Project Acronym: SEE River
Work package: WP4 – Application of the SEE River Toolkit on the Drava River Corridor
Action: 4.1. Preparation of the Drava River Framework – Analysis of the International Drava River Corridor

Preparation of the Drava River Framework
Analysis of the International Drava River Corridor

JOINT DRAVA RIVER CORRIDOR ANALYSIS REPORT

27 November 2014

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1. INTRODUCTION

Purpose of the Joint Report

This Joint Report was compiled with the purpose of providing an overview of the Drava river management issues that were judged as relevant for the preparation of one of the final products of the SEE River project, the Joint Drava River Corridor Action Plan.

Preceding this report, in each of the five Drava countries – Italy, Austria, Slovenia, Croatia, and Hungary – a National Drava River Corridor Analysis Report (SEE River, 2013a-e) has been prepared and these served as sources of information. Although the Joint Report is to a certain extent based on them, but it was not intended, and did not become, an edited recapitulation of the national analyses. Rather, it is a re-evaluation and enhancement of knowledge at a larger scale about the whole of the international Drava River and about the main river corridor issues that emerged out of the national analyses as bearing considerable importance in all Drava countries.

The Joint Report – similarly to the National Reports – drew also upon the River Basin Management Plans (RBMPs) of the individual countries as well as the Danube River Basin District Management Plan (ICPDR, 2009)[1]. Information on the Drava river corridor with respect to identified pressures, protected areas and water body status was derived from the above RBMPs – to the extent they proved to be valid to the present. Similarly, care has been taken for proposed development goals, i.e. solutions to identified stresses, and for pilot actions not to be in conflict with the RBMPs.

Important problem locations were identified and depicted on hotspot maps – GIS maps connected to databases with information on the type, cause, severity, transboundary effects, etc. of the problems. The Map of hotspots of the five national Drava river corridors can be found in the separate Annexes.

Main management issues of the international Drava river corridor

Based on the analysis of the river corridor in five countries, the following seven priority issues were identified as problems of general importance along the Drava:

1. Altered flow
2. Flood risk
3. Altered river ecology (including blocked species migration)
4. River regulation
5. Altered sediment balance
6. Water pollution
7. Drought

[1]The International Commission for the Protection of the Danube River (ICPDR, established in 1998) is an International organisation consisting of 14 cooperating Danube states and the European Union. The ICPDR deals with the whole Danube River Basin, including its tributaries and groundwater resources. The jointly prepared Danube River Basin District Management Plan (ICPDR, 2009) guides the way to achieving at least good status for all waters of the basin. The current plan covers the period from 2009 until 2015.
These problems and a number of further management issues are dealt with in detail in Chapter 5. Its Table 5.1 provides for the international Drava River Corridor an overview of the identified national and transboundary issues and the determined ranking.

The explanation on the selection procedure that resulted in this specific set of problems is most relevant and also given in Chapter 5 of the report.

Further, there is a series of thematic maps of the international Drava River Corridor provided in the separate Annexes which illustrate the locations and dimensions of the identified key issues.

This Joint Report provides more information and analysis for the Joint Drava River Corridor Action Plan by focusing in sub-chapters 5.1 to 5.8 on the following aspects: give explanations of the causes of the problem, description of its occurrences in different parts (river runs) within the river corridor, their effect on the environment, and potential solutions.

It was assumed that the potential and preferred solutions – together with the list of proposed measures presented in the Action Plan – are going to take shape after the SEE River project.

Serving the Joint Drava Action Plan is not the exclusive purpose of this report. At least three more aspects are kept in mind:

- The SEE River project is closely related to the Drava River Vision Declaration – an international policy document elaborated and issued by the five Drava countries in 2008. The Declaration set 10 long term goals that reflect the priorities of contemporary Drava river management. One aspect of the Joint Report is to look at the Drava is the analysis of the progress in, and the possibilities of, getting closer to the Drava Vision goals. Chapter 2 is dedicated to this overview; while the Drava Declaration is included for reference in Appendix 4.

- This Joint Analysis Report offers an opportunity to present and synthesise information available on the whole course of the Drava – information which is important from the river management point of view, which is not available in a consistent form and of controllable origin. Related information – such as length and stationing of the river by countries, river basin area, characteristic discharges, WFD river water body status, hydropower plants along the river, etc. – can be found in Chapter 3. Sources of the data are the national River Basin Management Plans, the water management institutions of the Drava countries, and topographic measurements based on up-to-date, high resolution GIS coverages of the river and its catchment.

- Although it was not its anticipated purpose, but the Joint Report gives an additional opportunity to add some important aspects that the National Reports could not provide but the SEE River project needs in its further course. An intrinsic role of the Joint Report was to synthesise – along selected aspects – the river corridor analyses that were carried out by individual teams of the five Drava countries. In that way and as a by-product, contradictory facts as well as inconsistent approaches could be identified and sorted out. This provided a feedback for the National Reports and improved the quality of the project’s final outputs.

Notwithstanding that it relies to a large extent on the National Reports, the Joint Report was envisaged as a stand-alone document, i.e. being understandable for a reader not familiar with the specific concepts, goals, and vocabulary of river corridor management as it is being developed also.
within this project. Therefore, *Chapter 2* is give in a nutshell a short characterisation of the Drava river corridor in Italy, Austria, Slovenia, Croatia, and Hungary and especially of the pilot areas assigned within each national corridor.

**River corridor management terms**

*River corridor (RC)*: a spatial domain intrinsically belonging to each river – an area along both riverbanks – where hydro-morphological processes took or take part.

*Contemporary river corridor management (CRCM):* an activity aimed at the harmonisation of ecological, social, and economic processes within the river corridor.

*Contemporary river:* of which the river corridor is managed in a way, which ensures accomplishment of all protective and developmental sector goals, initiatives and measures as well as interests of riparian local communities, at the same time ensuring good water status and reduction of flood risk.

![Figure 1.1: Overview map of the Drava catchment and the pilot areas](image-url)
2. SHORT OVERVIEW OF THE NATIONAL REPORTS

In this chapter some basic information on the river corridor of the five Drava countries is provided, based on the national Drava Analysis Reports.

**Italy:**

The river corridor along the Drava and tributaries Rios Sesto and Rio Fiscalina was delineated with a total area of 4.5 km². Delineation was based on morphological criteria and flood risk: the corridor was defined as that part of the river valley which was modified by sediment transport processes and/or was part of the flood zone during the last 150 years. Length of the river Drava in Italy is 10.6 km, it has a basin area of 190 km² at its border section with Austria, and an average flow of 3.7 m³/s. The corridor includes two larger municipalities, San Candido/Innichen, and Sesto/Sexten. Dominant land use of the river corridor is agriculture and forestry, while the main economic activities in the municipalities are tourism related services, handicraft business, and two main HPPs. Among river corridor issues, altered flow, river regulation and altered riverine ecology proved to be the most pronounced, with flood risk being a general problem in the two municipalities. One pilot area is located along the river Fiscalina in Fiscalina valley near Sesto and the second one along the river Drava between San Candido and Versciaco.

**Austria:**

A two-zone river corridor was established: the inner corridor (247 km²) was defined upon morphological criteria, basically as the superposition of the flood zone, the Natura 2000 areas, built up areas, and river related groundwater bodies. The outer zone (2881 km²) following the administrative borders of municipalities. The larger municipalities within the river corridor are Sillian, Lienz, Spittal an der Drau and Villach. Dominant land use in the river corridor is agriculture, above Lienz tourism services and industry is the main economic activity, in the lower part industry is more relevant, although cycle tourism is of high importance all along the Drava. Altered hydro-morphology, longitudinal discontinuity and flood risk at 17 municipalities are the main issues of the corridor. The pilot area is the river corridor between Oberdrauburg to Molzbichl in Upper Carinthia.

**Slovenia:**

The river corridor was delineated within the pilot area of 160 km² at a length of 47 km, which is subject in the outer boundary to the following 6 factors: land use, hydro-morphology, flood zone, phytocenology (with emphasis on riparian forests), pedology (fluvial soils), Natura 2000 areas. The corridor starts at Maribor and includes the following municipalities: Markovci, Starše, Hajdina, Miklavžna Dravsko Polje, Gorišnica, Ptuj, Duplek, Dornava, Videm, Maribor, Kidričevo, Cirkulane and Zavrč. Dominant land use in the area is agriculture, forestry and settlements. Besides, within the area two hydropower plants are situated. The most pressing river corridor issues are river bed erosion, altered flow, river regulation, longitudinal discontinuity, altered riverine ecology, potential accidental pollution, and untreated or inadequately treated sewage of recreation and tourism facilities.
**Croatia:**

The river corridor along the Croatian Drava (and on the right bank of the Croatian-Hungarian shared section) was identified as the outer protection zone of the Transboundary Biosphere Reserve Mura-Drava-Danube (TBR MDD). The whole flow of river Drava in Croatia is part of the Natura 2000 network and protected as a regional park. Major towns in the river corridor are Varaždin, Donji Miholjac and Osijek. The corridor is situated on the extended floodplain, which is basically a rural area, where agriculture is the main economic activity. The pilot area (33 km²) is situated in Koprivnica-Križevci County, along the Drava from the Mura confluence (rkm 237) down to Repaš bridge (rkm 208). There are three major hydropower plants operating on the river upstream of the pilot area. The most important river corridor issues are river bed erosion, altered flow, river regulation, longitudinal discontinuity, water pollution, potential accidental pollution, and drought.

**Hungary:**

River corridor definition is based on the superposition of the 100 year flood zone, fluvial-morphological characteristics of the floodplain, and river influenced groundwater bodies. The corridor is 2-5 km wide with an extent of 696 km². The pilot area is 347 km², a rural area where the main form of land use is agriculture and forested nature area. The floodplain contains a network of Natura 2000 areas. The largest municipalities in the corridor are Barcs, Sellye, and Vajszló. Regional development prospects in the area are limited mainly to labour intensive agriculture and tourism. River corridor issues include riverbed erosion, altered flow, with water pollution, while drought is less pronounced.
3. SOME IDENTIFIED MAIN CHARACTERISTICS OF THE DRAVA

The river has its source in South Tirol, Italy near the municipalities San Candido/Innichen and Toblach/Dobbiaco. The Drava enters the Danube at Aljmas (near Osijek) in Croatia. Its main tributaries are the Gail, Gurk, and Lavant in Austria, the Meža and Dravinja in Slovenia, and the Bednja and Mura (Mur) in Croatia. Significant municipalities along its course are Innichen/San Candido in Italy, Lienz, Spittal an der Drau, Villach and Ferlach in Austria, Dravograd, Vuzenica, Muta, Ruše, Maribor, Ptuj, and Ormož in Slovenia, Varaždin and Osijek in Croatia, and Barcs in Hungary.

Length of the Drava

Based on recent GIS coverages of the five Drava countries, the full length of the river could be established within 0.5 km accuracy. Total measured length of the Drava is 709.8 km, taken at the centreline of the river. In those cases, when a bypass channel and a natural stretch of the Drava run parallel, the natural Drava watercourse was taken into account (in the cases of the Rosegg-St. Jakob, Zlatolicije, Formin, Bori, Varaždin, Čakovec, and Dubrava bypass canals). The lengths of the Drava by country is shown in the following table.

**Table 3.1: Drava river length by country**

<table>
<thead>
<tr>
<th>River sections by country</th>
<th>Measured length of section [km]</th>
<th>Measured distance from mouth till upstream end of section [km]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
<td>10.6</td>
<td>710.0</td>
</tr>
<tr>
<td>Austria (Arnbach – Lavamünd)</td>
<td>254.7</td>
<td>699.4</td>
</tr>
<tr>
<td>Austria/Slovenia shared (Lavamünd – Tribej)</td>
<td>4.2</td>
<td>444.7</td>
</tr>
<tr>
<td>Slovenia (Tribej – Zavrč)</td>
<td>117.7</td>
<td>440.5</td>
</tr>
<tr>
<td>Slovenia/Croatia, shared (Zavrč – Ormož)</td>
<td>23.3</td>
<td>322.9</td>
</tr>
<tr>
<td>Croatia (Ormož – Legrad)</td>
<td>63.6</td>
<td>299.5</td>
</tr>
<tr>
<td>Hungary/Croatia, shared, (Legrad – Örtilos)</td>
<td>6.1</td>
<td>236.0</td>
</tr>
<tr>
<td>Croatia (Örtilos – Novo Virje)</td>
<td>31.2</td>
<td>229.9</td>
</tr>
<tr>
<td>Hungary/Croatia, shared (Novo Vírje – Gordisa)</td>
<td>126.9</td>
<td>198.7</td>
</tr>
<tr>
<td>Croatia (Gordisa – Aljmaš)</td>
<td>71.6</td>
<td>71.7</td>
</tr>
<tr>
<td><strong>Total length</strong></td>
<td><strong>710.0</strong></td>
<td></td>
</tr>
</tbody>
</table>

It should be noted that river kilometre (rkm) numbers and the actual distance from the mouth do not necessarily match, as length of the river often changes – either naturally or due to regulatory interventions – while river stationing is being kept constant over longer periods of time due to practical reasons.

Drava countries use different national stationing methods as described in the followings: Croatia and Hungary use the same stationing, and this coincides with the actual length of the river course up till the Slovenian border. In Slovenia national stationing sets out from an initial rkm value of 295.
attributed to the lowermost SI/HR border crossing of the river. (The present length of the Drava up to that point is 299.42 km.) In Austria two different stationings are in use: The one referred to in this report as national stationing – and applied in river basin management planning documents – starts from an initial value of rkm 407.08 attributed to the lowermost section of the Austrian Drava. (The present length of the Drava up to that point is 440.42 km.) The other stationing, used by the Austrian Hydrographical Service attributes an initial value of rkm 0 to the same section; Drava gauge stations are therefore having rkm values between 5.6 and 260.5. In Italy river stationing starts at the source of the Drava and progresses downstream till the Austrian border.

**Catchment area**

Distribution of the Drava catchment area (including that of the Mura) by country is depicted in the following table. Catchment delineations were based on digital maps provided by the Drava countries (except the Mura catchment in Austria that was based on SRTM version 4 digital terrain model).

