankments (around 2-3 km for 120,000 Euro per year). Significant impact on fish population, in specific on the endemic trout species, as well as macrophytes and sediment structures are to be expected, but not monitored (see Figure 13: Potential impacts of hydropower (CIS Technical Report on Hydromorphology) for the potential impacts of hydropower).

**Recommendation – high priority**: Develop strategy to assess impact of hydropower on biological quality elements and hydromorphology. The objective is two-fold:

1. Identify WBs at risk of failure - extent of impact upstream and downstream of all the dams (in their combination) should be assess using fish, macrophytes and sediment, water level information

2. Provide a tool to assess changes to hydropower production in the Neretva Basin, e.g. new dams or mitigation measures, including changed reservoir and water flow, fish by-pass.
Figure 12: Water flow at monitoring station Humac - before and after hydropower operation

Figure 13: Potential impacts of hydropower (CIS Technical Report on Hydromorphology)
4.3.2. Threat to endemic species from fish farms

Over a dozen in-stream fish farms at the Neretva are likely to cause significant deterioration of the water status in the river basin. The main impacts to be expected result from include the introduction of alien species (Californian trout and others) which are likely to disturb the population the three endemic trout species found in the Neretva. In addition chemical pollution, from the use of antibiotics, is to be expected. The extent of the impact can not be assessed as no fish monitoring is carried out.

Recommendations - high priority

Develop inventory of fish farms, including data about alien fish introduction, production volumes and chemical use. Assess their impact on the food chain in Neretva and whether they push back the endemic trout species. The required fish monitoring in the Neretva can be combined with the data collection necessary for assessing hydropower impacts.

4.3.3. Abstractions and pollution from agriculture

No significant impact is likely at basin scale, as only 3% of land are farmed and some 0.1% of average an 1% of low flow are abstracted for irrigation. The monitoring data do not indicate pesticide concentrations above EQS, but some pesticides are not covered, i.e. Dioron. Data do not indicate eutrophication either. Nevertheless on the water body scale impacts are likely especially at groundwater recharge areas with respect to pollution and at smaller rivers and aquifers with regard to low water levels. Further it has to be considered that farming land and pesticides/fertilizer use is set to grow as it was experienced in neighbouring countries after further integration into the EU common market and policies.

Recommendations - medium priority:

Inventory of pesticides and fertilizers use and spatial analysis regarding sensitive groundwater recharge areas and agricultural activities.

Inventory of abstraction for irrigation purposes.

4.3.4. Organic pollution from untreated urban waste water

43% of population is connected to a sewer system. Most waste water is discharged untreated. Significant impacts at WB level are expected. At river basin scale the discharge is unlikely to cause or contribute significantly to eutrophication at river basin scale. The BOD load of the around 0.5 million inhabitants is most likely diluted and biodegraded in the Neretva with is average discharge of 290 m3/s. But the water quality is not meeting safe bathing standards at several monitoring sites. No designation of bathing areas has been undertaken so far, while there is evidence of some bathing activities in Mostar. The biological classification based on the saprobic index does not show deterioration below class II, which eventually would correspond to a Goo Ecological Status. These results have to be treated with caution. The Adriatic Agency reports that the saprobic index might not deliver robust results as it has not been calibrated with reference conditions. In addition it is suspected that part of the organic pollution is sedimented and broken down in the hydropower reservoirs and not by the natural functioning river system, which might be more sensitive to BOD loads.

Recommendations - medium priority

Check whether saprobic index works by applying it to reference conditions, otherwise do not further use it.

Apply standard model for nutrients and BOD flow and degradation in river to improve confidence in assessing impact of urban waste water.

Designate bathing water sites, as part of the work of establishing a register of protected areas.
4.3.5. Other potential pressures for which little information is available

- DEHP pollution from unknown sources: in some monitoring sites concentrations above EQS are reported but source is unknown.
- Gravel mining in the river: occurring in the lower part and very likely causing failure
- Pollution from industry and waste dump: likely to occur locally
- Hydromorphological impacts from transport, tourism and urbanization: no information has been available

**Recommendations – medium to low priority:** Establish inventories and registers for Develop inventory of DEHP uses and potential releases. Location and types of industrial activities, including gravel mining; and Land use in flood plains and groundwater recharge areas.

