SUMAD

Sustainable Use and Management of
Alluvial Plains in Diked River Areas

Manual for Sustainable Use and Management of Alluvial Plains in Diked River Areas

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Alluvial Plains in Diked River Areas

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INTERREG IIIB CADSES

Phare

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Structure

Introductory messages

SUMAD – Sustainable Management of Alluvial Plains as Element of Preventive Flood Protection

Left: Dipl.-Ing. Claus Kumutat – Head of Unit of Bavarian Rivers and Lakes
Bavarian State Ministry of the Environment, Public Health and Consumer Protection, Munich, Germany
Project leader of the Interreg IIIB CADSES Projektes SUMAD since January 17, 2006

Right: Dipl.-Ing. Martin Grambow – Director General of Bavarian Water Management
Bavarian State Ministry of the Environment, Public Health and Consumer Protection, Munich, Germany
Project leader of the Interreg IIIB CADSES Projektes SUMAD from November 01, 2004 until January 16, 2006

The remarkable increase of "rare floods" has sensitised us to the importance of our protection systems. The people's need for safety is growing, while the anticipated danger of climate change is dictating new priorities in natural hazard management.

Integrated protection systems, as foreseen in the Bavarian Action Programme for Flood Protection 2020 prevail. The flood of 2005 in Southern Bavaria has caused comparatively less damage than a similar event in 1999. This has come as a result of focused interaction between conservation and reactivation of retention areas for controlled flooding and flood protection of inhabited areas on the one hand and land management, early warning and dialog in the field of risk management on the other hand.

In the field of flood protection, as elsewhere, the whole system can only be as strong as its weakest part.

Diked areas play an outstanding role in this flood safety system and are therefore at the core of the SUMAD project – "Sustainable management of alluvial plains in diked river areas". One major incentive for the project was the alarming observation that in certain areas the calculated freeboard was no longer in place. Based on similar observations by our neighbours in Austria and Hungary it became obvious to undertake joint studies. The motivation to do so was certainly enhanced by the pleasant and efficient international exchange of experience at a high technical level. The EU with its Interreg IIIB CADSES programme provided extremely welcome support.

One key finding of SUMAD has been the high impact which the management of alluvial plains has on dike safety. Agricultural use or forests, although ecologically desirable, can constitute severe impediments for the flood runoff. The resulting dilemma in riparian woodlands, which are important in terms of nature conservation and often designated as Natura 2000 site, cannot be resolved easily, whereas it must be clear that safety prevails.

This manual consolidates experiences and findings from the SUMAD project. It provides a comprehensive and practical guidance for sustainable management of alluvial plains, which is targeted at decision makers and users in the areas of nature conservation, land and water management, as well as local authorities. For concrete examples and all surveys and analyses please refer to the attached CD ROM.

The results of SUMAD will influence the maintenance and planning of installations for flood protection. One consequence has been deducted in analogy with corresponding EU projects: Rivers Need Space. The particular potential of this umbrella initiative lies in the comparatively strong involvement of partners from the new EU member states and a special focus on strong future partnerships.

We are proud to say that the SUMAD project has succeeded in presenting trans-nationally and interdisciplinary agreed solutions. We hope you will find this manual interesting and stimulating and we also hope that we have been able to convince you of the importance of preventive flood protection.

Claus Kumutat Martin Grambow

Transnational European cooperation for the development of national and regional concepts for flood protection and dike safety

Univ.-Prof. Dr. Wolfgang Stalzer – Head of Department VII of the Federal Ministry of Agriculture, Forestry, Environment and Water Management, Austria

Water management is shaped by the conflict between protection and usage – this clash reflects the public interest to a large extent. Human interference with the water balance and rivers bears testimony to these conflicting interests, which are themselves subject to a dynamic paradigm change. Original modifications require fine-tuning, adjustment or even complete reworking in order to comply with the latest requirements in flood protection, land management, nature conservation, water protection, water supply etc. as part of an integrated river basin management. This also concerns the impact on the water flow rate caused by development of housing and infrastructure, changes in agriculture and forestry, as well as natural transformations of alluvial planes in diked river areas, which may lead to an increased risk of flooding.

In an interdisciplinary approach the SUMAD project has developed strategies and tools for harmonising the requirements in river basins and alluvial plains in diked river areas. The project contains considerations to support the EU action programme for flood protection and joint planning for transnational rivers in the coming programming period, as well as the implementation of domestic and international European policy goals in environmental protection, such as Natura 2000.

The Austrian water management authorities have joined these efforts in the framework of SUMAD with their subprojects and a contribution on the management of alluvial plains in diked river areas. The aim has been to develop solutions which can also be applied to similar problems in other catchment areas. Ample space has been allowed to developing a multilaterally agreed evaluation of implementation measures taking into account regional/national specifications. Thus the three partners (Austria, Hungary and Bavaria) have developed various concepts and measures for ecologically, socially and economically sustainable flood protection, which are tailored to the specific local circumstances. The innovative approach gained from the project helps to match forward-looking contributions to flood protection and dike safety with sustainable development and usage of rivers and riparian woodlands.

Dr. Wolfgang Stalzer

New perspectives on co-operation in transnational flood protection in the expanded EU

Dipl.-Ing László Varga – General Director of the Middle-Tisza District Environment and Water Authority, Szolnok, Hungary

Several countries have a stake in the catchment areas of the big European rivers such as the Danube and Tisza. As a consequence, close international co-operation is required in the field of water management in line with the European Water Framework Directive. The Bavarian-Austrian-Hungarian co-operation has for decades created an exemplary basis for this goal. During this co-operation water management experts from these countries had the opportunity to get to know each other's procedures and exchange possible solutions for similar problems.

The floods in the last decade have focused and directed the attention to changes in the overflow areas of the rivers, which constitute negative developments in terms of hydraulics. Comprehensive studies have scientifically established the necessity to take measures for improving the water flow rate of alluvial plains. Recommendations for long-term development goals in the catchment areas can be deducted from the results of these studies.

The "Practical guidance for sustainable use and management of alluvial plains in diked river areas" is the core transnational result of the SUMAD project. This manual provides a compilation of the project findings and formulates strategic and practical recommendations for the management of alluvial plains, which can be used by the responsible planners and decision makers.

László Varga

SUMAD Manual for Sustainable Use and Management of Alluvial Plains in Diked River Areas

SUMAD

Sustainable **U**se and **M**anagement of
Alluvial Plains in **D**iked River Areas

Project partners

Germany (Bavaria)
Lead Partner
Bavarian State Ministry of the Environment, Public Health and Consumer Protection (StMUGV)

Hungary
Middle-Tisza District Environment and Water Authority (KÖTIKÖVIZIG)

Austria
Federal Ministry for Agriculture, Forestry, Environment and Water Management (BMLFUW)

1 Abstract

In the past, many rivers have been trained and diked. Recent flood events observed in Bavaria, Austria and Hungary revealed that quite a few diked discharge sections no longer dispose of the required capacity to carry off a design flood without causing any damage.