*Table 3.2: Catchment area of the Drava by country*

<table>
<thead>
<tr>
<th>Country</th>
<th>Area, km²</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy*</td>
<td>354</td>
<td>0.9%</td>
</tr>
<tr>
<td>Austria</td>
<td>22162</td>
<td>55.2%</td>
</tr>
<tr>
<td>Slovenia</td>
<td>4662</td>
<td>11.6%</td>
</tr>
<tr>
<td>Croatia</td>
<td>6822</td>
<td>17.0%</td>
</tr>
<tr>
<td>Hungary</td>
<td>6154</td>
<td>15.3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40154</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

* Apart from the 190.0 km² catchment in Bolzano Province, Drava river basin in Italy includes a further 193.4 km² area in Friuli - Venezia Giulia Province, as part of the catchment of the second order tributary Slizza/Gailitz (tributary of Gail).

For maximum accuracy, all river length and catchment area measurements were carried out within the national geographical grid and projection systems of the given country, using ArcGIS measurement functions.

**River run**

According to the classical categorisation, the Drava shows upper run river morphological characteristics between its source and Maribor, at around 400 km. Between Maribor and the confluence of the Mura (238 rkm) the river is in its middle run, and from the Mura mouth down to the confluence with the Danube the river has its lower run. Nevertheless, the river defies this categorisation in some sections: in Italy the Drava flows through an upland with relatively low slope; between the Italian border and Lienz the watercourse is still not a river but a torrent Alpine stream.

Due to riverbed regulations and dams the sediment transport balance of the Drava has been severely modified, consequently in large sections the river does not show the natural phenomena of its category.

**Characteristic river flow data**

Observed minimum, maximum, and mean annual flow data calculated from long term daily discharge time series of the main gauging stations are to be found on the next page in Table 3.3. *(Source: SEE River, 2013a-e).*
Table 3.3: Characteristic discharges of the Drava at gauging stations

<table>
<thead>
<tr>
<th>Station name (country) period of data series</th>
<th>National stationing(^*) [rkm]</th>
<th>Catchment area [km(^2)]</th>
<th>Minimum observed flow [m(^3)/s]</th>
<th>Mean annual flow [m(^3)/s]</th>
<th>Maximum observed flow [m(^3)/s]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Versciaco (IT) 7.92</td>
<td>139</td>
<td>1.06</td>
<td>3.7</td>
<td>34.5</td>
<td></td>
</tr>
<tr>
<td>Arnbach—Sillian (AT) 665.3</td>
<td>162</td>
<td>0.73</td>
<td>3.38</td>
<td>66.2*</td>
<td></td>
</tr>
<tr>
<td>Rabland (AT) 660.2</td>
<td>374</td>
<td>1.28</td>
<td>8.93</td>
<td>185*</td>
<td></td>
</tr>
<tr>
<td>Lienz-Falkensteinsteg (AT) 633.0</td>
<td>668</td>
<td>0.69</td>
<td>13.4</td>
<td>307*</td>
<td></td>
</tr>
<tr>
<td>Lienz-Peggetz (AT) 629.5</td>
<td>1876</td>
<td>5.1</td>
<td>53.3</td>
<td>915*</td>
<td></td>
</tr>
<tr>
<td>Oberdrauburg (AT) 611.0</td>
<td>2112</td>
<td>11</td>
<td>63</td>
<td>1000*</td>
<td></td>
</tr>
<tr>
<td>Greifenburg (AT) 593.5</td>
<td></td>
<td>15</td>
<td>69</td>
<td>1025*</td>
<td></td>
</tr>
<tr>
<td>Sachsenburg (AT) 573.0</td>
<td>2561</td>
<td>17</td>
<td>67</td>
<td>1050*</td>
<td></td>
</tr>
<tr>
<td>Drauhofen (AT) 569.0</td>
<td>3674</td>
<td>21</td>
<td>109</td>
<td>1400*</td>
<td></td>
</tr>
<tr>
<td>(Ober) Amlach (AT) 555.0</td>
<td>4790</td>
<td>28</td>
<td>128</td>
<td>1650*</td>
<td></td>
</tr>
<tr>
<td>Lavamünd (AT) 413.3</td>
<td>11052</td>
<td>95</td>
<td>280</td>
<td>2400*</td>
<td></td>
</tr>
<tr>
<td>Dravograd (SI) 1991–2010</td>
<td>428.8</td>
<td>12072</td>
<td>69</td>
<td>246</td>
<td>1361</td>
</tr>
<tr>
<td>Markovci, old Drava (SI) 1990–2010</td>
<td>13636</td>
<td>3.0</td>
<td>19</td>
<td>1159</td>
<td></td>
</tr>
<tr>
<td>Formin, Formin bypass canal (SI) 1990–2010</td>
<td>1.1</td>
<td>13636</td>
<td>14</td>
<td>255</td>
<td>730</td>
</tr>
<tr>
<td>Borl, old Drava (SI) 1990–2010</td>
<td>14662</td>
<td>6.5</td>
<td>35.5</td>
<td>1727</td>
<td></td>
</tr>
<tr>
<td>Borl + Formin, Drava total (SI) 1990–2010</td>
<td>---</td>
<td>14662</td>
<td>20.5</td>
<td>290.5</td>
<td>(1450)</td>
</tr>
<tr>
<td>Örtilos (HU) 1981–2010</td>
<td>30969</td>
<td>95</td>
<td>481</td>
<td>1860</td>
<td></td>
</tr>
<tr>
<td>Botovo (HR) 1961–2010</td>
<td>31038</td>
<td>73</td>
<td>500</td>
<td>2652</td>
<td></td>
</tr>
<tr>
<td>Barcs (HU) 1981–2010</td>
<td>33977</td>
<td>114</td>
<td>486</td>
<td>3040</td>
<td></td>
</tr>
<tr>
<td>Terezinopolje (HR) 1961–2010</td>
<td>33916</td>
<td>111</td>
<td>514</td>
<td>2889</td>
<td></td>
</tr>
<tr>
<td>Drávaszabolcs (HU) 1981–2010</td>
<td>35764</td>
<td>127</td>
<td>501</td>
<td>2490</td>
<td></td>
</tr>
<tr>
<td>Donji Miholjac (HR) 1961–2010</td>
<td>37142</td>
<td>152</td>
<td>529</td>
<td>2288</td>
<td></td>
</tr>
</tbody>
</table>

**Remark**: Stations marked with blue represent discharges reduced by flow diversions. Data of Borl and Formin could be added up as being situated on parallel channels.

\(^*\) On differences of national stationing methods see explanation on page 8-9.

* In case of the Austrian gauging stations the maximum flow during a 100-years flood (HQ100) is given.
Drava water bodies and status indicators

Following the EU Water Framework Directive, the Drava has been subdivided into 29 water bodies, 2 in Italy, 12 in Austria, 7 in Slovenia, 6 in Croatia, and 2 in Hungary. The biological, hydro-morphological, physico-chemical, chemical, and ecological status of the water bodies – as established in the RBMPs of the individual Drava countries – can be found in Table 3.4, in downstream order.

**Table 3.4: Water status of the Drava**

<table>
<thead>
<tr>
<th>WB Code</th>
<th>Country</th>
<th>Biological status</th>
<th>Hydro-morphological status</th>
<th>Physico-chemical status</th>
<th>Chemical status</th>
<th>Heavily modified?</th>
<th>Ecological status / potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>(source - R. Sesto)</td>
<td>IT</td>
<td>moderate</td>
<td>moderate</td>
<td>good</td>
<td>good</td>
<td>no</td>
<td>moderate</td>
</tr>
<tr>
<td>(R. Sesto – AT border)</td>
<td>AT</td>
<td>moderate</td>
<td>moderate</td>
<td>good</td>
<td>good</td>
<td>yes</td>
<td>good</td>
</tr>
<tr>
<td>AT9003540003</td>
<td>AT</td>
<td>moderate</td>
<td>moderate</td>
<td>good</td>
<td>good</td>
<td>no</td>
<td>moderate</td>
</tr>
<tr>
<td>AT9003540002</td>
<td>AT</td>
<td>good</td>
<td>good</td>
<td>good</td>
<td>good</td>
<td>no</td>
<td>good</td>
</tr>
<tr>
<td>AT9003540001</td>
<td>AT</td>
<td>poor</td>
<td>poor</td>
<td>good</td>
<td>good</td>
<td>yes</td>
<td>poor</td>
</tr>
<tr>
<td>AT900470001</td>
<td>AT</td>
<td>good</td>
<td>good</td>
<td>high</td>
<td>good</td>
<td>no</td>
<td>good</td>
</tr>
<tr>
<td>AT900470021</td>
<td>AT</td>
<td>good</td>
<td>good</td>
<td>good</td>
<td>good</td>
<td>no</td>
<td>good</td>
</tr>
<tr>
<td>AT900470022</td>
<td>AT</td>
<td>moderate</td>
<td>moderate</td>
<td>good</td>
<td>good</td>
<td>yes</td>
<td>moderate</td>
</tr>
<tr>
<td>AT900470003</td>
<td>AT</td>
<td>poor</td>
<td>poor</td>
<td>good</td>
<td>good</td>
<td>yes</td>
<td>moderate</td>
</tr>
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* Under reconsideration by HU authorities
** Based on saprobic index of macroinvertebrates
*** Under reconsideration by HR government

**Source:** Country RBMP reports, or information provided by the water management institutions responsible for the execution of the WFD in the given country.

It should be noted that the status information found in Annex 14 of the Danube River Basin District Management Plan (ICPDR, 2009) partly differs from the above data.
Since some stretches of the river are shared by two countries, there are overlaps among these 29 waterbodies: DDRIO20004 overlaps with HUAEP439 and HUAEP438, DDRIO20003 overlaps with HUAEP438.

Comparison of differences between overlapping water bodies clearly indicate the need for harmonisation of status definitions among the Drava countries.

**Biodiversity**

River Drava corridor extends along one of the last semi natural water courses in Central Europe, and represents an ecological mega structure that connects European regions, in the northwest southeast direction, passing through three European bio-geographical regions; Alpine Continental and Pannonian.

The corridor is generally characterized by natural zone along the river delimited by flood protection dikes, which contains, depending on the status of particular section of the river, still active river course with variety of endangered wet and aquatic habitats of European importance. The gravel or sand bars, meanders, oxbow lakes and steep eroded banks in the river are surrounded by natural flood forest and wet meadows in the remains of the former natural flood plains. The fauna is generally rich and in particular lower section of the river is an important bird area on the European level with wintering population in hundreds of thousands. Gravel banks of Drava are especially important as they are nesting sites of remaining populations of Small Tern (*Sterna albifrons*) and Little Ringed Plover (*Charadrius dubius*). Also, more than seventy fish species of which five endemics of Danube catchment area have been identified in Drava. The area along the river is also important as a favourable habitat for dragonflies and butterflies. The European otter and newly introduced beaver have important populations as well as other mammal species are present on the river. Many of the wetland plants that are threatened or rare on the European level such as German Tamarisk (*Myricaria germanica*) as well as related habitat types of European importance can still be found along the river.

The width of natural corridor varies from stretch to stretch and intensity of human intervention gradually increases away from the river. The more distal parts of the corridor contain intensive agricultural plots or mosaic fabric of arable land with small detached wetlands as well as hedges and water courses interwoven with villages or urban centres creating unique harmonious Drava river corridor landscape.

**Natura 2000 areas**

The EU Natura 2000 network is defined by two European directives usually referred as Birds Directive (*Directive 2009/147/EC*) and Habitats Directive (*Council Directive 92/43/EEC*). Natura 2000 sites exist in the river corridor in all Drava countries with more extensive coverage in Slovenia, Hungary and Croatia. In the latter two the whole river course belongs to the Natura 2000 network. To ensure appropriate management of areas with species and habitat types of EU importance, countries in the corridor have defined Special Protection Areas (SPA) in accordance with the Birds Directive and Sites of Community Interest (SCI) in accordance with the Habitats Directive. In order to reconcile development and nature conservation aims of the directives, Article (6.3) of the Habitats Directive introduces the mechanism of **Appropriate assessment of plans and projects likely to adversely affect the Natura 2000 sites**. This mechanism states that a plan or project cannot be approved unless it has been established by “appropriate assessment” that it is not likely to have significant negative impacts.
on the habitats and species for which the given Natura 2000 site was designated. The same Article sets up conditions for derogations that permit even some projects with established adverse effects to be implemented for imperative reasons of overriding public interest (IROPI) – as long as adequate compensation for the loss of Natura 2000 site is found. Thus, based on the natural characteristics of the corridor Natura 2000 sets up mechanisms to guide the development in a way that should contribute to the goal of halting the loss of biodiversity on EU level.

![Figure 3.1: Natura 2000 areas along the Drava (Source: Natura 2000 Network Viewer, http://natura2000.eea.europa.eu/#)](image)

Protected Areas

In all Drava countries there are important national protected areas established along the river. On international level the most important site is the UNESCO Trans boundary Biosphere Reserve Mura-Drava-Danube in Croatia and Hungary with associated strong initiative for its extension to sections in the remaining Drava and adjoining Danube countries. Ramsar sites are some parts of the Danube-Drava National Park in Hungary and the Kopačkirit Nature Park in Croatia at the Danube-Drava confluence. Along the Upper Drava in Austria a new Ramsar site has also been established.
Hydropower plants and dams on the Drava

Hydropower plants (HPPs) have a strong modification effect on the longitudinal continuity, flow regime, sediment transport processes and the hydro-morphological status of the Drava. Their location, construction, mode of operation, etc. are important information in the context of several river corridor issues. Table 3.5 contains a comprehensive summary on data of all Drava HPPs.