*The WFD together with other EU environmental legislation, like the IPPC, require a comprehensive licensing system for all major industrial activities and all other industrial activities which have a significant impact on a water body.*
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<td>NA</td>
<td>WWF 2008 and AVP Jadr. mora Mostar</td>
<td>MEDIUM PRIORITY: Assessment of land use</td>
</tr>
<tr>
<td>dredging</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gravel mining</td>
<td>unlikely</td>
<td>Very likely</td>
<td>Major gravel mining in the delta, smaller activities upstream</td>
<td>NA</td>
<td>Water Agency Mostar</td>
<td>few WBs likely to fail</td>
</tr>
<tr>
<td></td>
<td>drainage</td>
<td>Land take for agriculture</td>
<td>unlikely</td>
<td>Major gravel mining in the delta, smaller activities upstream</td>
<td>NA</td>
<td>Water Agency Mostar</td>
<td>MEDIUM PRIORITY: Assessment of land use</td>
</tr>
</tbody>
</table>
### 3. Pollution of surface water

<table>
<thead>
<tr>
<th>Pressure categories</th>
<th>Drivers</th>
<th>Significant Basin</th>
<th>WB explain</th>
<th>Pressure</th>
<th>Impact</th>
<th>Information sources</th>
<th>Risk of failing GS</th>
<th>Next steps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industry</strong></td>
<td>Aluminium, Electroplating</td>
<td>unlikely</td>
<td>likely</td>
<td>Discharge of Chromium, Zn, Ni</td>
<td>below EQS</td>
<td>WWF 2008</td>
<td>few WBs likely to fail</td>
<td>LOW PRIORITY: check temp changes</td>
</tr>
<tr>
<td></td>
<td>Energy production</td>
<td>unlikely</td>
<td>likely</td>
<td>1 Thermal Power plant</td>
<td>NA</td>
<td>WWF 2008</td>
<td>few WBs likely to fail</td>
<td>LOW PRIORITY: check temp changes</td>
</tr>
<tr>
<td><strong>Urban</strong></td>
<td>Waste water</td>
<td>unlikely</td>
<td>likely</td>
<td>only 43% of population connected, low level treatment, but dilution and biodegradation</td>
<td>Micro-biological pollution</td>
<td>AVP Jadr.mora Mostar</td>
<td>several WBs likely to fail</td>
<td>MEDIUM PRIORITY: Describe collection+ treatment, apply model</td>
</tr>
<tr>
<td><strong>Agriculture</strong></td>
<td>Trout farms</td>
<td>unlikely</td>
<td>likely</td>
<td>3% of land is farmed. No significant findings of copper, pesticides, nitrates pollution. But growth potential</td>
<td>below EQS</td>
<td>WWF 2008 / AVP Jadr.mora Mostar</td>
<td>increasing number WBs likely to fail</td>
<td>MEDIUM PRIORITY: Inventory of pesticide and fertiliser use</td>
</tr>
<tr>
<td><strong>Fisheries</strong></td>
<td>Trout farms</td>
<td>very likely</td>
<td>very likely</td>
<td>several trout farms in stream. Use of antibiotics, introduction of alien species</td>
<td>NA</td>
<td>Own observation</td>
<td>many WBs likely to fail</td>
<td>HIGH PRIORITY: Inventory of fish farms</td>
</tr>
<tr>
<td><strong>diffuse sources</strong></td>
<td>NA</td>
<td>NA</td>
<td>likely</td>
<td>for example waste dumps and uncontrolled industrial activities</td>
<td>DEHP above EQS</td>
<td>AVP Jadr.mora Mostar</td>
<td>some WBs likely to fail</td>
<td>HIGH PRIORITY: Inventory of DEHP uses and sources</td>
</tr>
</tbody>
</table>