Within the SUMAD project (acronym for "Sustainable Use and Management of Alluvial plains in Diked river areas"), transnational research into causes has been undertaken and the changes of selected alluvial plains following the construction of dikes have been looked into. On this basis, strategies and instruments have been developed for future management which may equally be applied to other alluvial plains. Apart from granting damage-free flood runoff, issues of ecology, nature protection and development of water bodies must be taken into consideration. The working area comprises the floodplains of a diked river.

The results are presented in the SUMAD Manual for sustainable use and management of alluvial plains in diked river areas. The printed manual gives practical guidelines for the use and management of alluvial plains, drawn from the experience and project results of all three involved European countries. The CD in the annex contains abstracts and complete reports on all relevant research and implementation topics of the SUMAD project.

The manual defines principles as well as strategic recommendations and points out instruments for alluvial plain management. They have been developed on the basis of present uses, demands for use and legal specifications. Alluvial plain management schemes are proposed as planning instruments for managing diked alluvial areas with the overriding target to carry off design floods without causing any damage. They must be implemented within water maintenance measures or development plans. Issues of nature protection (e. g. Natura 2000) and development of water bodies must be taken into account.

Apart from immediate measures ensuring flood runoff in alluvial areas, these management schemes also include medium and long term measures behind the existing dikes in order to extend alluvial plains (extension of the room for runoff, restoration of retention areas) and to restore the river and the floodplains in and outside the alluvial plains. This will contribute to achieving targets to enhance sustainable natural retention, to implement the Natura 2000 network, to conserve and achieve the good ecological potential according to the EU Water Framework Directive and to develop water bodies. With a view to determining spatial and efficient focal points for the different demands considering all issues involved, it is proposed to integrate measures targeted above all at regional issues of alluvial plain management into a supra-regional integrated river basin management.

For planning and implementation of alluvial plain management it is proposed that the planning authority, the authorities to be implied, experts, stakeholders, associations and people concerned (local population) co-operate at an early stage in order to enhance understanding of protection concepts and measures, to defuse potential conflicts and to simplify planning procedures.

Policy makers are asked to involve citizens in the development of action programmes, to inform about measures and to create promotional programmes aimed at the use of grassland in alluvial plains.

This approach has been developed jointly on a transnational level and has been tested and assessed regionally with those involved and concerned (water management, hydropower, navigation, agriculture and forestry, nature protection, municipalities, fishery, tourism and further users and associations).

2 Project targets – problem definition

Rivers and their floodplains are often subjected to varied uses.

Many rivers and floodplains have been diked in order to protect settlements, traffic arteries and to enhance agriculture. Often, there are conflicting demands to the resulting alluvial plains, that is, to the areas between the river and the dike. In the past decades, these demands have often been pursued independently, without sufficient recognition or consideration of effects and relations. Thus, in the course of the years, uses in the alluvial plains have changed. More and more, grassland has been broken up and used for crop growing. Other parts of the alluvial plains are no longer used, and, within a natural succession, shrubs and wood-like stands are developing. Often, such alluvial plains, their habitat types, animal and plant species protected on a European level are designated as Natura 2000 areas.

These changes in land use reduce the runoff capacity and produce a rise in flood levels leading to reduced flood protection of the diked areas. With a view to fighting such development and to granting protection during the runoff of a design flood, immediate measures must be implemented in these diked alluvial plains. If high maintenance costs are to be avoided in the long run, additional measures are required to grant flood protection. These may lead to conflicts with other users.

In the past it was realised that sustainable management of alluvial plains requires to involve all stakeholders in the planning and decision making process. This approach also fulfils the requirements of the EU Water Framework Directive (WFD)[1] The SUMAD project intends to point out necessary steps for such an approach.

Within the SUMAD project, strategies and instruments targeted at sustainable **management of alluvial plains in diked river areas** have been jointly developed on a transnational level by sectoral units in Bavaria, Austria and Hungary and have been implemented regionally. The results are summarised in this manual for sustainable use and management of such alluvial plains. They include short term measures to secure flood safety during underlying design floods. Furthermore, medium and long term concepts for an integrated and sustainable **river basin management** are presented which consider the entire floodplain, that is, the potential natural overbank area in terms of flood retention and runoff, water body development, nature protection, landscape pattern, land use and recreation. In this regard, use and management of alluvial plains is an important part of an integrated flood protection concept.

Strategic as well as practical recommendations for sustainable use and management of alluvial plains in diked river areas are proposed to developers and decision makers. They aim at reducing or clearing up target conflicts arising from different demands to the use of alluvial plains as well as at minimizing expenses for maintenance.

The SUMAD project was funded by the EU programme "INTERREG IIIB CADSES".

[1] Directive (2000/60/EC) establishing a framework for Community action in the field of water policy – Water Framework Directive (WFD)

3 Alluvial plains in diked river areas

3.1 Principles, uses, functions

1. The alluvial plains of diked rivers are part of the formerly natural floodplains, the overbank areas, shaped by man. These areas located between the river and the dike must fulfil requirements of water management, ecology, nature protection and economy.
The requirements are:

- to ensure flood runoff and retention (up to the level of a design flood),
- to serve as habitat, as area of expansion and as network area for fauna and flora,
- to give room to water body development,
- to serve agriculture and forestry,
- to serve as recreation area for people.

2. These functions and a near-natural development of the river and floodplain landscape are granted in expert plans (e.g. development schemes for water bodies, conservation and development schemes according to WFD or Habitats Directive [HD[2]]).

The said schemes consider the entire floodplain (the potentially natural overbank area) and define targets and measures for securing flood runoff, improving natural flood retention, near-natural development of waters and floodplains, protection of species and habitats and landscape patterns. They include statements on land use, conservation of alluvial plains and on ensuring flood runoff. Conservation targets for Natura 2000 areas (pSCI- and SPA-areas) and statements of management schemes according to HD[2] must be considered.

3. The priority task of diked alluvial plains is to grant damage-free runoff of design floods. When defining the design flood, foreseeable changes in hydrology (e.g. climate) and damage potential shall be taken into account.

4. Reducing the water level during floods improves flood safety in the considered diked river section.

5. Measures aimed at use and management of alluvial plains in diked river areas shall take into account targets for water body development and nature protection (in particular Natura 2000). The targets to bear in mind, apart from flood protection (water body development, nature protection), shall be defined individually.

6. For planning purposes it may make sense to divide wide alluvial plains into functional areas for
- flood runoff,
- nature protection and development of water bodies,
- economic use.

The different areas shall then be conserved, used or developed according to their main function. Distinct regulations shall be established for each functional area.