Six of the HPPs were built on bypass canals, in such cases a dam has been constructed on the river to divert water into the canal (Rosegg-St. Jakob, Melje, Markovci, Varaždin, Čakovec, and Dubrava dams). In a similar way, Strassen dam diverts water into a conduit supplying the off-river Amlach HPP. These pairs of co-operating dams and HPPs are marked by the same colour in Table 3.5.
Table 3.5: Hydropower plants and dams in the Drava river corridor

<table>
<thead>
<tr>
<th>Drava Hydrodams Name of HPP or dam</th>
<th>Country</th>
<th>National stationing rkm</th>
<th>Capacity [MW]</th>
<th>Annual energy production [MWh]</th>
<th>Start of operation [year]</th>
<th>Mode running / peak mode</th>
<th>Reservoir y/n</th>
<th>Bypass channel y/n</th>
<th>Residual low [m3/s]</th>
<th>Residual flow [%]</th>
<th>Impounded head [m]</th>
<th>Fishpass status planned/operating</th>
<th>Fishpass operating since year</th>
<th>Fishpass monitoring y/n</th>
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</tr>
<tr>
<td>Čakovec HPP</td>
<td>HR</td>
<td>278.0</td>
<td>165</td>
<td>548000</td>
<td>1964-1969 peak --- yes</td>
<td></td>
<td>29.0</td>
<td>not needed</td>
<td>--</td>
<td>14.60</td>
<td>17.42</td>
<td>14.20</td>
<td></td>
<td>--</td>
</tr>
<tr>
<td>Dubrava dam</td>
<td>HR</td>
<td>254.0</td>
<td>165</td>
<td>548000</td>
<td>1964-1969 peak --- yes</td>
<td></td>
<td>29.0</td>
<td>not needed</td>
<td>--</td>
<td>14.60</td>
<td>17.42</td>
<td>14.20</td>
<td></td>
<td>--</td>
</tr>
<tr>
<td>Dubrava HPP</td>
<td>HR</td>
<td>254.0</td>
<td>165</td>
<td>548000</td>
<td>1964-1969 peak --- yes</td>
<td></td>
<td>29.0</td>
<td>not needed</td>
<td>--</td>
<td>14.60</td>
<td>17.42</td>
<td>14.20</td>
<td></td>
<td>--</td>
</tr>
</tbody>
</table>

2 Besides its primary purpose of providing the impounded head for the Zlatoličje HPP, Maribor dam (also known as Melje dam) exploits – with the help of a small built-in HPP – the environmental minimum flow released into the old Drava riverbed.
4. PROGRESS TOWARDS THE DRAVA DECLARATION GOALS

The Drava River Vision Declaration was signed on 24 September 2008 in Maribor by the 4 riparian states’ Heads of Delegations (Austria, Slovenia, Hungary and Croatia) to ICPDR and a high Italian representative. It set the future priorities and a common vision for integrative management of the Drava River. The SEE RIVER project is intended to substantially contribute to achieve this vision. The preparation of the Joint Drava River Corridor Action Plan as well as of the Local Pilot Area Action Plans and related Stakeholder Agreements should therefore take into account the ten objectives agreed upon in 2008 (for details see the Appendix).

Since 2008 several steps have been taken by the Drava countries along these goals. In this chapter the progress is demonstrated by the following list and short description of activities, projects, policies and regulations carried out or adopted within the five Drava countries. Items are listed under the specific Declaration Goal they are seen as to enhance.

1. To promote the Drava River as a model for integrated implementation of EU policies on water and nature protection

- In South Tyrol the interdisciplinary/integrated river basin management plan PRODrau was elaborated between 2009 and 2011. Since then the responsible agencies collaborate to implement the measures identified in the plan. (IT)

- In Austria the river development scheme is one of the most important management tools. It presents the status quo of a river, and the measures concerning the main topics (e.g. flood protection, ecological improvement and recreation) that were developed with a group of stakeholders. This management tool also integrates the principles of the EU policies. For implementing single projects in Austria, the EU policies have to be met. Further details and other management tools are presented in the national report of Activity 3.1 of this project (AT).

- Establishment of the Regional Park Mura-Drava in Croatia (2011). Regional park Mura Drava extends through 5 counties (Međimurje, Varaždin, Koprivnica-Križevci, Virovitica-Podravina, Osijek-Baranja and covers an area of 87 680 ha. The park is managed through coordination of the 5 county public institutions for the protection of Nature. (HR)

- In September 2013, the Republic of Croatia Ecological Network became a part of Natura 2000 European Ecological Network. The whole river Drava in Croatia is covered by the Natura 2000 pSCI and SPA sites. (HR)

- The Transboundary UNESCO Biosphere Reserve Mura-Drava-Danube (TBR MDD) was designated in 2012. It extends along the Drava, Mura and Danube Rivers in Croatia and
Hungary. In Croatia it contains their whole floodplain. This area is mostly divided by flood prevention dykes into an inundation area which is also the core zone, and a flood-protection area which includes the buffer zone and a wide transition zone. The biosphere reserve fulfils three functions: nature conservation, sustainable development of local communities and logistics in facilitating innovative approaches as well as cross border cooperation in nature conservation and management.

Surface Area: 631,460.71 ha (395,860.71 ha in Croatia and 235,600 ha in Hungary)
Core area: 97,187.9 ha (66,587.9 ha in Croatia and 30,600 ha in Hungary)
Buffer zone: 111,798.12 ha (85,098.12 ha in Croatia and 26,700 ha in Hungary)
Transition area: 422,474.69 ha (244,174.69 ha in Croatia and 178,300 ha in Hungary)

2. To enhance flood protection through the improvement of flood warning systems and through increased information exchange

- There is an acute level of exposure and vulnerability to floods of the settlements of San Candido and Sesto. Since the onset of the flood wave in the head water streams and, hence, also in the Upper Drava in Italy, is very rapid, a short-term comprehensive realization of constructive flood protection measures are out of reach. Therefore intervention plans were elaborated with the support of the Department for Civil Defense. Herein flood scenarios were hypothesized and the associated interventions to mitigate the adverse effects were mapped. (IT)

- In general the forecast of a flood event is available and valid for 1 to 2 days (24 to 48 hours), the lead time depends on the characteristic of the event and the so caused wave form of the flood event. The Drava downstream of Molzbichl is a big reservoir, divided into 10 hydropower stations and the corresponding reservoirs (following the water framework directive defined as heavily modified water body). There the situation is also connected to the operation of the hydro power stations and the management strategy (“Wehrbetriebsordnung”). The flood warning system is on a high level and the warning is satisfactory. The way of working has improved from year to year, also from 2008 until now. (AT)

- When implementing projects also the neighboring countries are contacted. The responsible people for flood warning know each other. But there is yet no real cross-border flood warning system. The members of the Austrian-Slovenian Drava Commission make efforts to improve the flood warning system also at transnational level. Within this Drava Commission a working group defines recommendations for the future cooperation with one main task being the establishing of a hydrological warning protocol for the Drava River. (AT)

- Project Dra-Mur-CI: The project was a platform for sharing flood data between Austria and Slovenia. It improved the early warning system. A catalogue of flood scenarios gives also hydrologic and hydraulic analysis of the Drava river with some of its tributaries. Studies of flood protection measures on Drava river (sections from Rosegg to Lavamünd and Malečnik to Duplek) and on Mura river were made. (AT, SI)
3. To enhance flood protection through protection and restoration of water retention areas along the Drava River

- South-Tyrol, PRODrau project: The objective was set, to assign areas in the valley bottom as potential retention zones. (IT)

- Since many years (already before 2008) the Austrian strategy requires for flood retention areas that a new project has to maintain the existing retention areas to prevent any increase of the downstream flood risk. The funding of flood protection measures (active and passive) stipulate in the regulations that any loss of retention area/volume has to be compensated. (AT)

4. To continue and further develop restoration of the Drava River and its floodplains

- For the Drava river in South Tyrol / Italy a riparian vegetation management plan was elaborated. Emphasis in the implementation of the activities is placed on the ecological function of the riparian vegetation as buffer zones and as habitats. Currently within the framework of the SEE River Project restoration goals are discussed and planning activities between San Candido and Versciaco have been initiated accordingly. (IT)

- The Austrian strategy is to implement interdisciplinary measures to solve existing problems by creating synergy effects. One main problem along the Drava from Lienz to Molzbichl was the erosion of the river bed. With the implementation of river widening along the Drava the erosion was reduced and, in parallel, the situation for the riparian forest and the floodplain species could be improved, as the recent evaluation within the SEE RIVER project has shown. This further served as a starting point for a new catalogue of measures for the next 20 years that will tackle the still existing problems. (AT)

- The following table shows the most important restoration measures along the Upper Drava from Oberdrauburg to Molzbichl that were implemented over the last 6-8 years, as part of the programs:
  A.)...LIFE II „Lebensader Obere Drau“ from 2006-2011
  B.)...current maintenance of the Drava
<table>
<thead>
<tr>
<th>No.</th>
<th>Name of measure</th>
<th>Time of implementation</th>
<th>km (restoration along the river)</th>
<th>ha (backwaters, dead branches, riparian waters, etc.)</th>
<th>Benefit from restoration</th>
<th>benefit for nature protection through</th>
<th>benefit for river engineering/flood protection</th>
<th>Settlements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>River bed widening Oberdrauburg railway bridge</td>
<td>A</td>
<td>1,5</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>River bed widening StanaWiesen</td>
<td>B</td>
<td>0,5</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>River bed widening Stein at left and right banks</td>
<td>B</td>
<td>1,3</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>River bed widening Dellach right bank</td>
<td>B</td>
<td>1,2</td>
<td>0,2</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>Berg riparianwaterbodies</td>
<td>B</td>
<td>0,2</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>6</td>
<td>Rebuilding sediment barrier at Berger Feistritzbach</td>
<td>C</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>7</td>
<td>GreifenburgAmlach lateral erosion</td>
<td>B</td>
<td>0,4</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>8</td>
<td>River bed widening Greifenburg Bruggen</td>
<td>A</td>
<td>1,0</td>
<td>0,1</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>9</td>
<td>River bed widening Greifenburg Radlac h</td>
<td>D</td>
<td>0,4</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>10</td>
<td>Biotop Reisacher Obergottesfeld</td>
<td>B</td>
<td>1,6</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>11</td>
<td>Riparian water bodies Obergottesfeld</td>
<td>B</td>
<td>0,3</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>River bed widening Obergottesfeld (2011)</td>
<td>C</td>
<td>2,8</td>
<td>3,2</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>13</td>
<td>River bed widening Lendorf</td>
<td>D</td>
<td>1,0</td>
<td>0</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>14</td>
<td>Flood channel Lendorf</td>
<td>B</td>
<td>0,1</td>
<td>0</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>15</td>
<td>River bed widening Spittal West</td>
<td>B</td>
<td>1,6</td>
<td>0</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>16</td>
<td>Flood channel Baldramsdorf</td>
<td>B</td>
<td>0</td>
<td>2,0</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>17</td>
<td>Riparian water bodies Rip Spittal Ost</td>
<td>B</td>
<td>0,3</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>18</td>
<td>Riparian water bodies Spittal Mitte</td>
<td>B</td>
<td>0,9</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>19</td>
<td>River bed widening Spittal Ost</td>
<td>B</td>
<td>0,9</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>20</td>
<td>River bed widening Amlach/St. Peter (2010)</td>
<td>C</td>
<td>1,0</td>
<td>0,6</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


**Table 4.1: Assessment of restoration measures along the Upper Drava from Oberdrauburg to Molzbichl (resulting from two EU LIFE projects)**

- Sustainable Management of Drava River / Trajnostnoupravljanjeobmočjareke Drave (TrUD)
  Aims of the project were: to improve knowledge and awareness about biodiversity,
improvement of habitat conditions and making a strong base for management and sustainable use of the area. The project provided an improved information infrastructure, an integrated draft management plan and an inventory of nature (habitats, birds, butterflies, fish, plans). (SI)

- Riparian Ecosystem Restoration of the Lower Drava River in Slovenia – LIVEDRAVA project (SI)


5. To maintain and further develop the Drava River as an “ecological backbone”

- Along the Drava River in South Tyrol / Italy no protected areas are located in the immediate vicinity of rivers. In the upper catchment area alpine protected areas have been established, including Natura 2000 sites and the nature park Three Peaks Sesto Dolomites with the Dolomites designated as a UNESCO World Natural Heritage. (IT)

- The Drava, the riverbanks and the existing riparian forest from Oberdrauburg to Molzbichl with a length of 68 rkm is assigned as aNatura 2000 area. (AT)

6. To re-establish the ecological connectivity of the Drava River for migratory fish

- In South Tyrol the Drava River features the continuity requirements for fish migration. Need for action however still exists to extend this continuity to the main tributaries such as the Sesto stream. The River Development Plan explicitly addresses this issue. (IT)

- The River Basin Management Plan (first version elaborated in 2009) contains measures with a specific time schedule to reach fish connectivity. Nearthe Italian border there is one migration barrier in Sillian (Arnbach HPP) that is to be removed within the next years.BetweenStrassenand Lavamünd (border to Slovenia) 10 hydro power stations (Paternion, Kellerberg, Villach, Rosegg-St. Jakob, Feistritz–Ludmannsdorf, Ferlach-Maria Rain, Annabrücke, Edling, Schwabeck, Lavamünd)and 2 dams (Strassen and Rosegg-St. Jakob) pose migration barriers on the Drava with a cumulated height of more than 175 meters. Out of these, the Villach and Roseggdams already have a fishpass, at further fourhydropower plants new fishpasses will be constructed in 2015 (Paternion, Kellerberg, Annabrücke, Lavamünd). Further fish migration passes are being planned at the other 4power stations (Feistritz-­­-Ludmannsdorf, Ferlach-Maria Rain, Edling, Schwabeck) in order to make the entire dam chain passable by 2021.
There is also an idea for future projects/measures to restore fish migration also to all tributaries that discharge into the reservoirs of the 10 hydro power stations along the Carinthian Drava (AT). Progress of the measures aimed at ecological continuity on the Austrian Drava is shown in the following table:

<table>
<thead>
<tr>
<th>Name of power station / dam</th>
<th>Start of operation</th>
<th>Situation concerning fish connectivity</th>
<th>Height difference [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paternion</td>
<td>1989</td>
<td>fish pass will be built until 2015</td>
<td>9.70</td>
</tr>
<tr>
<td>Kellerberg</td>
<td>1986</td>
<td>fish pass will be built until 2015</td>
<td>9.70</td>
</tr>
<tr>
<td>Villach</td>
<td>1984</td>
<td>fish pass already exists</td>
<td>10.10</td>
</tr>
<tr>
<td>Rosegg-St. Jakob</td>
<td>1975</td>
<td>fish pass already exists</td>
<td>24.00</td>
</tr>
<tr>
<td>Feistritz-Ludmannsdorf</td>
<td>1969</td>
<td>fish pass will be built until 2021</td>
<td>23.70</td>
</tr>
<tr>
<td>Ferlach-Maria Rain</td>
<td>1976</td>
<td>fish pass will be built until 2021</td>
<td>21.40</td>
</tr>
<tr>
<td>Annabrücke</td>
<td>1982</td>
<td>fish pass will be built until 2015</td>
<td>25.60</td>
</tr>
<tr>
<td>Edling</td>
<td>1963</td>
<td>fish pass will be built until 2021</td>
<td>21.78</td>
</tr>
<tr>
<td>Schwabeck</td>
<td>1944</td>
<td>fish pass will be built until 2021</td>
<td>20.35</td>
</tr>
<tr>
<td>Lavamünd</td>
<td>1950</td>
<td>fish pass will be built until 2015 (under construction)</td>
<td>9.31</td>
</tr>
</tbody>
</table>

Table 4.2: Rehabilitation programme for ecological continuity along the Austrian Drava


7. To establish the Drava River as a cross-border recreation area

The best known cross-border tourist facility is the Drava Cycling Path, that has been established in all Drava countries and its facilities are continuously improved. A similar project, the Mura-Drava-Danube Bike Road or Three Rivers Bike Road developed in Slovenia, Croatia and Hungary is also connected to the Drava Cycling Path.