### 4. Pollution of groundwater

<table>
<thead>
<tr>
<th>Pressure categories</th>
<th>Drivers</th>
<th>Significant Basin</th>
<th>WB explain</th>
<th>Pressure</th>
<th>Impact</th>
<th>Information sources</th>
<th>Risk of failing GS</th>
<th>Next steps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industry</strong></td>
<td>Uncontrolled activities</td>
<td>NA</td>
<td>likely</td>
<td>NA</td>
<td>Pollution of springs</td>
<td>AVP Jadr.mora Mostar NA</td>
<td>some WBs likely to fail</td>
<td>MEDIUM PRIORITY: Inventory of uncontrolled activities and waste dumps</td>
</tr>
<tr>
<td><strong>Urban</strong></td>
<td>Waste, diffuse discharges</td>
<td>NA</td>
<td>likely</td>
<td>NA</td>
<td>Pollution of springs</td>
<td>AVP Jadr.mora Mostar NA</td>
<td>growing number of WBs likely to fail</td>
<td>MEDIUM PRIORITY: Inventory of pesticide and fertilisers use, apply model</td>
</tr>
<tr>
<td><strong>Agriculture</strong></td>
<td>Domestic water supply</td>
<td>unlikely</td>
<td>likely</td>
<td>3% of land is farmed, but significant development potential and plan accordingly</td>
<td>NA</td>
<td>WWF 2008</td>
<td>growing number of WBs likely to fail</td>
<td>MEDIUM PRIORITY: Need to develop inventory of groundwater abstractions</td>
</tr>
<tr>
<td></td>
<td>Industry water supply</td>
<td>unlikely</td>
<td>unlikely</td>
<td>Over 90% of total water abstracted in Neretva basin are groundwater resources</td>
<td>NA</td>
<td>WWF 2008</td>
<td>growing number of WBs likely to fail</td>
<td>MEDIUM PRIORITY: Need to develop inventory of groundwater abstractions</td>
</tr>
<tr>
<td><strong>Agriculture irrigation</strong></td>
<td>NA</td>
<td>NA</td>
<td>likely</td>
<td>NA</td>
<td>WWF 2008</td>
<td>growing number of WBs likely to fail</td>
<td>MEDIUM PRIORITY: Need to develop inventory of groundwater abstractions</td>
<td></td>
</tr>
</tbody>
</table>
5. Conclusions

Implementing the WFD in the Neretva-Trebišnjica River Basin in Bosnia and Herzegovina presents a major challenge. Administrative capacities and coordination between regions is developing but yet insufficient to successfully carry out a complete and coherent Basin Characterisation. This is a prerequisite to achieve the ambitious WFD objectives.

A systematic, scientific approach to assessing the risks to the aquatic environment in the Basin is on the other hand a great opportunity to achieve responsible water management which is effective for both the ecology and the public budget.

A lot is at stake in the Basin: A unique aquatic environment, which is home to endemic species and at the same time providing great services to people, like fishing, hydropower and leisure. Low population density and level of agricultural and industrial activities have kept pressure on the general water quality low. But massive hydromorphological changes from hydropower production and the likely introduction of alien species from trout farms have caused already a severe change of the rivers main characteristics and ability to provide its services for the future.

This situation corresponds partly to the experience in the EU: hydromorphological pressures present the large negative impacts. For the Neretva-Trebišnjica River Basin this situation might be surprising considering that pollution from urban waste water, agricultural and industrial chemicals is largely not managed well or at all. But the number of people and activities seem to be too low to cause significant damage to the rather large water volume and flows in the Basin. Despite this dilution effect, smaller streams and individual water bodies are likely to be negatively impacted and further investigation will be necessary. Also it is expected that specific activities will increase in future, like farming driven by the impact of EU integration, and therefore sufficient control and monitoring has to be put in place to influence the development of those activities to prevent future risks to the Basin.

While the Basin Characterisation would not necessarily single out urban waste water as a major issue in the Neretva-Trebišnjica River Basin, another EU law, the Urban Waste Water Treatment Directive, will do so. It has to be highlighted that this Directive does not prescribe technical standards, like treatment levels, but requires establishing emission limit values to support a good water status (Scheuer 2005).

Therefore, the Basin Characterisation and the following Management Plans, as required by the WFD, should guide the urban waste water management to ensure cost-effectiveness – waste water treatment infrastructure can be extremely expensive and inflexible to cope with future developments if not well designed, for example to deal with scattered settlements and to cope with population dynamics.