7. Continuous maintenance of alluvial plains is compelling as long as it is impossible to grant more room to the river. Measures maintaining the main function of the area must be binding within the management schemes for alluvial plains. The type of maintenance is decisive for the runoff capacity of the alluvial plain and must be taken into account when drafting schemes (e.g. increase of vegetation due to succession where few maintenance measures are taken). In the medium or long term, expenses for maintenance measures may be reduced to a minimum by increasing the size of alluvial plains (relocation of dikes).

8. Uses corresponding to the designated main function which additionally serve further functions shall be positively assessed. In the best of cases, they increase the degree of sustainability of the use of alluvial plains of diked rivers.

9. In the functional areas, additional functions may be pursued, provided that they do not interfere with the main function.

10. If a use differs from the main function, necessary compensatory measures targeted at conserving the main function shall be considered and implemented.

11. The long-term runoff capacity of alluvial plains shall be proved by hydraulic investigations (normally 2-dimensional hydrodynamic-numerical models). Additionally, scenarios shall be calculated with respect to the long-term development of vegetation (e.g. riparian shrubs, floodplain forest), to modified uses (e.g. agriculture, constructions) and to changes of alluvial plains resulting from aggradation or erosion (morphological changes).

12. This evidence is to be provided for all rearrangement and maintenance measures, as well as for natural changes in the alluvial plains of diked rivers. In this connection, the effects of future measures shall be predicted and taken into account at an early stage. These measures shall not affect flood safety (flood-neutral).

13. As a matter of principle, those in charge of maintaining water bodies shall take measures targeted at maintaining runoff requirements. With a view to sustainability, measures targeted at conserving alluvial plains of diked rivers should preferably be implemented by farmers. These measures will be based on economic investigations, so that financing and funding systems may be developed or adapted.

14. In many river landscapes, neophytic species are wide spread, a development which, in most cases is irreversible. It may hinder all other uses. Therefore, neophytic species must be suppressed as far as possible, provided that, in specific areas, this makes sense and is acceptable from an economic point of view.

15. Legal competences and procedures should be clarified in regulations applicable to individual sectors and across sectors.

16. If the national laws do not already provide for commitment authorizations to claim private grounds, these should be created in order to implement the agreed use and management of alluvial plains in diked river areas.

3.2 Requirements to alluvial plains of diked rivers

A target status (overall environmental concept and visions) based on regional factors should be defined for each river district. In this regard, demands of the different stakeholders shall be taken into account. They are described below.

3.2.1 Water management

With respect to the alluvial plains of diked rivers, the priority targets of water management shall secure design flood runoff (flood protection), to avoid substance inputs, to conserve and if necessary restore the ecological functionality of the river and its floodplain along trained rivers and, if required and possible, to restore overbank areas within the framework of water body development.

Flood of the Danube at Straubing

Flood protection is a priority target in order to avert risks for life and limb, as well as damage to goods and property assets of the riverine population.

In order to ensure flood protection, hydraulic measures and calculations shall prove the required runoff capacity of alluvial plains, taking into account vegetation (e.g. riparian shrubs, floodplain forests), uses (e.g. agriculture) and a rise of the alluvial plains due to sedimentation. In the long run, maintenance measures sustainably secure runoff capacity. Flood runoff shall be ensured in alluvial plains used for agriculture and forestry without creating ecological disadvantages. The cultivation of field crops hindering runoff (in particular corn and sunflowers) should be avoided. As a matter of principle, and with a view to erosion protection, there should be no land cultivation in alluvial plains. A conversion of fields into grassland is desirable. This however presupposes that corresponding cultivation agreements have been made, avoiding additional maintenance expenses.

The relocation of dikes contributes to the restoration of overbank areas (at least in part) and to sustainable flood protection. Extended flood retention is of great importance for the protection of downstream users. Retention is achieved by slowing down flood runoff and by creating additional retention surfaces. At all events, the runoff capacity of the alluvial plains and thus sufficient security of flood protection devices must be granted.

Alluvial plains should have a closed vegetation cover (e.g. grassland) avoiding substance inputs into waters (e.g. surface soil). In general, there should not be any fertilisation.

The use and management of alluvial plains in diked river areas must eventually take into account further water management targets, as well as uses permitted by water legislation. The operation of hydropower plants shall be granted, as well as the necessity to manage low flows according to requirements (e.g. drinking water production, treatment of wastewater inputs, meeting requirements for cooling water, etc.).

3.2.2 Nature protection

Alluvial plains in diked river areas are part of the river floodplains. The natural dynamics of river-floodplain-ecosystems is substantially characterised by varying water levels, overflow during floods, varying groundwater levels as well as erosion, sedimentation and displacement of the water course. The result is a continuous displacement and new development of floodplain sites and communities (e.g. floodplain forests). The overall environmental concept and condition for structural and biological diversity typical of floodplains is that of a functional river and floodplain ecosystem network with hydro- and morphodynamical features typical of the nature area, and a use compatible with floodplain requirements.

From the point of view of nature protection, the particular importance of floodplains lies in their structural richness and their enormous diversity of species. Floodplains function as supra-regional axes in a habitat patch connectivity, they serve recreation, flood retention, groundwater recharge and are main features of landscapes (see picture on the right).

The joint target of nature protection and water management is to restore the ecological functionality along trained waters and overbank areas wherever required and possible. In many cases, these targets are achieved within the development of water bodies.
The following aspects must be considered:

- waters and their floodplains shall be regarded as an entity and be treated as such when planning measures,
- river sections near to the natural state and natural retention areas shall be conserved, developed or restored,
- sufficently big areas must be provided for water body development,
- in unobstructed landscapes, natural displacement of the river bed should enable and enhance autonomous development; management and maintenance will be reduced to what is strictly necessary,
- in all places, where peripheral conditions do not permit any autonomous development, structurally poor river sections shall be designed as nature near as possible,
- in the river as well as in the floodplain a near-natural discharge and transport of solid matter should be strived for.
- additional retention areas should preferably be created by relocating dikes,
- in overbank areas, uses shall be compatible with water management; natural surface retention shall be conserved and enhanced,
- regular/episodic floodings and variations in groundwater level (hydrodynamics) shall be ensured,

Flooded river floodplains

- substance inputs into the water system shall be minimized (nutrients) or impeded (noxious substances),
- plant and animal habitats shall be conserved and, wherever possible, restored,
- habitats (water bodies, floodplains and valley edges) and their cross-links shall be conserved or restored,
- the variety of habitats and small structures typical of the floodplain shall be conserved,
- the diversity and characteristic features of the river landscape shall be taken into account.

In some river landscapes nature protection aims at conserving and developing extensively used meadow landscapes of historic origin as well as their biocoenosis and species.

In many river landscapes, neophytic species are wide spread, a development which, in most cases, is irreversible. If sensible and economically acceptable, these neophytic species are to be suppressed to the greatest possible extent.