- The Drau Cycle path is of great importance for the area downstream of San Candido, for the tourism sector as well as for recreation purposes. Connection of the cycle routes to the Pusteria valley was also established. (IT)

- The Drava cycling path in Austria was established with a length of 366 km (see www.drauradweg.com). Mostly the cycling bath uses existing tracks, when there new sections of the track had to be constructed people from different sectors (f. e. nature protection, tourism) were involved in the planning process. (AT)
• Numerous cross border (SI – AT) recreation projects, which improved cycling infrastructure, promotion, developed information brochures and build new touristic products. Those project were:
  
  o Bike route from the source to the mouth of Drava river - Dravskakolpot-Dravskakolesarska pot od izvira do izliva - Dravskakolpot;
  
  o Mura-Drava Biking Route;
  
  o Hiking and biking (Recreation in nature - hiking and biking without borders). (HR)

• "Dravaroute" (84 km) is the first marked bike trail in the region opened in 2002. It spread through the valley of the Drava confluence of Mura at Legrad until Pitomaca. The trail is very well marked, easy to ride and orientation and ideal for family tourism and recreation. The "cycling route along the Drava River" - a mound Noskovci-Sopje, haust Mound County canal and levee Vrbovka-Terezinofield with a total length of about 28 kilometres. The "Cycling along the river" - a mound Drava-Danube embankment and Harvest-state border with a total length of about 17 kilometres. Shares EUROVELARoute that passes near Osijek. The Mura Drava biking route has been completed. There is a described biking route in Koprivnica – Križevac county, a new biking route in Virovitica-Podravska county along Drava as well as in Osječko-Baranjska County along the dikes that is being developed through IPA project as well as Via Pacis Pannoniae (Pannonian Peace Path). (HR)

• Initiated by an INTERREG IIIA fund, Hungary is continuously developing a bicycle path, at present having a length of more than 120 km as part of the Drava Cycling Path and of the Three Rivers Bike Road. (HU)

• Between Lavamünd (AT) and Dravograd (SI) rafting (wooden rafts) is possible. (AT)

• There are no regulations about the number of recreational facilities along the Drava in Austria. Many information points, lookouts, rest and play areas on the riverbanks were built before or after 2008. Almost all these facilities are located along the Drava cycling path from Innichen (Italy) to Maribor (Slovenia). They are used almost every day by tourists and local people. Any new idea of a recreational measure is discussed with the relevant experts from nature protection and water management. All measures for flood protection or nature protection are usually with some recreational facility and certain visitor guidance. (AT)

• Establishment of the Regional Park Mura-Drava (2011). Since continues human activity has had greatly positive role in the protection of the natural values this category is adequate since it supports sustainable development and opens new perspectives for ecological agriculture and eco – tourism. (HR)

Joint Drava River Corridor Analysis Report
8. To use opportunities for the Drava River to be a connecting lifeline for different nations
   - The Interreg Council Dolomiti Live Project promotes the collaboration of the region and cross-border project initiatives. (IT)

9. To undertake integrated river basin management rather than fragmented sector measures
   - With the integral basin management plan and the current integral implementation of measures the integrated management of the basin continues. The SEE River project is expected to improve methods and communication in this process. (IT)
   - One main strategy for all projects already before 2008 was and still is to elaborate the projects on interdisciplinary ways with using synergy effects. For example a project with the main focus on flood protection can still improve the situation for ecology and recreation. (AT)

10. To undertake further development of the Drava River area in partnership with its resident human populations
    - During the development of the catchment plan PRODrau a so-called control group for strategic project solutions has been established. This group consists of representatives of municipalities, water management, nature conservation and environmental protection, farmers, fire brigades and civil defence, and continues to pursue the implementation of planned activities. (IT)
    - There are photo exhibitions, cultural events, and concerts regularly organised. Also a book has been published titled “Die Drau istineeigene Frau/Drava je svojafrava” by Martina Berchtold-Ogris, Brigitte Entner and Helena Verdel. Most of these initiatives have private organizers and are carried out without the benefit of an international platform to provide publicity for these events or activities. (To connect all the different projects through the SEE River web page could be a useful idea.) (AT)
5. IDENTIFIED RIVER CORRIDOR MANAGEMENT ISSUES

Identification procedure of river corridor management issues

The SEE River project's primary goal is to offer tools, ideas, and action plans for an improved management of the Drava river corridor. Improved management might be the result of a thorough analysis of the whole river, an intensive participatory procedure involving stakeholders from five Drava countries, and of conservation and development actions based on the understanding of natural, social, and economic processes of a large international river.

To arrive to sound management options one has to – at best jointly - identify and clearly understand the problems that are to be solved: their reasons, effects, the interconnections with other problems, their importance from environmental, social and economic point of view. A contemporary river management problem assessment – similarly to any decision-making – needs an integrated approach: the integration of sector aspects, stakeholder interests and the views of the public. This might lead to a two pillar system – i.e. a more technical analysis of the river corridor by a group of experts (top down approach) and a participatory process involving interested local stakeholders (bottom up approach). Eventually, both have to lead to a harmonised and widely accepted conclusion with subsequent actions.

River corridor analysis and stakeholder participation were central elements of the SEE River project concept and implementation, both procedures being strongly interconnected: information, aspirations and views revealed by stakeholders became elements of the analysis; while technical, scientific or methodological results provided by the expert analysis might become arguments and evidence endorsed by stakeholders in the dialogue process.

In case of international rivers such as the Drava, it is necessary to differentiate between problems of the local-national scale and those of transboundary or transnational extent; while some can be adequately solved at local level, others need the joint effort of two or more countries.

Identification of the main local problems (core problems)

Steps from identifying local and national river management problems towards a priority order of national Drava management issues were the following:

- Identification of an initial problem set (individual views)
- Identification of core issues (joint reflection)
- Identification of feasible solutions (joint conclusion with allocated responsibilities and/or commitments).

A scheme of the problem assessment procedure leading from problem identification to agreed-upon solutions is depicted in Figure 5.1.
A. Identification of an initial problem set

In the first phase of a problem assessment during the SEE River project, a wide array of river corridor problems were collected during the preparation of the National River Corridor Analysis Reports, by recording expert opinions, reviewing existing studies and carrying out in depth analyses at the five pilot areas selected in each of the Drava countries.

At the end of this phase, the project invested special time and resources to identify river corridor management issues through a series of dialogues with stakeholders. Altogether 5 national and 10 local workshops engaging more than 150 stakeholders were dedicated to this problem identification.

As a result of the river corridor analysis, national and local experts identified a total of 130 environmental problems (15 to 40 per country or pilot area). Important problem locations were identified and depicted on hotspot maps – GIS maps connected to databases containing information on the type, cause, severity, transboundary effects, etc. of the problems. The Map of hotspots of the five national Drava river corridors are shown in the separate Annexes. Hotspot maps and problem tables helped to establish spatial patterns and relationships of the problems on one hand, and clustering, comparing and classifying them according to severity or complexity on the other.

Besides environmental problems, the dialogue brought to the surface a number of economic and social issues relevant in the individual river corridors. These help to better understand the local stakeholder’s perception of the environmental problems, moreover gain a more realistic context for the search of feasible solutions.

B. Identification of core issues

Analysis and the stakeholder workshops resulted in a relatively large number of problems differing in severity, complexity and spatial effects. Moreover, a subset of these issues (e.g. mainly social and economic problems of regional extent) might definitely be outside of the scope of river corridor management. At this step those issues had to be identified that form the core of river corridor problems and should be considered more in depth at a next stage.

Core problems are those

- considered important by the stakeholders (prioritisation) and upon analytical evidence;
- that trigger secondary and tertiary problems (e.g. hydro-morphological, ecological, economic) in the river corridor;
- that can be handled by means available to river corridor managers.

In this step stakeholders identify and attribute priorities to the problems, and it is the responsibility of the analysis to provide reliable information on environmental pressures, risks, trans-boundary effects, external constraints, etc.

C. Identification of feasible solutions

This step is about reducing problems by feasible solutions. During the workshops several solution ideas were proposed either by stakeholders or experts, and jointly reflected in terms of their feasibility, e.g. from a technical, land use or nature conservation point of view.

The guiding criteria for discussing feasible solutions were the following:
The solution guides the river corridor with all its uses and functions towards becoming a "contemporary river" – serving the interests of riparian local communities and stakeholders without compromising protective and developmental sector goals and good water status;

- Problem should have a high priority assigned by stakeholders, and connected to the – not strictly defined – geographic boundaries of the river corridor (core issues);

- A follow-up action plan – acceptable for the stakeholders and reasonable from practical, technical and financial aspects – can be drawn up for effectively resolving the problem.

In a similar way, stakeholders involved in the participatory process should jointly identify, reflect and prioritise the corridor issues as well as formulate a future vision for the corridor, i.e. a long-term development perspective as a “contemporary river” where the identified problems are all resolved.

In their next step, they discuss with the technical experts how to address the problems in the various technical alternatives. This may also lead to the agreed need to first conduct further data collection and feasibility studies.

Third step is a list of future activities, compiled in an Action Plan that leads to feasible and effective solutions through the committed effort of responsible and engaged stakeholders.
Identification of the key Drava issues

The SEE River project considered problems as key Drava river corridor management issues that are pressing in the majority of the Drava countries, and where a proposal of actions towards their solutions was considered reasonable, even necessary. In line with the goals of the project, the aim of a further analysis was the selection of these issues.

The guiding criteria for selecting the key Drava issues were similar to those applied in case of the pilot area or national issues:

- Problem should have a high priority at national level and have a transboundary dimension;
- Problems should be within the geographic boundaries of the river corridor;
- Problems could be solved by the tools available for river corridor management;
- The solution guides the river corridor towards becoming a “contemporary river” (vision);
- Have high significance in most or all of the Drava countries;
- Solution of the problem needs – and will benefit from – a concerted approach along the river or within the whole Drava basin.

The joint analysis of the international Drava river corridor set out of the same initial set of 130 problems mentioned above. In order to make the joint analysis more transparent, this initial set was classified into the following 17 types of river corridor management problems:

- Altered river flow
- Deposition of sediment
- Disturbance of recreation and habitats by dredging
- Drought
- Flood risk
- Habitat deterioration
- Inadequate visitor management in nature areas
- Land use changes in the form of abandonment of Alpine pastures
- Loss of agricultural area to land development
- Obstructed migration of fish and other species
- Potential accidental pollution
- Presence of land mined areas
- Riverbed erosion
- River regulation
- Sedimentation
- Species at risk
• Water pollution due to point and diffuse sources.

In the next step SEE River project experts from the five Drava countries were asked to co-evaluate the problem tables and classify the problem issues into clusters relevant from a technically and/or ecological point of view, moreover to attribute a score in terms of environmental severity and range of trans-boundary effects. Setting out of the initial 17 types of river corridor issues, this analysis led to 5 general clusters containing further problem groups resp. key issues (see Table 5.1):

• Altered hydro-morphology (including altered flow, riverbed erosion, river regulation, sedimentation)

• Flood risk

• Altered river ecology (habitat deterioration, habitat loss, species at risk, obstructed migration)

• Pollution (including water pollution and potential pollution by accidents)

• Other (including drought, intensive land use, visitor management deficit, presence of land mine areas)

This selection of key issues has been done by a simple weighting technique: the scores attributed to the given problem group in each of the Drava countries (i.e. the national impact and effect scores) were summed up; and that gave a two rank sequence, one according to the environmental impact severity, and one for the transboundary effects. The first ranking shows the overall severity of the problem, while the second can be related to the transboundary interest the given problem might involve.

This simplified weighting was done by the competent national Partners on the base of their wider technical know-how (e.g. in form of river studies, impact analyses, development projects, long-years expert experience).

The environmental severity ranking resulted in the following priority order of international key Drava issues:

• Altered flow – due to diversion of the river flow into bypass channels, intensive daily fluctuation of the water levels in the river, decreasing water supply into side-arms, or due to reservoir operation.

• Flood risk – due to inadequate protection against high floods, or utilisation of the flood zone without due foresight. It is an issue of relatively high importance in each of the Drava countries.

• Altered riverine ecology – appearing mainly as a consequence of river management problems such as the altered flow and sediment regime, loss of longitudinal continuity due to dams and weirs, river regulation activities, and eventually as a result of land development within, or intensive utilisation of, the river corridor. Ecological alteration might happen in form of habitat deterioration, habitat loss, species at risk or obstruction of migration routes.

• River regulation – affected the Drava in diverse forms, ranging from river straightening to the construction of diversion canals for hydropower plants, and dredging of the fairway for navigation purposes.
- **Altered sediment balance processes** – the natural sediment flux of the river became imbalanced by impounded sections of hydropower plants, the dredging of gravel from the riverbed, and river regulation. This problem of the Drava came into focus within the SEE River project, formerly little attention has been paid to the sediment issue.

- **Water quality and pollution risk** – as caused along the Drava river by inadequately treated sewage discharges, diffuse pollution, and as potential threat, accidental pollution caused by industrial plants and landfills in the catchment.

- **Drought** – This is a diverse phenomenon in the Drava valley, where there are large differences between the geographical conditions, precipitation amounts, and the need and availability of water resources to compensate for missing precipitation and soil moisture. Draught has three components in the region: hydrological drought, atmospheric or agricultural drought and the decline of groundwater level.

Please note that for “Altered river ecology” the indicated combined scores are set as worst case values out of its three aspects (habitats, species and migration). Although the summed score equals that of “River regulation”, the SEE River partnership attributes for “Combined impacts on river ecology” a higher priority due to its multiple reported environmental impact dimensions.