Hydropower is likely to cause the failure of many water bodies to achieve Good Status. Information on the impacts is scarce and it is recommended as a high priority to improve the knowledge about hydropower pressures and its impacts. Appropriate monitoring has to be established in order to inform the further development of management plans and programme of measures. The new 2009-11 monitoring programme established in Neretva-Trebišnjica River Basin is inadequate as it does not include the parameters indicative for hydropower impacts. Methods and international standards for assessing the relevant quality elements like macrophytes and fish are indeed missing or underdeveloped, but this should not prevent authorities to use available expertise to develop a method fit for the Basin.

Basin Characterisation is an ongoing process which can be refined as new knowledge is created. The most important is that the direction taken at the start is coherent with the current knowledge.
6. References

**CIS Guidance documents and reports:** These documents developed under the Common Implementation Strategy for the Water Framework Directive can be found at: [http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive&vm=detailed&sb>Title


1. Annex: Pressure screening criteria for selecting potential reference sites or values (CIS Guidance Nr 10)

<table>
<thead>
<tr>
<th><strong>High ecological status</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General statement</strong></td>
<td>• High status or reference conditions is a state in the present or in the past corresponding to very low pressure, without the effects of major industrialisation, urbanisation and intensification of agriculture, and with only very minor modification of physico-chemistry, hydromorphy and biology.</td>
</tr>
<tr>
<td><strong>Diffuse source pollution</strong></td>
<td></td>
</tr>
<tr>
<td>Land-use intensification: Agriculture, forestry</td>
<td>• Pre-intensive agriculture or impacts compatible with pressures pre-dating any recent land-use intensification.</td>
</tr>
<tr>
<td></td>
<td>• Pressures pre-dating any recent intensification in airborne inputs that could lead to water acidification.</td>
</tr>
<tr>
<td><strong>Point source pollution</strong></td>
<td></td>
</tr>
<tr>
<td>Specific synthetic pollutants</td>
<td>• Pressures resulting in concentrations close to zero or at least below the limits of detection of the most advanced analytical techniques in general use (A Selection process for relevant pollutants in a river basin is presented as an example of best practice in section 6 of the guidance document from Working Group 2.1, IMPRESS).</td>
</tr>
<tr>
<td>Spec. non-synthetic pollutants</td>
<td>• Natural background level/load (see reference above)</td>
</tr>
<tr>
<td>Other effluents/discharges</td>
<td>• No or very local discharges with only very minor ecological effects.</td>
</tr>
<tr>
<td><strong>Morphological alterations</strong></td>
<td></td>
</tr>
<tr>
<td>River morphology</td>
<td>• Level of direct morphological alteration, e.g. artificial instream and bank structures, river profiles, and lateral connectivity compatible with ecosystem adaptation and recovery to a level of biodiversity and ecological functioning equivalent to unmodified, natural WBs</td>
</tr>
<tr>
<td>Lake morphology</td>
<td>• Level of direct morphological alteration, e.g. structural modifications that hinder fluctuations of the water surface, compatible with ecosystem adaptation and recovery to a level of biodiversity and ecological functioning equivalent to unmodified, natural WBs</td>
</tr>
<tr>
<td><strong>Water abstraction</strong></td>
<td></td>
</tr>
<tr>
<td>River and lake water abstraction</td>
<td>• Levels of abstraction resulting in only very minor reductions in flow levels or lake level changes having no more than very minor effects on the quality elements.</td>
</tr>
<tr>
<td>Flow regulation</td>
<td></td>
</tr>
<tr>
<td><strong>River flow regulation</strong></td>
<td>Levels of regulation resulting in only very minor reductions in flow levels or lake level changes having no more than very minor effects on the quality elements.</td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Riparian zone vegetation</strong></td>
<td>Having adjacent natural vegetation appropriate to the type and geographical location of the river.</td>
</tr>
<tr>
<td><strong>Biological pressures</strong></td>
<td></td>
</tr>
</tbody>
</table>
| **Introductions of alien species** | Introductions compatible with very minor impairment of the indigenous biota by introduction of fish, crustacea, mussels or any other kind of plants and animals.  
No impairment by invasive plant or animal species. |
| **Fisheries and aquaculture** | Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.  
Stocking of non indigenous fish should not significantly affect the structure and functioning of the ecosystem.  
No impact from fish farming. |
| **Biomanipulation** | No biomanipulation. |
| **Other pressures** | |
| **Recreation uses** | No intensive use of reference sites for recreation purposes (no intensive camping, swimming, boating, etc.) |
2. Annex: Step-by-step approach for establishing reference conditions and boundaries between high, good and moderate ecological status classes (CIS Guidance Nr 10)