Alluvial plain management schemes shall take into account objectives for protection areas (e.g. Natura 2000, conservation targets and proposals for measures within the HD management plans) and interventions shall compensate for applying regulations of nature protection (e.g. rules for intervention and appropriate evaluation according to HD).

3.2.3 Agriculture

Demands of water management and nature protection (among others sufficient runoff capacity of alluvial plains, reduction of substance inputs into waters, ecological functionality of floodplains) imply that crops must not be grown in alluvial plains. These requirements have considerable influence on the framework conditions for farmsteads, i.e. their economic conditions as well as their production technology. Nevertheless, farmsteads and their properties are submitted to social commitments including the tolerance of flood protection measures.
The main requirements of agriculture are:

- land utilisation to the highest possible extent, this means maximising profits while minimising costs and work load,
- production conditions which can be met (crop rotation, machine equipment, professional practice, etc.),
- integrating variations of land use into the strategy of the farmstead.

With respect to agriculture it must be taken into account that management cannot exclusively follow the economic aspect of a short term maximisation of profits. From the point of view of plant hygiene, crop rotation requirements make it impossible to grow certain crops with the highest profit contribution (profit minus variable expenses) too many times in a row on the same soil.

Due to lacking machine equipment, cropping farms are often no longer capable of autonomously managing grasslands. They cannot be converted into livestock breeding farms just because livestock breeding offers more economic possibilities. Considerable investments may entail a long-term determination of the type of production.

All these factors require a fair treatment of agriculture if, results based on consensus are to be achieved in the long run. For public welfare, a balance of interests between economic profit and socio-economic costs must be found in a dialogue between the stakeholders.

3.2.4 Forestry

Intact alluvial forests figure among the most productive land ecosystems. The above average nutrient content of soils combined with a mostly very good water supply and long vegetation periods (mild microclimate in the river valleys) leads to a considerable increase in timber. Groundwater tables varying over a short term press “stale” air out of the soil pores so that oxygen-rich air may sieve in when the groundwater table falls. This additional factor enhances growth and contributes to the structural richness of alluvial forests.

At the time being, and due to the timber properties, the economic significance of softwood-floodplain tree species tends to be low. On the other hand, hardwood-floodplain tree species play a significant economic role for woodland owners, provided that forest management conserves their value. Timbers like oak, ash, elm and birch have multiple uses, they achieve top prices when sold at highest bid and may replace tropical hardwood.

The relocation of dikes can create, additional surfaces for hardwood floodplain stands, or those existing can be reconnected to the surface- and groundwater dynamics of rivers.

Following the heavy surface losses of the past, the increase of floodplain forests ranges among the foremost targets for land-use planning and forest policy. From the point of view of forestry, this is an interdisciplinary high ranking task. However, intact floodplain forests can only develop or be conserved in alluvial plains. Sites on the land side of dams tend to very rapid maturation processes accompanied by an immigration of terrestrial forest species. The typical vegetation of alluvial plains is threatened by more powerful species.

Availability of suitable surfaces and financial investment incentives are important conditions for afforestation in floodplain forests. Dynamic surface and groundwater development is an important basic condition for

typical and intact alluvial forests. These conditions are best fulfilled in alluvial plains which may still be expanded [by dike relocation].

3.2.5 Further requirements

Regional and local conditions may lead to extremely differing demands of other stakeholders to alluvial plains of rivers:

- tourism/recreation,
- fishery (professional fishery and leisure angling),
- municipal development of settlements,
- business and industry, ports,
- navigation.

These demands are taken into account when involving spokespersons of the groups concerned in the planning process of alluvial plain management. The relevance and compatibility of these demands with objectives for water management and nature protection and the determination of priorities as well as decisions with respect to how these interests are enforced shall be considered in interdisciplinary working groups and decided individually for each region (see: “management of alluvial plains in diked river areas”).

3.3 Legal guidelines

Nationally, EU directives, in particular the Habitats Directive (92/43/EEC), the Birds Directive (79/409/EEC) and the Water Framework Directive (2000/60/EC) are not immediately applicable, as they require transposition into national law. Directives only have an immediate effect if a Member State fails to transpose them in time or if transposition is unsatisfactory, if the content of a directive is of absolute or sufficient liability or if the European Court of Justice has stated in favour of immediate applicability. It must nevertheless be assumed that the directives have already been transposed into the law applicable in the Member States or that such transposition will be performed in the foreseeable future, and that the standards set by the directives shall be taken into account when implementing measures or projects within alluvial plain management.

3.3.1 Habitats Directive

Protection under article 6 of the Habitats Directive does not become effective until a member state has reported the area to the Commission and it has been integrated into the list of Natura 2000 sites of the Community. (The respective lists which, in September 2005 were still partly incomplete, are published on the website of the EU Commission.)

Provided that the required protection according to article 6, par. 2 of the Habitats Directive is applied, planning and project interventions in Natura 2000 areas are only possible after strategic environmental (impact) assessment. If the result of this assessment is that the intervention is incompatible, implementation is only possible

- for compelling reasons of prevailing public interest (art. 6, par. 4 of the Habitats Directive) or,
- in areas with priority natural habitat types on behalf of considerations in connection with human health and public safety or,
- following a statement of the Commission, for other compelling reasons of prevailing public interest and accompanied by necessary compensatory measures of which the Member State will inform the Commission.

Flood risk, for example, is a threat to human life and health as well as to public safety and may, in individual cases, justify reasonable interventions in Natura 2000 areas according to HD, provided that required compensatory measures targeted at preserving the overall coherence of Natura 2000 network are taken.

3.3.2 Birds Directive

The individual EU Member States are in charge of pointing out and designating bird protection areas (SPAs). As long as the required steps (so-called “factual bird protection areas”) have not been taken, deteriorations of the site are prohibited. Nevertheless, article 9, par. 1a of the bird protection directive allows to modify the protection rules if public health and safety are at stake and no other satisfactory solution is found.

These bird protection areas according to article 7 of the Habitats Directive are integrated into the said directive once they have been designated by a Member State. Then, art. 6, par. 2 of the Habitats Directive applies, opening up for possible changes (in this case interventions) based on schemes and projects. Prior to such changes impact assessments and corresponding compensatory measures are required.

3.3.3 Water framework directive (WFD)

The WFD aims at a Europe wide improvement of the quality of surface and groundwater. In particular, water management shall be such that a deterioration of the status of waters is prevented (art. 4, par. 2 WFD).

Temporary deteriorations are acceptable, if their causes are of natural origin or unforeseeable and due to force majeure, in particular extreme floods (art. 4, par. 6 WFD).

Furthermore, deteriorations of the physical properties of a water body are tolerable in cases of overriding public interest and if all measures to avoid and minimise impacts have been taken (art. 4, par. 7 WFD).