The following Table 5.1 provides for the international Drava River Corridor an **overview of the identified national and transboundary issues** and the scored ranking. The subsequent **sub-chapters 5.1 to 5.8 assess** for each issue the main characteristics and the potential solutions to reduce their environmental impacts.

Further, there is a series of **thematic maps of the international Drava River Corridor** provided in the **separate Annexes** which illustrate the locations and dimensions of the identified key issues.
### Joint Drava River Corridor Analysis Report

#### Table 5.1: Environmental impact severity and transboundary effect scores of the key Drava issues

<table>
<thead>
<tr>
<th>Identified Drava Problems</th>
<th>Italy</th>
<th>Austria</th>
<th>Slovenia</th>
<th>Croatia</th>
<th>Hungary</th>
<th>Summed score*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Environm. impact severity</td>
<td>Trans-boundary effect</td>
<td>Environm. impact severity</td>
<td>Trans-boundary effect</td>
<td>Environm. impact severity</td>
<td>Trans-boundary effect</td>
</tr>
<tr>
<td>Altered river hydro- morphology</td>
<td>5. River bed erosion</td>
<td>III</td>
<td>no</td>
<td>IV</td>
<td>medium</td>
<td>IV</td>
</tr>
<tr>
<td>1. Altered flow</td>
<td>II</td>
<td>medium</td>
<td>IV</td>
<td>medium</td>
<td>IV</td>
<td>medium</td>
</tr>
<tr>
<td>Sedimentation from tributaries</td>
<td>III</td>
<td>medium</td>
<td>III</td>
<td>medium</td>
<td>III</td>
<td>medium</td>
</tr>
<tr>
<td>4. River regulation</td>
<td>III</td>
<td>medium</td>
<td>III</td>
<td>medium</td>
<td>III</td>
<td>medium</td>
</tr>
<tr>
<td>Flood risk</td>
<td>2. Flood risk</td>
<td>III</td>
<td>medium</td>
<td>III-IV</td>
<td>high/low</td>
<td>IV</td>
</tr>
<tr>
<td>Altered river ecology</td>
<td>3. Combined impacts on river ecology</td>
<td>III</td>
<td>medium</td>
<td>III</td>
<td>medium</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td>Habitat loss and deterioration</td>
<td>III</td>
<td>medium</td>
<td>II-III</td>
<td>medium</td>
<td>III</td>
</tr>
<tr>
<td></td>
<td>Species at risk</td>
<td>II</td>
<td>medium</td>
<td>IV</td>
<td>medium</td>
<td>II</td>
</tr>
<tr>
<td></td>
<td>Obstructed migration</td>
<td>II-III</td>
<td>medium</td>
<td>III</td>
<td>medium</td>
<td>III</td>
</tr>
<tr>
<td>Pollution</td>
<td>6. Water pollution</td>
<td>III</td>
<td>medium</td>
<td>III</td>
<td>medium</td>
<td>III</td>
</tr>
<tr>
<td></td>
<td>Potential accidental pollution</td>
<td>II</td>
<td>medium</td>
<td>IV</td>
<td>high</td>
<td>III</td>
</tr>
<tr>
<td>Other</td>
<td>7. Drought</td>
<td>III</td>
<td>low</td>
<td>III</td>
<td>high</td>
<td>III</td>
</tr>
<tr>
<td>Intensive land use</td>
<td>III</td>
<td>medium</td>
<td>5 (3+2)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Sum of attributed national environmental impact severity and trans-boundary effect scores (see further remarks on next page)
Remarks:

a Flush flows along the Drava downstream to Dubrava HPP, effect dampened below Noskovci.
b Flush flows along the Drava downstream to Dubrava HPP, effect dampened below Drávasztára.
c Sedimentation occurs in the upper reservoirs of the Austrian Drava.
d High transboundary effects along the Croatian-Slovenian and Croatian-Hungarian Drava stretches.
e High transboundary effect along the Croatian-Hungarian Drava.
f High flood risk near the Italian and Slovenian borders.
g The „Low“ transboundary effect refers to the Austrian-Slovenian border region.
h Combined scores were set as worst case values chosen from the three types of “Altered river ecology”. Although their summed score equals that of “River regulation”, “Combined impacts on river ecology” got a higher priority due to its multiple reported environmental impact dimensions.
i High transboundary effect in case of an accident.
j High transboundary effect on the Croatian riverbank in case of an accident.
5.1 Altered river flow

Causes of the problem

River flow alterations are abrupt or sustained significant changes of the natural water regime, to which the riverine ecosystems are unable to adapt and which therefore leads to sustained deterioration of the natural water bodies and its habitats.

Sustained river flow alterations usually caused by the disconnection of river sections – on the Drava this happens at bypass canal or bypass conduit hydropower stations, where most of the flow is diverted into the bypass canal on which the power station is situated, and the bypassed original riverbed practically receives a minimum or residual flow only.

Diminishing inflow to Drava side-arms is another form of sustained flow alteration. It is caused by riverbed erosion and consequently by the deepening of the riverbed and decreasing water stages within the main river channel and the inter-connected ground- and surface water bodies of the entire floodplain. This is a secondary effect of riverbed erosion, which is discussed in Section 4.3 of this report. Depending on morphological conditions, the only inflow a side arm may have is during flood waves, also decreasing in frequency and height.

Flush flows – abrupt artificial changes in river flow – are caused by hydropower plants (HPPs) operating in peak mode and generating peak time electricity, once or twice a day. During those periods flushes of often cold water are released from a reservoir, and this has a high impact on the downstream free flowing Drava, it’s sediments and small biota.

Occurrences

Bypassed Drava sections are closed down by means of dams that divert water into a bypass canal as in the case of the Rosegg-St. Jakob, Melje, Markovci, Varaždin, Čakovec, and Dubrava dams, or into a bypass conduit as at the Sesto and Strassen dams. (Sesto dam is situated on Rio di Sesto/Sextenbach, the conduit bypasses 4.6 km of R. Sesto and 3.6 km of the Drava.)

The following table lists the bypassed Drava sections, the total length of which is 123.6 km (17% of the length of the Drava):

Table 5.2: Bypassed Drava sections

<table>
<thead>
<tr>
<th>Bypassed Drava river sections</th>
<th>Length [km]</th>
<th>Dam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rio Sesto confluence – Versciaco (IT)</td>
<td>3.6</td>
<td>Sesto dam (Rio di Sesto), with conduit</td>
</tr>
<tr>
<td>Strassen – Amlach (Lienz) (AT)</td>
<td>23.6</td>
<td>Strassen dam, with conduit</td>
</tr>
<tr>
<td>Rosegg – St Jakob (AT)</td>
<td>7.0</td>
<td>Rosegg-St. Jakob dam</td>
</tr>
<tr>
<td>Maribor (Melje dam) – Ptuj (SI)</td>
<td>25.2</td>
<td>Melje dam</td>
</tr>
<tr>
<td>Markovci – OtokVirje (SI, HR)</td>
<td>23.3</td>
<td>Markovci dam</td>
</tr>
<tr>
<td>DonjeVratno – Varaždin (SI, HR)</td>
<td>21.0</td>
<td>Varaždin dam</td>
</tr>
<tr>
<td>Čakovec lake – Dubrava lake (HR)</td>
<td>10.3</td>
<td>Čakovec dam</td>
</tr>
<tr>
<td>Dubrava lake – Legrad (HR)</td>
<td>11.6</td>
<td>Dubrava dam</td>
</tr>
<tr>
<td><strong>Total length:</strong></td>
<td><strong>123.6 km</strong></td>
<td></td>
</tr>
</tbody>
</table>
**Diminishing inflow to Drava side-arms:** Since this problem occurs along river stretches affected by riverbed erosion (see Section 5.3), such problems might be encountered with at two particular stretches: in Austria between Lienz and Molzbichl, along a stretch of 60 km, and downstream to Legrad until the Drava mouth, along 243 km.

There is no inventory available on the Drava side-arms – as there is no unique definition of the side-arm, in many cases a temporary formation. Most of the larger side-arms can be found on the Drava downstream to Lake Ptuj, where intensive meandering created long oxbows. A study, carried out in Hungary (DDVIZIG-DDNPI-WWF, 2004) assessed 29 side-arms on the left bank of the Drava, out of which 21 was in need of rehabilitation with respect to the improvement of water supply.

There are 16 side-arms along the Hungarian Drava receiving diminishing water supply from the river. In particular, the amplitude and frequency of small flood events – 1-5 year annual floods – decreased in the free flowing Drava between Croatia and Hungary.

**Flush flows,** abrupt flow changes occur in the tailwaters of HPPs operating in peak mode. As listed in Appendix 1 (Hydropower plants in the Drava river corridor) of this report, 4 HPPs operate in that mode: Strassen-Amlach HPP (AT), and the Varaždin, Čakovec and Dubrava HPPs (HR). Since Varaždin and Čakovec HPPs are not on the Drava but on a bypass canal and are followed by a reservoir, they do not have this adverse effect on the Drava.

Flush flow occurs also below the Malta Unterstufen HPP (AT), a power station utilising energy of the tributary Möll but having its impact on the Drava.

**Table 5.3:** Drava river sections affected by flush flows

<table>
<thead>
<tr>
<th>Hydro power plant</th>
<th>River section</th>
<th>Length [km]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strassen-Amlach HPP (AT)</td>
<td>Amlach – Lienz</td>
<td>4</td>
</tr>
<tr>
<td>Malta Unterstufen HPP (AT)</td>
<td>Sachsenburg – Molzbichl</td>
<td>22</td>
</tr>
<tr>
<td>Dubrava HPP</td>
<td>Legrad – Vejti</td>
<td>130</td>
</tr>
<tr>
<td><strong>Total length:</strong></td>
<td></td>
<td><strong>156 km</strong></td>
</tr>
</tbody>
</table>

**Effects on the environment**

In all cases, the consequences fall primarily on the natural habitats and species of the water bodies affected, although fluctuations are also a disturbance for some recreational uses of the river, especially during summer low flow periods. Sustained flow alterations(towards minimum flow conditions) initiates or accelerates succession processes that lead to diminishing water surfaces, erosion and loss of the typical river character. Under the present regulated river conditions the bypass channels are not replacing the old river sections as natural riverine habitats. Abrupt flow fluctuations have a harmful effect on macro-zoobenthos and are severe for most young fish.

**Potential solutions**

**Bypassed Drava sections**

There is no realistic solution to this problem, but adverse ecological consequences can be reduced by assigning a minimum amount of flow – defined upon ecological criteria – to be continuously released into the bypassed stretch.
**Diminishing inflow to Drava side-arms**

Deepening the bottom of the side-arm by dredging might improve water supply, but without effectively halting riverbed erosion (see Section 4.3), dredging can only be a temporal solution.

**Flush flows**

- Ecological improvement of the mode of operation of the HPPs together with morphological and structural improvement of certain river stretches
- Building of reservoirs to reduce the influence of the flush flow (discharge from the peak mode of certain hydro power plants is stored for a certain time and flows into the river later)
- According to WFD the flush flows and their negative impacts have to be eliminated. (EU, 2000)
5.2 Flood risk

Causes of the problem

Flood risk of a location might be due to inadequate protection against high floods, or utilisation of the flood zone without due foresight or realistic assessment of the involved risks. It is an issue of relatively high importance in each of the Drava countries. In the mountainous countries Italy, Austria, and Slovenia, where densely populated settlements have developed since long near to the Drava in the narrow valley, both the type of the problem and the potential solutions are different from that of the downstream lowland countries Croatia and Hungary.

Occurrences

Italy - Urban areas at risk are: San Candido, Versciaco and Prato alla Drava along the Drava, and Sesto and Moso at Rio Sesto and Rio Fiscalina, respectively.

Austria - Municipalities at risk are: Sillian, Assling, Lienz, Nussdorf-Debant, Oberdrauburg, Irschen, Dellach, Berg, Greifenburg, Kleblach Lind, Möllbrücke, Lendorf, Spittal, Paternion, Fillach, Lavamünd.

Slovenia – Sub-urban areas of Dogoške,Duplekand Malečnikand agricultural area on the floodplain downstream Maribor might be flooded by the HQ100 event. Town of Dravograd, near to the Austrian border is partly flooded by HQ30 or 100 events, depending also on water levels of Meža tributary.

Croatia - Urban, forestry and agricultural areas within the Drava flood zone are exposed to the risks of inundation by the HQ100 flood event. Settlements at risk are: Gotalovo, Otočka, Novačka, Repaš, Levača, GornjaŠuma, GabajevaGreda, Komatnica, Sigetec, Drenje, Botovo and Legrad (mainly the northern and north-eastern parts of these settlements).

Hungary - part of the built up area of the following municipalities is within the zone of the HQ100 flood: Péterhida, Bolhó, Babócsa, Heresznye, Vízvár, Somogyudvarhely, Berzence, Gyékényes.

Potential solutions

Preventive flood protection: aims at preventing floods at their origin, by retaining water in the catchment (mountain forests and tributaries), riparian forests, meadow lands, old floodplains, and “undeveloped” valleys areas; extension of existing floodplain area, more space for the river concept.

Structural flood protection: by construction of flood levees or dikes, dams, and flood retention reservoirs, use of mobile protection elements which can be installed right before the event on underground foundations and then be removed again. Structural protection should be applied only if preventive or non-structural flood protection cannot be applied (e.g. in settlements), but should be avoided for agricultural and forest areas (see: EU Flood Directive, 2007, especially par. (14)).

Non-structural flood protection: include regulatory means, and forecasting, early warning systems. Regulatory means: land use provisions (designation of flood zones with restricted use), engineering provisions (flood-compatible construction of infrastructure), risk provisions (insurance, compensation), behavioural provisions, and technical cooperation between water management organisations and water users, including HPP operators, from local to international level. Early warning and forecasting systems: improvement of the flood forecasting system in order to
increase preparedness (e.g. setting up additional dikes and walls) and minimise damages in flood prone areas from local to trans-boundary level.

Flood management in the Drava river corridor needs all three types of solutions, taking carefully into consideration which measure can be best applied at a given location. It is worth to mention, that a definite concept on flood protection of the river corridor can be found in the Italian River Corridor Report only, where the area is relatively small and the potential measures are limited by meteorological and spatial constraints. In the frame of the EU Flood Directive, flood risk management plans are currently under intensive preparation in all Drava countries (ProDrau, 2011; Ministry of the Environment and Spatial Planning (2011b), Hrvatskevode, 2012; OVF, 2012.