(RC=reference conditions, EQR=Ecological Quality Ratio)
3. Annex: Examples of results of the Risk Assessment in Scotland

Table 2: River water bodies at risk from point source pressures

<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Number of water bodies</th>
<th>% of number</th>
<th>Length (km)</th>
<th>% of Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1a - At Risk</td>
<td>158</td>
<td>17.0</td>
<td>2078</td>
<td>30.0</td>
</tr>
<tr>
<td>1b - Probably At Risk</td>
<td>11</td>
<td>1.2</td>
<td>177</td>
<td>2.6</td>
</tr>
<tr>
<td>2a - Probably Not At Risk</td>
<td>13</td>
<td>1.4</td>
<td>155</td>
<td>2.2</td>
</tr>
<tr>
<td>2b - Not At Risk</td>
<td>750</td>
<td>80.5</td>
<td>4517</td>
<td>65.2</td>
</tr>
<tr>
<td>Total</td>
<td>932</td>
<td>100.0</td>
<td>6927</td>
<td>100.0</td>
</tr>
<tr>
<td>Total At Risk</td>
<td>1a + 1b</td>
<td>169</td>
<td>2255</td>
<td>32.5</td>
</tr>
</tbody>
</table>

Figure 1: Point source pressures in 1a and 1b river water bodies

Table 3: River water bodies affected by point source pollution

<table>
<thead>
<tr>
<th>Reporting category</th>
<th>Number of water bodies</th>
<th>% of number</th>
<th>Length (km)</th>
<th>% of length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1a</td>
<td>156</td>
<td>7.6</td>
<td>1682</td>
<td>8.1</td>
</tr>
<tr>
<td>1b</td>
<td>129</td>
<td>6.4</td>
<td>1818</td>
<td>8.7</td>
</tr>
<tr>
<td>2a</td>
<td>23</td>
<td>1.2</td>
<td>360</td>
<td>1.7</td>
</tr>
<tr>
<td>2b</td>
<td>1697</td>
<td>84.6</td>
<td>16963</td>
<td>81.5</td>
</tr>
<tr>
<td>Total</td>
<td>2005</td>
<td>100</td>
<td>208222</td>
<td>100</td>
</tr>
<tr>
<td>Total at risk</td>
<td>1a + 1b</td>
<td>285</td>
<td>3489</td>
<td>16.8</td>
</tr>
</tbody>
</table>

Figure 1: General industry sectors affecting 1a and 1b river water bodies (point source pollution)
Table 21: River water bodies affected by all pressures

<table>
<thead>
<tr>
<th>Reporting category</th>
<th>Number of water bodies</th>
<th>% of number</th>
<th>Length (km)</th>
<th>% of length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1a</td>
<td>343</td>
<td>17.1</td>
<td>3453</td>
<td>16.6</td>
</tr>
<tr>
<td>1b</td>
<td>570</td>
<td>28.4</td>
<td>6523</td>
<td>31.3</td>
</tr>
<tr>
<td>2a</td>
<td>261</td>
<td>14.5</td>
<td>3286</td>
<td>15.8</td>
</tr>
<tr>
<td>2b</td>
<td>801</td>
<td>40.0</td>
<td>7559</td>
<td>36.3</td>
</tr>
<tr>
<td>Total</td>
<td>2005</td>
<td>100</td>
<td>20822</td>
<td>100</td>
</tr>
<tr>
<td>Total at risk</td>
<td>913</td>
<td>45.5</td>
<td>9976</td>
<td>47.9</td>
</tr>
</tbody>
</table>

Figure 18: Relative cause of river water bodies at risk

- Abstraction & flow regulation: 25%
- Diffuse: 25%
- Morphology: 34%
- Point: 15%
- Alien species: 10%

*Neretvanska Mekousna*  
*Glavatica*

*Zubatak*