Deteriorating measures in the sense of the WFD may be justified for reasons of flood protection representing an overriding public interest. However, within the framework of appropriateness, such measures should be limited to unavoidable subzones. On the whole, measures aimed at alluvial plain conservation as defined by the WFD should aim at and achieve an improvement of the status of water bodies.

3.3.4 State laws

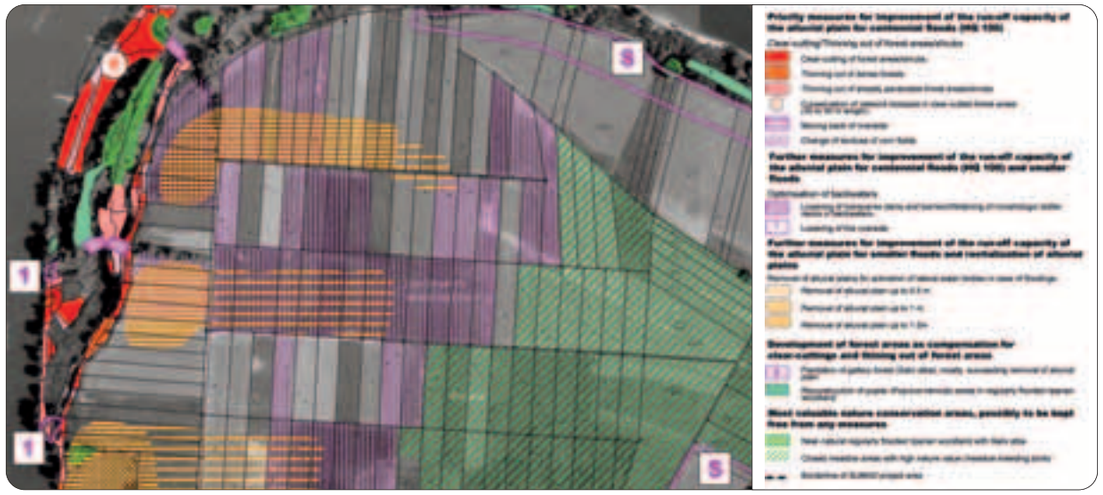
As a matter of principle, EU directives accept higher protection conveyed by state law. Therefore, with respect to conservation measures applied to alluvial plains, the state laws applicable in each member state shall be taken into account. Considering the transnational orientation of this manual, it only refers to publications of laws typical for each state and which may contain further specifications.

[2] Directive (92/43/EWG) for the protection of natural habitats and of wild fauna and flora (Habitats Directive)

4 Alluvial plain management for diked rivers – planning and implementation

4.1 Management scheme for alluvial plains of diked rivers

It is proposed to draft a management scheme for alluvial plains of diked rivers with measures aimed at securing damage-free flood runoff and taking into account ecological water body development, natural retention, landscape features and nature protection. In general, this scheme will present short to long term measures on a scale 1: 5.000 and should be agreed upon with the different groups of stakeholders.



Example of a management scheme for alluvial plains of diked rivers

For the purposes of sustainable river management, all stakeholder groups shall be involved in the planning process.

Alluvial plain management schemes may be based on management schemes and action plans according to the WFD, water body development schemes and management schemes according to the Habitats Directive. If such specialised schemes do not exist at the time of drafting management schemes for alluvial plains in diked river areas, they should be set up at the same time so that targets for flood discharge, natural flood retention and near-natural development of waters and alluvial plains may be fine-tuned. Also, it is recommended to co-ordinate alluvial plain management with all further known planning, such as regional development plans or construction measures at an early stage.

For purposes of national harmonisation, the alluvial plain-management schemes resulting from such co-ordination should follow a uniform model approach. They should at least be valid for a period of 10-15 years and be followed by an evaluation of achievement.

The implementation of alluvial plain management schemes should be monitored by a relevant technical authority. Depending on national structures, monitoring may be done by municipal or regional authorities as well as technical authorities, e.g. water management authorities.

4.2 Steps towards an alluvial plain management scheme

The method described below is based on the experience of working groups with different focal points within the SUMAD project. It has been summarised as general method including elements and possible steps. The final choice and order of the different steps as well as their scope should be based on the individual project and regional requirements (see picture on the right).

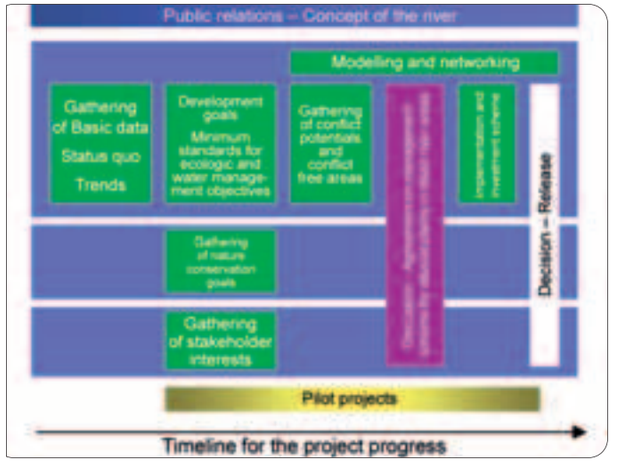
Inventory

Investigations should start with an inventory of basic data and development trends. All relevant documents shall be checked with respect to potential sources of error (e.g. different coordinate systems or reference in altitude). The following issues shall be part of the inventory:

- historical development of the river landscape
- legal specifications and existing legal relationships
- water rights, water abstraction
- protection areas
- fishery, hunting
- hydrological situation, flood runoff
- ecological basis, mapping of valuable floodplain forest structures, backwaters and other habitats, Natura 2000 areas
- eco-morphological structures of waters including a status assessment
- water quality parameters
- water fauna (fish, macrozoobenthos)
- land use
- recreational use
- present spatial planning

Determination of development targets and minimum standards

- Development targets aimed at improving and conserving the ecological functionality while maintaining a certain flood level (design flood)
- Definition of minimum standards to monitor achievements



Steps and development when drafting an alluvial plain management scheme

Inventory of nature protection targets

- Protection purpose or Natura 2000 conservation targets
- Other objectives, e.g. according to landscape plans

Inventory of stakeholders targets

- Identification of stakeholders and their targets depending on the regional situation

Model development and cross linkage

- Development of a theoretical model for conflict situations in specific project areas
- Overall environmental concept: knowledge about the potential state of a water body is the starting point for drafting a sustainable management scheme for alluvial plains

Determination of conflict potential

- Determination of conflict potential with respect to aspects of spatial planning and contents as well as to zones exempt of conflicts – this leads to determining focal points for further work

Discussion and co-ordination

- Discussions with all stakeholders on objectives, conflicts and solution models piloted by water management
- Joint determination of alluvial plain management with definition of spatial assignment of priorities of use

Implementation and investment scheme

- Legal commitments
- Planning of technical projects and constructions
- Development of a monitoring concept
- Adopt and release the implementation and investment scheme (including timetable)

Start of pilot projects

- going on in parallel to the co-ordination process

Public relations (accompanies all phases)

When drafting the alluvial plain management scheme, the public shall be informed about the project and shall participate in the drafting process in order to convey a better “understanding” of the river

4.3 Functional areas and priorities for use

4.3.1 Co-ordination of priorities for use

It is recommended to let all stakeholders and people involved participate in the process from the very beginning, so that conflicts are reduced and possible solutions are jointly developed. It is of equal importance to implement the planned measures as rapidly as possible in order to foster the acceptance by the population concerned. As a matter of principle, public relations work should run in parallel so as to enhance the understanding of citizens concerned and of local politicians and to discuss problems and measures on a broad scale.