In Austria for all APSFR (areas of potential significant flood risk – definition following the EU Flood directive) flood risk management plans are elaborated at the moment. For Austria there are defined certain measures which are described by key information (location of the region, responsible groups, type of problem, measures to solve the problem, status of making plans to solve the problem, status of implementation of the planned measures, monitoring, etc.). In the end of the year 2014 there will be a detailed data base on information concerning every single APSFR in Austria.

In spite of the relatively high ranking the flood risk issue indicated for each of the Drava countries, no general, overall strategy seemed to emerge yet in most countries. An example of an overall strategy for flood risk management is indicated in the followings.

**Figure 5.3:** Implementation of measures on all levels (prevention, response and aftercare)

(Source: EU Intrreg project AdaptAlp, 2012)

In Austria flood risk management plans (following the instructions of the Flood Directive) are being developed. For each part of the risk cycle certain measures (21 defined groups/types of measures to choose) have to be implemented.
Effects of flood management on the environment

Floods in general are not damaging to the environment but an important ecological factor of river ecosystems. Instead, structural flood protection measures are the result of intensive human land uses in flood-prone areas. Flood levees disconnect riverine, riparian habitats from the floodplain and thus from the natural flood retention space. Moreover, flood levee construction is frequently coupled with river regulation, in order to protect the dike itself, and to adapt the space available for the levee and the foreshore with the riverbed. Guiding philosophy was the accelerated discharge of flood waters to downstream sections. This proved to be neither a useful nor a fair and sustainable solution.

The operation of large artificial flood reservoirs did not prove to be successful, even more at times of unpredictable weather events due to climate change. The WFD and FD require the restoration of natural flood retention spaces in the entire catchment which triggers further benefits for wetlands and groundwater-related uses (agriculture, forestry, drinking water etc.).

Suggestion

- Do not plan flood protection measures alone. Always try to find a win-win situation and plan flood protection together with ecological improvement and possibilities for recreation.
5.3 Altered riverine ecology

Causes of the problem

The primary cause of riverine ecology alterations in the Drava valley is physical/technical interferences into the water and sediment regime – mainly related to hydropower generation or river regulation. Typical impact is the blocked species migration. Damages by excessive recreational uses or land use pressures are isolated cases and not typical over longer river sections. Water quality related alterations are not characteristic either. (About water quality issues see Section 4.6)

The above causes might result in ecological alterations of different types and severity ranging from habitat deterioration to disappearing of certain species from the river.

Occurrences

Italy:
- Loss of natural habitat along the Drava due to river regulation, agricultural cultivation close to the river, and torrent control measures in the settlements area.

Austria:
- Habitat changes in riparian forests due to riverbed erosion, Lienz - Paternion.
- Disrupted longitudinal river continuity (blocked fish migration) at 9 HPPs and 1 dam: all in 2014 without fish passes.
- Habitat changes at the riverbank and riverbed of impoundments and reservoirs of HPPs.
- Loss of typical habitats due to river regulation by disconnection of side-arms.
- Changes of habitat quality due to altered flow by HPPs, Malta Unterstufe – Paternion.
- Potential deterioration of habitats, Landfill Ferndorf.
- Degradation and habitat changes in riverbed between Strassen dam and Amlach HPP.
- Habitat changes in riparian forests between Strassen dam and Amlach HPP.

Slovenia:
- Habitat loss at gravel bars to be dredged, due to river regulations for flood management.
- Habitat changes in riparian forests due to riverbed erosion, downstream to Maribor.
- Habitat changes due to daily flow fluctuations induced by HPPs.
- Degradation of habitats due to channel profile maintenance.
- Loss of typical habitats due to river regulation by disconnection of side-arms.
- Loss of habitats such as erosion walls, riparian forests and wet meadows due to river regulation.
- Disrupted longitudinal river continuity (blocked fish migration) at 7 HPPs without fish passes.
- Potential deterioration of habitats, and loss of populations of sensitive species due to accidental pollution.

Croatia:
- Habitat changes in the riverbed due to daily flow fluctuations by upstream HPPs.
- Loss of typical habitats and species in side-arms due to river regulation and riverbed erosion.
- Disrupted longitudinal river continuity at 3 HPPs.

Hungary:
- Habitat changes in the riverbed due to daily flow fluctuations by upstream HPPs.
- Loss of typical habitats and species, blocked fish migration into side-arms due to river regulation and riverbed erosion.
- Reduction of fish populations and loss of species because of riverbed erosion there are less and shorter floodings of the foreshore, where fish used to breed.
- Habitat changes in riparian forests due to lowering of the groundwater table, as a consequence of riverbed erosion.
- Degradation of floodplain forests and aquatic habitats.

Severity of effects
The Drava countries’ National River Corridor Reports used the following terms to describe the altered riverine ecology problems:
- habitat deterioration,
- blocked migration of fish,
- habitat loss,
- species at risk.

This could well be considered in this order as the severity sequence of ecological alterations. Out of these, habitat loss and species at risk are the most severe: in Austria and Slovenia these are caused by river regulation, in Croatia and Hungary they are due to riverbed erosion and river regulation.

Potential solutions
Since most ecological alterations on the Drava are consequences of hydro-morphological changes, the most effective actions means of rehabilitation of modified river sections and the improving of flow conditions. Proposed solutions are:
- River deregulation at some (short) sections as refuges for sensitive ecosystems and breeding areas for fish.
- Halting or even reversing of riverbed erosion; and increasing river dynamics (lateral erosion) possibly in connection with river deregulation.
- Ecologically optimized operation of the upstream HPPs – softer hydro peaking.
- Construction of effective fish passes at HPPs in Austria, Slovenia and Croatia. It is recommended that Drava countries (including dam operator and fish experts) harmonise and coordinate their efforts in dimensioning and construction of fish passes, to ensure effective connectivity along the whole river.

Suggestions
- Make research where and how ecological improvement near the river and along the river banks are most needed or most effective.
- Gather good examples of measures for ecological improvement.

- With regard to selection criteria of suitable fish passes for a given river section in the Danube Basin, and technical guidance on how to build a fish pass in the most effective way, consult the ICPDR Technical Paper \((ICPDR,2013)\) or the Austrian guidance, including specific values upon which the design of the fish pass can be orientated\((BMLUFW, 2012)\).

- Do not plan flood protection measures alone. Always try to find a win-win situation and plan flood protection together with ecological improvement and possibilities for recreation.
5.4 River regulation

Causes of the problem

River regulation affected the Drava in diverse forms, and for different reasons. Among the primary reasons navigation and flood defence can be mentioned, and its objective and form was river straightening by cutting through the meanders and stabilising the riverbanks by groynes, longitudinal structures, and embankment protection (e.g. riprap), in order to halt further natural meandering. The navigation fairway is being maintained by dredging. These interventions contributed to local flood safety too, especially by reducing the risk of ice jams, furthermore to recover land for agriculture.

Another form of river regulation is the rebuilding of natural river stretches by diversion or bypass canals with high dikes that make possible the construction of hydropower plants in lowland areas. At these sites the deviation weir is also being built in the main bed to regulate water levels in the reservoir/impoundment, and to control the minimum flow into the old river stretch.

In the mountain sections of the Drava river regulations take the form of bottom sills and retaining walls, to reduce riverbed erosion of steep sloped streams and maintain riverbank stability in built up areas and in the vicinity of infrastructure.

Some form of river regulation is in many cases a necessary activity; e.g. in areas where natural river dynamics would otherwise endanger existing land uses, infrastructure, and human life. Nevertheless, river regulation introduces physical constraints into a natural system, the long term consequences of which do seriously impair natural ecosystems, and result in other unaccounted, or unforeseen negative consequences (riverbed erosion, increased downstream flood risk etc.). Experiences with existing regulations show that knowledge about river dynamics is still limited and river forces can be hardly fully controlled, i.e. long-term economic costs can be huge.

Occurrences

The Drava is regulated from its source in Italy nearly down to its mouth. River regulation affects the entire Italian Drava (10 km section). It continues along the Austrian Drava from Lienz to Spittal (straightened river course) as well as between rkm 550 to 413, along 10HPP reservoirs from Paternion to Lavamünd, the Slovenian Drava related to hydropower plants and especially along reservoirs from Maribor till Markovci, on the Croatian Drava from Ormoz to Mali Dubrava, and between Botovo and Repas; on the Croatian-Hungarian Drava downstream from Barcs.

Effects on the environment

Traditional methods of river regulation aim at the stabilizing the river bed into a predefined straight form, and the suppression of those continuous morphological changes a river would undergo under natural conditions. Without such continuously reproducing changes the morphological variation of river would vanish, or diminish in size – together with the habitats they shelter. Examples of diminishing habitats are the gravel and sand bars, the side-arms of different age, the transitory landforms between the river, the riverbank and floodplain. As a consequence, ecosystems including rare breeding grounds are to be lost or deteriorate, and species disappear from the river corridor. It has to be stressed that especially the Lower Drava still features many rare elements that were lost already in other European rivers many decades ago (this is why the TBR MDD and many Natura 2000 sites were established).
Bypass canals are special forms of river regulation, when not only a river-bend, but long sections of the river get disconnected. The existing examples of bypass canals along the Middle Drava are mostly straight, geometric channels with hardly any riverine vegetation, morphological variation or potential shelter for ecosystems.

Potential solutions

River regulation was and sometimes is still considered a necessity in its existing form, both by professionals and by those local stakeholders interested in utilising the regulated river. Its construction took a long period, was usually carried out by large expenses that had to be justified. Any changes would demand considerable expenses, may involve a risk, and might undermine opportunities that are available at present (e.g. navigation). Still, any modern river corridor management has to follow the guidelines of the EU FD and WFD. Consequently, prior to any modifications (river bed restoration), one has to prove that the new solution is superior to the old one in several aspects:

- Water management (flood management) goals and economic advantages that lead to the given river regulation are no longer valid or as positive as they were at the time of construction, e.g. due to high maintenance costs or expensive side effects (water supply); modern comprehensive cost assessments (incorporating ecosystem service values) end up with other results.
- New developments in river management techniques can offer more natural and less expensive solutions compared to the existing one, including environmental and maintenance costs (ICPDR/Platina, 2010);
- Priorities of the society did change with regard to ecological benefits of river deregulation.

The basic measure of river deregulation would be to give more space to the river, in terms of riverbed width (and less depth, to decrease velocity and thus riverbed erosion), in terms of foreshore width (increasing river length by allowing more pronounced curvatures or meandering and more variation possibilities for the river) to develop and to form its bed and riverbank.

River deregulation, the modification, correction, or removal of existing regulation structures is still a controlled procedure of river self-restoration that should not lead to increased flood risk for human life.

Since it is a major intervention into river morphology, river deregulation might be connected to the solution of other river engineering problems or nature protection projects, such as riverbed erosion, sidearm rehabilitation, habitat restoration, etc.

Suggestion

- From the point of view of planning and implementing it would be good to gather experience and techniques how to (re)develop regulated rivers in a natural way. There are many projects, brochures, studies (ICPDR/Platina, 2010) – see the “good practices” list.
- Do not plan flood protection measures alone. Always try to find a win-win situation and plan flood protection together with ecological improvement and possibilities for recreation.
5.5 Riverbed erosion - altered sediment balance

Causes of the problem

Sediments are transported by the kinetic energy of the water in move. Whenever this energy is reduced, part of the sediment content is deposited in the riverbed. When water regains its momentum, e.g. along a sloping river valley, it starts dragging sediment from its channel (bed and banks). Over a longer time and under constant environmental conditions this process is in equilibrium at any given location. Artificial, sustained interventions to the velocity or amount of flow and to the availability of sediment disturbs this equilibrium and results in continuous sedimentation at one location and riverbed erosion at another. Such changes are typically caused by HPPs where impounded river sections face permanent sedimentation (retaining bed load) and downstream sections permanent erosion (lacking upstream bed load supply). Similarly, the removal of naturally deposited sediments at one river section causes a deficit at downstream sections, where the removed sediment was supposed to naturally replenish the locally eroded volume. River regulations usually shorten the course of the water thus increase velocities; that also lead to long-term bed erosion processes.

This issue came into focus within the SEE River project, as these problems exist in Austria, Slovenia, Croatia, and Hungary.

Data on sediment processes in the Drava are scarce in all countries. The Austrian pilot area is subject to a long-term sediment monitoring programme that assesses the effects of recent river restoration projects. Concerning the sediment process, all measures and the related monitoring results were analysed. Within another EU funded project SedAlp (www.sedalp.eu) the sediment management and sediment balance of the Isel and Drava catchments are analysed. During the SEE River the result of the Austrian pilot project will be a concept of new measures for the next decades along the Drava pilot area – also first ideas for measures concerning sediment management. As a first follow-up, the results of the SEE River pilot project will be combined with the results of SedAlp, thus a very detailed concept of measures on sediment management in the pilot area is expected to emerge.

A study on the Slovenian Drava river section between Zavrč and Ormož, has estimated the average annual sediment transport to be 136000 m³/year for the location of Markovci, before the dam was built (Sovinc, 1995). Now there is only 335 m³/year measured at the same location, i.e. less than 1%.

Long term suspended sediment transport at Botovo, Croatia is shown on the following figure (SEE River, 2013d). Due to the HPPs installed on upstream sections, sediment load decreased at least by 75% compared to the pre-dam period.
The following table shows the annual rate of riverbed erosion along the Croatian-Hungarian stretch of the Drava, between the Mura confluence and Drávaszabolcs or Donji Miholjac:

<table>
<thead>
<tr>
<th>Station name</th>
<th>Location [rkm]</th>
<th>Gauge 0 [m a. Baltic s.l.]</th>
<th>Riverbed degradation [cm/year]</th>
<th>Change within 1967-2012 [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Örtílos</td>
<td>235,9</td>
<td>125,94</td>
<td>4,8</td>
<td>-2,0</td>
</tr>
<tr>
<td>Barcs</td>
<td>154,1</td>
<td>98,14</td>
<td>3,7</td>
<td>-1,7</td>
</tr>
<tr>
<td>Szentborbás</td>
<td>133,1</td>
<td>94,74</td>
<td>2,0</td>
<td>-0,9</td>
</tr>
<tr>
<td>Drávaszabolcs</td>
<td>77,7</td>
<td>86,76</td>
<td>1,6</td>
<td>-0,7</td>
</tr>
</tbody>
</table>

From these numbers the annual amount of sediment deficit on this river stretch can be estimated at 300 000 m³ or 700 000 tons, comparable to the Slovenian calculation for Markovci.

**Occurrences**

Sedimentation occurs in all impounded river sections of hydropower plants in Austria, Slovenia and Croatia.

Dredging and removal of gravel and sand from the riverbed (for industrial and river maintenance purposes) happens in Austria, Slovenia, Croatia, and until recently also in Hungary.

Riverbed erosion processes exist along river regulation stretches, especially where the river was straightened and the average slope of the river increased. Along the Drava this is typical below Botovo and Zákány, and especially below Barcs but also on the Upper Drava downstream from Lienz.

**Effects on the environment and water management**

*Side-branches* became temporarily or permanently disconnected from the main river; as erosion progresses, connection periods are getting shorter, and flow volumes decrease, thus sedimentation...
The lack of hydro-morphological dynamics leads to habitat changes and degradation (e.g. silting, drying up).

*The river-floodplain system* separates more and more (i.e. the river bed erodes, the side-arms raise), resulting in a loss of wet and pioneer habitats, as migration routes become blocked, and water bodies that naturally would serve for spawning, refuge, feeding and wintering, become isolated and dry.

*Groundwater levels* of the adjoining areas sink parallel with the riverbed, which has a negative effect on the quality of floodplain habitats and the agricultural and forestry production even kilometres away from the river.

*Water management* - Sedimentation in impounded river sections and reservoirs seems primarily to be an economic problem (increased maintenance costs) of the HPP, but in reality its negative consequences are felt much stronger at the downstream sections where the deficit of natural sediment supply causes maintenance problems of river banks and regulation structures, bridges and harbours as well as increased needs of water supply to the drying up floodplain.

**Potential solutions**

Similarly to flood management and water resources management, sediment management is an issue along the entire Drava that needs an overall, catchment wide approach. Isolated attempts of solutions are neither ecologically nor economically sustainable and end up with provisional results. The means of potential solutions are the following:

- Sediment management in reservoirs and impounded river sections: increased release to downstream sections, and/or mechanical transfer of the coarse accumulated sediment (provided that it is chemically clean). Fine and chemically polluted sediments should be removed and safely deposited.

- River bottom stabilization by granulometric riverbed improvement, the technology being in a test phase in the Austrian Danube near Hainburg (*ICPDR/Platina, 2010*).

- Halting of gravel and sand dredging or other forms of sediment excavation from the downstream riverbed.

- Promoting lateral erosion (side erosion) to re-mobilize sediments and increase sediment input into system (removal of embankments, riverbed widening, sidearm connection, to increase river dynamics).

**Suggestion**

- Do research for the entire catchments to get to know the most important sources of gravel (bed load), and find the best places/tributaries to improve/restore the sediment transport.

- Implement river restoration projects by (re)mobilizing sediment and gravel from the river bank and floodplain.
5.6 Water quality and pollution risk

Causes of the problem

Water quality problems are caused in the Drava River by inadequately treated sewage discharges and probably by diffuse pollution from the river corridor. These types of problems could be traced from water quality monitoring and from the physico-chemical status indicators of various water bodies in the river corridor, as required by the WFD.

Pollution risk is a potential threat from accidental water pollution caused by industrial plants, wastewater treatment facilities, waste disposal sites, chemical dumps or transportation accidents in the catchment but posing a higher risk if originating from the river area or the river corridor. For the assessment and classification of potential accident risk spots, ICPDR set up an inventory and elaborated a common procedure to assess the risk to the environment and the effectiveness of existing safety measures. As a result, since 2007 all suspected contaminated sites in the Danube Basin are assessed. It has to be mentioned that the pollution risk issue attained by the expert panel a much higher priority than water quality (see Table 5.1).

Occurrences and risk spots

For a comprehensive and uniform indicator of the Drava water quality, the physico-chemical status – as defined in the Water Framework Directive – was selected. The general assessment of the Drava surface water bodies by physico-chemical elements can be of support for the biological elements: thermal conditions, oxygenation conditions, salinity, acidification status, nutrient conditions.

The WFD physico-chemical status indicators of the Drava water bodies can give a comprehensive overview of the river water quality. Based on information available in the National Drava River Corridor Reports, the following assessment can be given:

<table>
<thead>
<tr>
<th>Drava river section</th>
<th>Country</th>
<th>Physico-chemical status</th>
</tr>
</thead>
<tbody>
<tr>
<td>From the source down to the Italian/Austrian border</td>
<td>IT</td>
<td>good</td>
</tr>
<tr>
<td>From the Italian/Austrian border down to Lienz</td>
<td>AT</td>
<td>good</td>
</tr>
<tr>
<td>From Lienz to the Austrian/Slovenian border</td>
<td>AT</td>
<td>high</td>
</tr>
<tr>
<td>From the Austrian/Slovenian border down to Croatia</td>
<td>SI</td>
<td>high / good</td>
</tr>
<tr>
<td>From the Slovenian/Croatian border down to the Mura confluence</td>
<td>HR</td>
<td>high</td>
</tr>
<tr>
<td>From the Mura confluence along the Croatian/Hungarian shared river section</td>
<td>HR/HU</td>
<td>HR: good / HU: high</td>
</tr>
<tr>
<td>From the Hungarian/Croatian border down to the Danube</td>
<td>HR</td>
<td>good</td>
</tr>
</tbody>
</table>

As a preliminary conclusion, it can be stated that the physico-chemical status of the Drava is mostly good or high. According to the Hungarian RBMP (VKKI, 2010) the quality of the Mura – being good only – has possibly an adverse effect on the Drava, downstream to its confluence. (There seems to be some discrepancy between the Croatian and the Hungarian evaluation of the same river section.)
**Risk spots:**

**Italy:** none

**Austria:** 5 industrial sites, mainly along the tributaries.

**Slovenia:** 3 industrial plants identified as posing a risk under the SEVESO directive, moreover, potential malfunction of municipal WWTPs.

**Croatia:** Wagon Laundry at Botovo. There may be other risk sites outside the Pilot Area.

**Hungary:** an industrial plant and 3 municipal WWTPs pose a significant pollution risk.

**Effects on the environment**

Available data show that existing pollution sources – point and diffuse – do not pose a significant pressure on the river water quality.

Pollution risk sites are a threat with maybe very serious potential consequences, but it is beyond the scope of this project to further assess this.

**Potential solutions**

- Upgrading and monitoring of existing WWTPs and sewer systems (especially on the Mura).
- Introduction or enforcement of Good Agricultural Practices for reducing diffuse pollution in the catchment.
- Upgraded monitoring of the adequacy of accident preparedness and safety.
- Upgraded accident management, alarm system and mitigation capacity.
- Implementation of the WFD.
5.7 Drought

Causes of the problem

Drought is a diverse phenomenon in the Drava valley, with large differences between the geographical conditions, precipitation amounts, and the need and availability of water resources to compensate for missing precipitation and soil moisture. Drought has three components in the region: hydrological drought, atmospheric or agricultural drought and the decline of groundwater levels. Hydrological drought is the phenomenon of long spells of dry periods, with no precipitation at all, or only a small fraction of the average precipitation. Atmospheric drought is the result of the interaction between precipitation and evapotranspiration, when evaporation loss of the vegetation cannot be balanced by the available soil moisture. Hydrological drought reduces the runoff, the available surface and groundwater resources, while atmospheric drought may cause losses for agriculture within days. Both phenomena might be aggravated by sinking groundwater levels that could be the consequence of riverbed erosion or of excessive groundwater exploitation (e.g. for irrigation).

Occurrences

Italy: There is no indication of any drought problems.

Austria: Severe hydrological droughts in 2010-2011 in the lower part of the Drava catchment but no indication of being a high priority issue.

Slovenia: For agriculture along the Drava River, especially for the local production of corn and crops, periods with low precipitation cause harvest losses. So far such periods lasted only a few months. If the dry periods get longer, serious problems for agriculture can emerge.

Croatia: Possible increase in the extremity and frequency of hydrological and atmospheric droughts, aggravated by decreasing groundwater in the river corridor due to riverbed erosion.

Hungary: Prolonged dry periods and frequent atmospheric droughts in the last two decades cause losses to agriculture. In the river corridor drought phenomena are enhanced by a decreasing groundwater table and drainage of the floodplain.

Effects on the environment

- Degradation of sensitive habitats, especially in wetlands.
- Degradation and habitat changes in forests, especially on areas of fast decreasing groundwater levels (e.g. due to riverbed erosion).
- Reduced productivity (plant growth) in forest stands and agricultural land, possibly requiring to change to more drought-resistant tree species and crops
- Degradation of soil structure, potential over-extraction of groundwater due to irrigation.

Potential solutions

- Improved water retention in the floodplain, notably in wetlands, side-arms, drainage canals, and reservoirs. Water retention is achieved by storage in the soil and underground, not
necessarily in surface reservoirs. Retention will also serve as a preventive flood protection measure.

- **Adaptation of agricultural practices:**
  - Cultivation methods may be increasing the soil moisture retention (application of mulch on the soil surface for reducing evaporation), and increasing soil moisture storage capacity (deep ploughing), and
  - Production of drought resistant crops.

- **Irrigation, and improved efficiency of irrigation,** improvement understood both in terms of energy and water saving, and in terms of environmental pressures. Micro irrigation or drip irrigation is a very efficient method, with hardly any evaporation loss, since it lets water get to the root zone of the plants, and does not cause damages to the soil structure, although an expensive technique. Saving of irrigation water places less stress on water resources.
5.8 Other identified trans-boundary challenges and opportunities

A. Tourism

The Drava valley has a high touristic potential, with respect to nature values (ranging from the Alpine to the Danube-Drava riverine ecosystems), cultural heritage, sporting opportunities, scenery, and manifold historical connections among people living along the river. In South Tirol and Austria this potential is already extensively utilised by a well developed tourist industry, local tourism strategies, and widely known brands. This is not the case in the other three Drava countries, especially in Croatia and Hungary, where tourism in the Drava river corridor is still much below its potential and is lacking adequate infrastructure, funding, expertise, and strategy – although development of individual elements of the tourism infrastructure is already in progress.

This section of the Joint Report is focusing on the trans-boundary initiatives and possibilities of tourism within the Drava river corridor, in line with Paragraph 7 of the Drava River Vision Declaration (see Appendix). The Declaration aims to enhance cross-border recreation within the Drava river corridor, stresses the importance of sustainable regional recreation development and the enhancement of the quality of the river’s environment as an attractive landscape setting.

In the followings three trans-national initiatives of touristic importance will be discussed: the Drava bicycle path, boat tourism, and tourism related aspects of the Transboundary Biosphere Reserve Mura-Drava-Danube.

Trans-boundary Drava bicycle path

The Drava cycling route starts at Dobbiaco/Toblach (near the Drava’s spring) and follows the river downstream to Maribor, in Slovenia. In the three countries it crosses, it is called Ciclabiledella Drava, Drauradweg and Dravskikolesarskipot. The route follows the river for 366 km and is also connected with the cycling route of Val Pusteria (Italy). From Innichen (South Tyrol/Italy) to Lienz this cycle path is in intensive use by Italian tourists. There are special offers to cycle downstream to Lienz, to visit the Bruck castle and then return to Innichen by train.

There is no adequate information available on development of the bicycle path between Maribor and the Mura confluence in Croatia.

The Croatian “Drava Route” is 84 km long and stretches from the Mura confluence until Pitomača. This route is linked with the “Bilodravska Route” in Novo Virje. This route links Bjelovar with the Drava Valley and splits into two branches: the northeast towards to Đurđevac and east towards to Pitomača in Virovitica County. In Osijek – Baranja County, – there is also a circular route “Drava Bike Tour” which starts in Belišće and connects DonjiMiholjac, part of Hungary and BaranjskoPetrovoSelo back with Belišće.

The “Three Rivers Bike Route (Mura–Drava-Danube)” in Hungary connects the Hungarian-Croatian Drava with the network of international bike routes, partly towards Austria along the Mura, and partly with the international “EuroVelo” bike route network at Mohács.

For the time being, there is a need for better integration of the bicycle routes among three Drava countries: Slovenia, Croatia and Hungary. As it is evident from examples of other countries, bicycle
routes form valuable tourism potential that can stimulate the development of other forms of tourism.

**Boat tourism on the Drava**

Boating and rafting is a popular touristic attraction along the Drava, downstream Leisach (East Tirol, Austria). The fast-flowing section of the river between Leisach and Lienz is known as an interesting area for kayaking. Downstream of Lienz the river is calmer and many tourists use it for canoeing and rafting, both in Austria and Slovenia (upstream Maribor). Since there are no shiplocks on the dams and hydropower plants of the Drava, boating is practically limited to sections between consecutive dams.

An example of trans-boundary boating between Austria and Slovenia is the traditional river floats operating between Lavamünd and Dravograd.

Along the Croatian-Hungarian Drava regular boating tours are organised by the Danube-Drava National Park. The tours are popular but constrained to short periods of time, due to nature conservation regulations.

**Tourism aspects of the Trans-boundary Biosphere Reserve**

The *Trans-boundary Biosphere Reserve Mura-Drava-Danube* (TBR MDD) was established in 2012, and connects Croatia, Hungary, Slovenia and Austria. One of the goals of TBR MDD is to help utilising the region’s eco-touristic potential (traditionally agriculture, branded local agricultural and gastronomic products, vines, etc.) and cultural heritage. Membership in the biosphere network as recognition of the region’s exceptional natural value also promotes the area as a tourist destination. The biosphere reserve might also provide a framework to market this area as a single tourist product to regional as well as international visitors. The area has already begun to shift its economy towards eco-tourism.
B. Navigation

The Drava between Osijek (14.0 rkm) and the confluence to the Danube (0.0 rkm) was designated by the European Agreement on Main Inland Waterways of International Importance (AGN) rev.4 (UN ECE, 2009) to be part of the international network of European waterways (E waterway network) as Class IV inland waterway. Parameters of the waterway are the following: maximum length of the vessel 80-85 m, draught 2.5 m, tonnage 100-1500. Fairway is qualified both for day and night navigation.