It is proposed that conflicts arising from conflicting objectives, in particular when involving demands of water management and nature protection, shall be solved by splitting the alluvial plains into shares with focal points of priority use. The overall aim is to secure damage-free flood runoff taking into account the ecological development of water bodies. The following order and priorities for criteria should be applied when fixing focal points for functions in the alluvial areas:

Criterion 1

- Consider hydraulic investigations of river flow (together with a definition of areas of high runoff capacity)

Criterion 2

- Consider ecological dynamics and functions (together with a definition of the ecologically most valuable areas)

Criterion 3

- Consider demands for surfaces for economic use (in cases of precise need)

These criteria offer a basis for dividing sufficiently large alluvial plains into functional areas.

Based on the afore mentioned criteria, an interdisciplinary committee composed of representatives of all major technical disciplines and stakeholders (at least: water management, nature protection, agriculture, forestry, municipalities) shall determine priorities for use and define functional areas to be documented in the alluvial plain management scheme.

4.3.2 Definition of functional areas

Flood runoff

"Flood runoff" functional areas must secure flood runoff, the main water management function of alluvial plains of diked rivers.

In these areas, all other and eventually conflicting uses are subordinated to this objective. These other uses shall not reduce the flood cross section or deteriorate runoff conditions. In diked alluvial plains the – principally desired – retention effect of alluvial plains is of subordinate importance in so far as the safety of dikes shall not be put at risk.

The long-term runoff capacity of alluvial plains and thus the permanent compliance with the design flood level shall be proved with the help of hydraulic investigations (normally 2-dimensional hydrodynamic-numerical models). The present situation and the expected or targeted long-term development of vegetation (e.g. riparian shrubs, floodplain forests), uses (e.g. agriculture, constructions) and morphology (alluvial deposits, erosion) shall be taken into account.

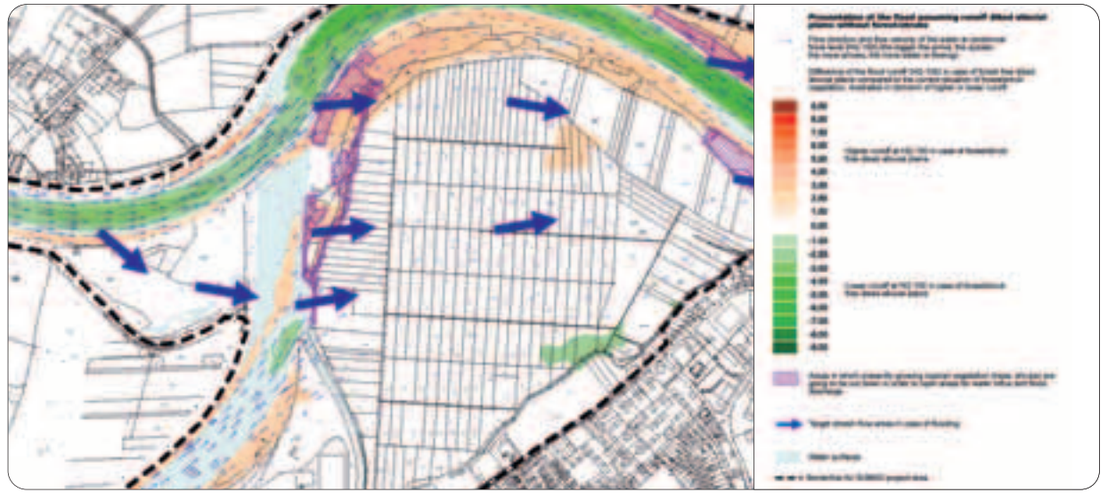
Phased approach

In cases of important demands of other issues (nature protection, water body development) it shall be examined whether flood protection can be ensured by means of alternative short term measures aimed at improving of runoff capacity in the alluvial plain. In this case, medium to long-term measures must also be defined for the diked floodplains. These may include a relocation or opening of dikes in order to give more room to the river. This additional room for the river offers alternatives for combining target values of all interests (flood protection, flood retention, water development, nature and landscape protection, agriculture and forestry).

Nature protection and development of water bodies

The task of the functional areas "nature protection and development of water bodies" is to secure plant and animal habitats as well as ecological dynamics. An important element is to conserve the variety and characteristics of river landscapes as well as the cross-linkage between the water body and its floodplain or alluvial plain (Natura-2000 areas, nature reserves or other valuable habitat complexes). To this end, an overall ecological concept will be drafted including regional differentiation and taking into account nature protection.

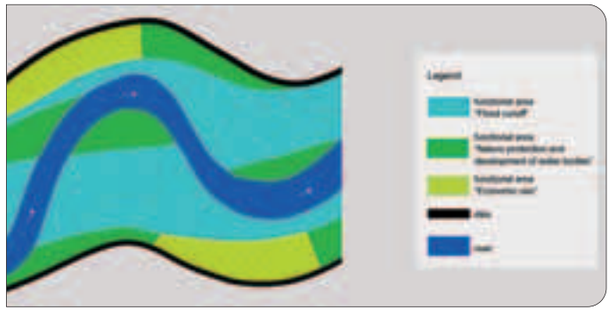
In these areas, other uses are only permitted if they do not deteriorate ecological functions and processes.



Example of a calculation of the flow situation in a 2D-model aimed at defining measures for alluvial plain management

Economic use

The functional areas „economic use" aim at conserving agricultural use and forestry use which is not conflicting with the other main functions in the alluvial plains of diked rivers. This includes development of tourism and recreational use. Industrial uses in alluvial plains (e.g. harbours) are only admitted in exceptional cases.



Functional areas in the alluvial plain

4.4 Experience drawn from pilot projects – principles and measures

Within the SUMAD project, and based on the principles developed, a number of measures have been examined and implemented in pilot projects aimed at ensuring damage-free flood runoff, and taking into account ecological development of water bodies. The recommendations based on these projects are designed to give ideas and indicate possible solutions.