Based on parallel Croatian and Hungarian regulations the Drava is an international waterway up till 198.6 rkm, although not part of the E waterway network.

In Hungary, the navigation status of the Drava is regulated by the Decree 17/2002. (III.7.) of the Ministry of Transport and Water Management (KöVIM), on natural and artificial waters which can be navigated, or can be made suitable for navigation. The decree defines the class of the waterway upon the dimensions (length, width, draught, vertical clearance, and safety distance between the bottom of the vessel’s body and the river bed) of the vessel category. According to the classification system given in Annex 1 of the above mentioned decree, the River Drava belongs to waterway Class II. The allowed main parameters of a vessel for the Drava on the basis of the above mentioned Class II waterway is the A similar regulation is in effect also in Croatia. (Water Management Strategy, Hrvatskevode, 2009).

According to these regulations the river is considered navigable by

- Class III vessels, between Osijek and Belišće (river km 56 +500). Navigation is allowed at daylight only.

- Class II vessels from Belišće up till 198.6 rkm (Bélavár in Hungary or the confluence of the Ždalica in Croatia). Characteristic parameters of a Class II vessel are the following: length 57 m, width 7.5 m, draught 1.6 m and carrying capacity 500 tons. Distance between the bottom of the vessel and the river bed must be at least 0.2 m, and the waterway should ensure these parameters for at least 240 days a year. Navigation is allowed at daylight only.

It should be mentioned that although defined as a waterway up to 198 rkm, the Drava above Osijek (14.0 rkm) is little used for commercial navigation. With no actual or planned traffic of that kind; it is not known, whether the freeway really fulfils the criteria set by the standards in terms of riverbed geometry and duration of water levels.

Ports on the Drava:

- Osijek 14.0 rkm (basin port)
- Drávaszabolcs 77.7 rkm
- Barcs 155.2 rkm (basin port)
C. Bilateral Commissions

The following bilateral water commissions exist among the Drava countries:

<table>
<thead>
<tr>
<th>Bilateral commission of</th>
<th>Name of the commission</th>
<th>Area of responsibility, sub-commissions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Italy</strong></td>
<td><strong>Austria</strong></td>
<td>No bilateral commission exists. The Province of South Tyrol on behalf of Italy, and the land East Tyrol on behalf of Austria handle all cross-border water issues.</td>
</tr>
<tr>
<td><strong>Austria</strong></td>
<td><strong>Slovenia</strong></td>
<td>Permanent Austrian-Slovenian Commission for the Drava River (since 1993)</td>
</tr>
<tr>
<td><strong>Slovenia</strong></td>
<td><strong>Croatia</strong></td>
<td>Permanent Slovenian-Croatian Commission for Water management (since 1998).</td>
</tr>
</tbody>
</table>
Joint Drava River Corridor Analysis Report

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**Remark:**
There are further Bilateral Commissions involved with the Mura, the major transboundary tributary of the Drava:

- *Permanent Austrian-Slovenian Commission for the Mura River* (since 1993)
- *Permanent Slovenian-Croatian Commission for Water Management, Sub-commission for the Drava and the Mura River* (since 1997).

Today, the existing Bilateral Commissions are dealing with cross-border river flood management, water quality protection and water resources management issues but **no organisation is responsible for**

- transboundary river management issues along **the whole river** (catchment),
- the **integration of other uses relevant for the environmental status and development of the river corridor** (such as nature conservation, agriculture & forestry, recreation & tourism, transport as well as spatial planning and regional development).

It is noted that certain international organisations take care for some of the aspects – e.g. UNESCO within the biosphere reserve program, or ICPDR for river basin management within the wider context of the Danube basin. Transboundary Drava issues are limited to those commissions that concern two neighbouring countries.

To **address issues of common concern of all Drava countries**, such as

- flood forecasting and management
- nature conservation and ecological aspects
- sediment balance problems,
- sharing of water resources for drinking water and agriculture,
- etc.

**amultilateral body** (commission, regularly convening forum, etc.) seems more appropriate, similar to other multi-national river basins (Sava, Tisza, Elbe, Oder, Rhine etc.).

However, taking into account the limited budgets and capacities of competent government bodies, it seems crucial for a more effective multi-country coordination that at least the **existing commissions**

**meet at least once a year at five-country level** in order to mutually inform each other on the

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<table>
<thead>
<tr>
<th>Croatia</th>
<th>Hungary</th>
<th>Hungarian-Croatian Water management Commission (since 1995)</th>
<th>Danube-Drava Sub-commission, Mura Sub-commission, Water Quality Protection Sub-commission, Sub-commission for the Multipurpose Utilisation of the Common Sections of the Drava and Mura. Flood defence, surface and groundwater resources management and protection, water uses, water quality protection, protection of aquatic ecosystems, analysis of the effect of hydraulic structures on the environment, moreover the monitoring, information exchange, planning and research of the above activities.</th>
</tr>
</thead>
</table>

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progress made and to pro-actively discuss the common Drava river corridor issues, especially those they identified during the SEE River project, and their related solutions (e.g. improved reporting to more than one downstream party, joint applications of projects etc.).

Multilateral coordination is made difficult by the fact that different persons usually represent their country in bilateral commissions with other countries, moreover, there is little formal connection (regular communication, coordination, awareness etc.) with 2nd or 3rd countries down- or upstream. For this reason, the recommended 5-country coordination meetings have their clear function and task in ensuring joint responsibility in river corridor governance and effective management action.

In this respect, the commissions and their representatives in the middle section of the catchment could have a key role, though all five involved countries should share their responsibility and opportunity in initiating / promoting / stimulating / ensuring coordination across all 5 countries.

In line with the EU policy and since long-years established procedures of other river commissions, all meetings of the Drava commissions should allow the participation of observers, i.e. stakeholders from any sector engaged in improving, or affecting, the status of the Drava corridor.
LIST OF MAP ANNEXES

Thematic maps of the international Drava River Corridor

1. Overview map and pilot areas
2. Altered river flow
3. Flood risk
4. Longitudinal connectivity and ecological status
5. Protected areas
6. Altered sediment balance
7. Physico-chemical status
8. Hydro-morphological status

Pilot area maps

9. Drava river corridor in Italy
10. Drava river corridor in Austria
11. Drava river corridor in Slovenia
12. Drava river corridor in Croatia and Hungary

Hotspot maps

13. Map of hotspots of the Italian Drava river corridor
14. Map of hotspots of the Austrian Drava river corridor
15. Map of hotspots of the Slovenian Drava river corridor
16. Map of hotspots of the Croatian Drava river corridor
17. Map of hotspots of the Hungarian Drava river corridor
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APPENDIX  DRAVA RIVER VISION DECLARATION 2008

concerning common approaches to water management, flood protection, hydropower utilization and nature and biodiversity conservation in the Drava River basin

Based on the holding, from 23 to 25 September 2008 in Maribor, Slovenia, of the international Symposium “Drava River Vision”, in which representatives from water management and nature conservation bodies, education institutions and non-government organizations (NGOs) from the Drava River riparian states Italy, Austria, Slovenia, Croatia and Hungary participated,

in response to popular demand for the protection and maintenance of the riverine landscape of the Drava River across the different national borders concerned, and in order to strive for a good status of the river,

aspiring to support and strengthen existing strong common approaches to water management, flood protection, hydropower utilization and biodiversity conservation in the river basin,

affirming our intention to cooperate in the conservation, administration and further appropriate development of the Drava River and its associated topographical, hydrological and ecological systems,

Present situation:

The Drava River (Italian: Drau, German: Drau, Slovenian: Drava, Croatian: Drava, Hungarian: Dráva) is a tributary of the Danube, and has its source at Toblach (Italy), approximately 1,450 m above sea level. It flows through Italy, Austria, Slovenia, Croatia and Hungary, and discharges into the Danube at Osijek (Croatia) at approximately 90 m above sea level. With a length of 749 km and a median flow of 560 m³/s, the Drava River is the fourth largest tributary of the Danube.

The Drava River basin is rich in natural resources of water and raw materials, and offers huge potential for sustainable development.

During past centuries, large sections of the Drava River were regulated, successfully reducing natural hazards. Fish migration however has been prevented by the many structures that have been introduced. From Paternion (Carinthia, Austria) downstream, the Drava River is heavily utilized for hydropower. On the Austrian side of the river there are eleven hydropower stations, with a further eight on the Slovenian side and three on the Croatian side. Additional proposed stations are under discussion in Slovenia and Croatia.

Along the Drava River there are important and well preserved ecological core zones, with a huge diversity of animal and plant species. Many of these areas have been placed under protection by the governments concerned, through protection regimes such as National Parks and Nature Parks, and they form part of the “Natura 2000” European protected areas network. In the EU-candidate country Croatia, the nomination of suitable Natura 2000 areas is in preparation, alongside other national protected area designations. The EU has supported many river restoration and rehabilitation projects in recent years, which have served flood protection objectives as well as the conservation of wild fauna, flora and habitats. Increasing areas of natural inundation has been a benefit not only for rare and endangered wildlife but also for the status of the waters.

Overall there has been an obvious improvement in the water quality of the Drava River in recent decades. This has been achieved by the connection of numerous settlements and industrial plants to sewage systems and waste-water treatment plants, which generally operate at high efficiency. There is, nonetheless, still a need for action in several areas.

Declaration

To secure the values and ecological functions of the Drava River basin for generations to come, we agree the following ten objectives as priorities for the future:

1. To promote the Drava River as a model for integrated implementation of EU policies on water and nature protection

The EU Directives on water management (Water Framework Directive), flood protection (Flood Directive), and biodiversity conservation (Flora-Fauna-Habitat Directive and Birds Directive) constitute a fundamental basis for river basin management in the Drava River catchment. Intergovernmental coordination and exchange of information can positively reinforce the implementation of relevant policies.

2. To enhance flood protection through the improvement of flood warning systems and through increased information exchange

Flood protection in the Drava River basin is a shared responsibility of all riparian countries. To give warnings in flood-prone areas at an early stage, flood risk must be detected sufficiently early to provide time for people to react. In a context of cross-border coordination and climate change along the Drava River, emphasis should be given in future to the improvement and adjustment of flood forecast models and flood warning systems.
3. To enhance flood protection through protection and restoration of water retention areas along the Drava River
Recent insights – particularly based on flooding disasters – indicate that linear security measures for protection from floods alone may not provide the most effective solutions. In the face of climate change and an expected increase in extreme flood events, we aspire to an improvement in the flood situation and raising the level of system security along the Drava River – this means in the first instance preservation, and then, where necessary and feasible, creation or restoration of suitable water retention areas.

4. To continue and further develop restoration of the Drava River and its floodplains
In recent years many river restoration and rehabilitation projects have shown that flood protection and nature conservation need no longer conflict with each other. River restoration often leads to an enhancement of ecological diversity. Water retention areas associated with the river can prevent uncontrolled outflow of water, thus improving flood protection. Further river restoration and rehabilitation projects with these multiple benefits will be encouraged, both on national level and in a transboundary context, taking into account the economic capacities of particular states.

5. To maintain and further develop the Drava River as an “ecological backbone”
Ecological core zones along the Drava River such as Natura 2000 areas, nature conservation areas, landscape conservation areas or free flowing river sections form an “ecological backbone” of the river basin. This transnational biotope network has to be safeguarded through active transboundary cooperation. The establishment of transboundary protected area systems such as the proposed UNESCO Biosphere Reserve “Danube-Drava-Mura” across five riparian countries forms a key part of this, and will be supported.

6. To re-establish the ecological connectivity of the Drava River for migratory fish
As a result of numerous barriers, the Drava River is no longer passable for fish migrating over long distances. In the future we aim to cooperate in establishing appropriate measures, including fish passes and fish by-passes, to support fish migration in the Drava River and its tributaries, in accordance with the objectives of the Water Framework Directive and the Habitats Directive.

7. To establish the Drava River as a cross-border recreation area
The Drava River provides an attractive location for holiday-makers. A 366 km Drava River cycle path leads from the river’s source to Maribor in Slovenia. Opportunities for sustainable regional recreation developments of this kind, based on the Drava River’s intrinsic values, should be further explored. We aim to enhance the quality of the Drava River’s environment for those who seek recreation and relaxation in an attractive landscape setting.

8. To use opportunities for the Drava River to be a connecting lifeline for different nations
After many years of fragmented approaches, today’s more unified Europe offers new opportunities to bring together the people of many different origins who live in the Drava River basin. Those responsible for water management and nature conservation in each country will initiate new dialogues with their counterparts in the other riparian countries, in coordinated efforts towards the shared aim of a high quality of life for the people in this region.

9. To undertake integrated river basin management rather than fragmented sectoral measures
International agreements concluded in recent years such as “Agenda 21”, and EU Directives such as those on Water, Floods, Flora, Fauna and Habitats, Wild Birds and SustainableEnergy Sources, together with the shift in social perceptions which these texts represent, strengthen the ongoing development of more sustainable approaches in the field of flood protection and hydropower. Modern approaches to activities such as these, therefore, in a context of integrated river basin management, seek to integrate economic, ecological and social aspects. Harmonised planning of water management, flood protection, hydropower use, recreation and biodiversity conservation can lead to sustainable solutions that also have higher public acceptance.

10. To undertake further development of the Drava River area in partnership with its resident human populations
Those engaged in agriculture, forestry, tourism, energy production and economic development, as well as residents in local communities, are all important partners in achieving the objectives of sustainable development of the Drava River. Adequate cooperation among all these groups can help to minimize any conflict between ecosystem values and economic development.
Signed as a signal for full support at the Drava River Vision Symposium, Maribor, 23rd September 2008

by the Heads of Delegation of the International Commission for the Protection of the Danube River from the Danubian States Austria, Croatia, Hungary and Slovenia and by the Director of the Department for Hydraulic Engineering of Bolzano, South-Tyrol in Italy,

Richard Stadler
Austrian HOD to the ICPDR

Zelko Ostojic
Croatian HOD to the ICPDR

Gyula Holló
Hungarian HOD to the ICPDR

Mitja Bricelj
Slovenian HOD to the ICPDR

Rudolf Pollinger
Italian Representative to the ICPDR

Hydraulic Engineer

and adopted by the Participants at the Drava River Vision Symposium, Maribor, 24th September 2008.

Let us join forces in the conservation and sustainable development of the Drava River - an aquatic ecosystem functioning as a corridor of recovery in the heart of Europe!