Principles to be applied

- The effects of measures enhancing runoff must be proven by hydraulic calculations and, eventually, physical model experiments.
- Reductions of the discharge section which may e.g. be due to the overriding importance of particularly protected nature areas or objects must be compensated by adequate measures and on the basis of alluvial management plans without influencing the water level.
- Location and extension of the „flood runoff" functional areas may, in a first phase, be estimated in the form of effective areas for runoff based on morphology. Testing, adaptation and final determination of these areas will be based on a hydrodynamic-numeric modelling (1D, 2D) taking into account the tolerable flood level. (see picture above)
- When constructing new or rehabilitating existing dikes, the model calculations should consider the foreseeable development of hydrology, construction, use and natural succession during a period covering at least 15, in certain cases 50-100 years.
- The „flood runoff" functional areas should be determined in a legally binding form.

Agriculture and forestry should be carried out while the main function "flood runoff" is maintained and should, if possible, also fulfil ecological functions.

- The determination of the functional areas „nature protection and development of water bodies" shall be based on national or European categories of existing protection areas (e.g. nature conservation areas, Natura-2000 areas and plans for development of water bodies). Furthermore, such areas are to be considered, which are of importance for a functional, cross-linked ecosystem of the river, its floodplain and the equivalent typical structural and biological diversity of the floodplain.
  Their location and size must be co-ordinated with the spatial demands of the "flood runoff" functional areas. An overall nature protection concept will be drafted with respect to development aspects, determining minimum criteria aimed at conserving the ecological functions (e.g. room for river and floodplain development).

- The expansion of alluvial plains by relocating dikes may be an effective possibility to minimise conflicts of use. However, as additional aspects are concerned, these measures often give rise to new conflicts.

- In certain river landscapes, the objective of nature protection is to conserve and further develop historical and extensively used grass landscapes with their biocoenosis and species. This also serves flood protection.

- As a matter of principle, it must be avoided to strengthen the runoff capacities in alluvial plains with floodplain forests by thinning out forest undergrowth and pruning trees up to flood level, as this work has to be carried out regularly, at high costs and considerably intervenes with the natural balance. The target is not a "well-kept", that is thinned out wood (without undergrowth and a crown above flood level). As far as necessary, runoff depressions and open strips are preferred, where shrubs are removed.

- Open runoff strips as grassland and open wetland habitat types may be compatible with requirements of nature protection.

- Levelled grassland should be optimised with runoff channels (depressions) contributing to achieve both water management and nature protection targets.

- From the point of view of nature protection, coppicing is acceptable in softwood-floodplain sections.

- Agriculture is accepted, if inputs of noxious substances into the water body are avoided and year-round soil cover (avoiding soil erosion) is granted.

- Land owners should voluntarily decide to cultivate alluvial plains on the basis of relevant management schemes. Such cultivation should be financed by funding programmes for agriculture.

- Legal regulations obliging farmers to a certain form of cultivating property in the alluvial plain should only be applied in extreme cases.

- Recreational uses and tourism are not fundamentally excluded in alluvial plains of diked rivers.

- Business and industry should basically be banned from alluvial plains. Exemptions apply to the protection of existing installations and uses in connection with water, such as ports.

On the basis of these principles to enhance runoff capacity, the following measures may be taken:

- Reduce the roughness of alluvial plains in diked river areas by changing arable land into grassland
- Reduce the roughness of alluvial plains in diked river areas by thinning out shrubs

Thinning out shrubs in alluvial plains (before/after)

- Remove obstacles to runoff (constructions, vegetation, etc.)
- Remove bank aggradations
- Remove alluvial deposits and mounds in the alluvial plain
- Create flood depressions also serving as backwaters or periodical wetland habitat
- Widen the river bed by guided displacement of the course of the river, that is, by redesigning due to river dynamics after removal of bank stabilisations, simultaneous monitoring of the displacement and securing pre-set limits.

Widening the river bed/bank renaturation (before/after)

- Widen the river bed by construction operations
- Reconnect cut-off river branches and oxbow lakes
- (Re-)locate dikes and create runoff corridors, floodable areas and riparian forests

Relocation of dikes

4.5 Transnational problems

Additional problems are to be expected when treating transnational river systems and must be taken into account or solved at an early planning stage. Important aspects of alluvial plain management for diked river areas are among others:

- different languages, language barriers,
- different ordinate systems of planning bases
- different design levels,
- different flood protection concepts and degrees of flood protection (development targets),
- different demands regarding alluvial plains of diked rivers.

5 Recommendations

Sustainable management of alluvial plains of diked rivers is an important aspect of flood protection, but can only be considered as part of an integrated flood protection concept. It is developed in the middle and lower reaches of a diked river. Alluvial plain management can only contribute to overall flood protection when combined with other measures, such as preventive flood protection, technical flood protection and flood control. Retention basins in the upper reaches of a river or management of flood control storages (flooding reclaimed land) in the middle and lower reaches may significantly reduce runoff.

It is perfectly obvious that flood control must be acceptable from a socio-economic point of view. In the long run, concepts must be safe and affordable. European as well as global development (e.g. consequences of climate change) shall be taken into account when developing national and regional programmes.

Besides this necessary and integrated technical approach, policy makers must create the framework conditions for sectoral co-operation and co-ordination of water management, nature protection, agriculture, forestry and spatial planning. Apart from serving the objective of water management to secure the safety of dikes on the short, medium and long term, an integrated flood protection concept shall take into account sufficient protection of natural habitats and resources as well as the specific interests of different groups of land users.

The co-ordination of the different demands to alluvial plains shall be included into the management schemes for alluvial plains and the respective measures shall be determined in appropriate, legally binding forms.

Wherever possible, agricultural use of alluvial plains should be converted into grassland management. Since, in many places, grassland management is unprofitable to agriculture, grassland may often only be conserved by grassland husbandry entailing permanent expenses and efforts. In order to achieve grassland husbandry within agriculture, agricultural funding programmes will be created on a national level. These funding programmes would be part of the second financing pillar of the European Agricultural Fund for Rural Development (EAFRD) for the implementation of environmental measures in agriculture.

Focussing on the „elements" of sustainable use and management of alluvial plains in diked river areas, the SUMAD project within the INTERREG III B CADSES framework points out possibilities to develop a co-ordinated concept by applying an integrated approach involving all relevant disciplines to be implemented in pilot projects. In future, constructive co-operation of the different stakeholders and land users should be continued and intensified. Policy should integrate the concepts resulting from interdisciplinary co-operation into existing action programmes.

Furthermore, it is the role of policy to involve citizens in the development of the corresponding action programmes and to inform them about measures planned.

6 Annex

6.1 Glossary

Floodplain
Potential inundation area of a river before construction of dikes.

River basin management
Integrated approach to a river basin. Co-ordination of all planning and communication tasks. Dialogue of all stakeholders (experts, people affected, etc.).

Apart from the alluvial plain, sustainable river basin management includes natural floodplains and inundation areas behind the dikes und thus creates the prerequisites for a compelling integrated approach. By giving more room to the river, the indicated objectives for flood protection, water body development and nature protection may efficiently be implemented, simultaneously taking into account realistic possibilities.

Bank aggradations
Bank aggradations (levee banks) are embankment-like aggradations of the river bank created by deposits (sedimentation). They develop when water tops the banks and flows into the alluvial plain, reducing flow velocity and depositing fine particles.

Bank aggradations

Alluvial plains
The alluvial plains are areas which, at mean water flow lie between the river and the dike and are more or less periodically or episodically flooded.

Alluvial plain management
Guidance of development and maintenance measures aimed at securing flood protection targets on the long term and at conserving, restoring and enhancing ecological functionality of waters and their floodplains in the alluvial plain of diked rivers on the long term with a minimum of management interference. It must take into account objectives of eventually existing other uses.

Management scheme for alluvial plains of diked rivers
Scheme comprising the framework structure for all measures aimed at securing flood runoff; takes into account objectives of nature protection and water body development as well as of eventual other uses; should be integrated part of a water development scheme. When drafting management schemes for alluvial plains, schemes based on scientific findings pointing out the objectives for the river-floodplain-landscapes (e.g. water body development schemes or HD management schemes) should be taken into account.

6.2 Strategic recommendations addressed to the EU

Within the framework of SUMAD, an INTERREG III B CADSES project, an interdisciplinary work process was initiated aimed at co-ordinating requirements of water management in diked river sections (runoff capacity) with interests of nature protection, agriculture and forestry. Basic scientific research (hydraulic model development) led to findings that vegetations in the alluvial plains and particular agricultural uses may interfere with runoff capacity during floods and thus eventually pose a threat to the safety and security of dikes.

Regarding the serious impacts of specific kinds of use of the alluvial plains (e.g. corn growing) on water runoff, the SUMAD project recommends a legal framework stating that all uses of alluvial

plains other than those provided for from the point of view of water management or ecology should only be possible in the sole responsibility of the initiators, i.e. without compensation for eventual losses. Eventually, liability regulations must be determined including damages caused to third parties (e.g. due to breaches of dikes or erosion).

Also, nature protection objectives for the conservation and development of water bodies and river floodplains must be compatible with those applicable to flood protection. A management scheme for alluvial plains shall be drafted, reconcile the different demands to alluvial plains and determine appropriate and legally binding measures.

7 List of project reports and surveys (CD)

CD is enhanced on the last page

01_Leitfaden_Vorlandbewirtschaftung	Haimerl, G., Kettler-Hardi, S. & Lovas, A. (2006): Leitfaden für nachhaltige Vorlandbewirtschaftung
02_Manual_Management-Alluvial-Plains	Haimerl, G., Kettler-Hardi, S. & Lovas, A. (2006): Manual for Management of Alluvial Plains in Diked River Areas
03_Kurzfassungen_Deutsch-Ungarisch	Abstracts original language
04_Abstracts_English	Abstracts English
Austria (A)	**Working group Austria**
	The following persons co-authored the report: Maier, C., Haider S., Mader, H., Schober, S., Holler, C., Tomasits, S., Artner, R. & Fink, P.
A1_Alluvial-Plains-Diked-Rivers-Concept	Maier, C., et al. (2006): SUMAD management plan for alluvial plains
Germany (D)	**Working group Germany**
D02_2D-Hydraulic-Modelling	Haimerl, G., Kröbl, P. & Kettler-Hardi, S. (2006): Historical development and investigation into scenarios with the help of a 2-dimensional HN-model
D03_Roughness-Cornfield	Hartlieb, A. & Strobl, T. (2005): Roughness of corn fields
D04_Vegetation-Structure-DEG	Herrmann, T. (2004): Mapping of the vegetation structure in the alluvial plains of the Danube river between Straubing and Pfelling
D05_Agriculture-Economy	Schwarz, T. (2005): Concept for land use and agroeconomic investigations
D06_Management-Plan-Danube	Herrmann, T. (2004): Maintenance and development plan SUMAD area Straubing – Pfelling
D07_PP-Beaver-Management	Schwab, G. (2006): SUMAD: Managing beavers
D08_PP-Renaturation	Herrmann, T. & Sundermann, J. (2005): SUMAD pilot project 2 “Pillmoos backwater”
D09_2D-Hydraulic-Modelling-Sedimentation	Nujic, M. (2005): Alluviation in the alluvial plains of the Danube downstream the Vohburg barrage
	Elsner, T. (2005): Morpholgical studies into the section of the Danube between the Vohburg barrage and the B299 bridge across the Danube at Neustadt upon Danube
D10_Ecology	Krüger, G. (2005): Ecological project monitoring – Section of the Danube between the Vohburg barrage and the bridge at Neustadt
D11_Vegetation-Structure-IN	Ludwig, T. (2005): Survey of vegetation units and structures in the alluvial plains of the Danube between Vohburg and the bridge across the river at Neustadt relevant for runoff

D12_History	Krüger, G. (2005): Historical research, section of the Danube between the Vohburg barrage and the bridge at Neustadt (land use, editor´s note)
	Wasserwirtschaftsamt Ingolstadt (2005): Historical research, part hydraulic engineering and hydraulics between the bridges of Großmehring and Neustadt
D13_PP-Dike-Relocation	Krug, M. (2005): Relocation of the left bank dike on the Danube at Pförring: Explanatory report accompanying the construction draft; documentation of ground water simulation model for capturing the current and forecast status
	Kunzmann, G. & Schittenhelm, J. (2006): Relocation of dike: Enviromental compatibility, accompanying planning in landscape planning and compatibility with HD directive
D14_PP-Solid-Management_Alluvial-Forest	Wasserwirtschaftsamt Ingolstadt (2006): Pilot project 7 – Retention of solids; Pilot project 5 – New planting of floodplain forest

Hungary (HU) **Working group Hungary**

The following persons co-authored the report:
Bancsi, I., Czeglédi, I., Csibrán, Z., Fazekas, H., Ivaskó, L., Kertai, I., Kovács, S., Lovas, A., Nagy, I., Szécsi, K., Szigligeti, B., Vajk, Ö., Varga, L. & Váriné Szöllösi, I.

HU15_Stream-Flow-1D	Varga, L., et al. (2005): Lefolyási koncepció – Vision for Stream flow
HU16_Scenario-Analysis	Varga, L. et al. (2005): Szcenário analizis – Scenario analysis
HU17_Future-Prospect-Water-Bodies	Varga, L. et al. (2005): Víztestek és hullámterek jövöképe a NATURA 2000-nek megfelelöen – Future prospects for water bodies and alluvial plains in compliance with NATURA 2000
HU18_Landuse-Catalogue	Varga, L. et al. (2005): Megfelelö területhasználat katalógusa – Catalogue of appropriate forms of land use
HU19_Flood-Protection-Concept	Varga, L. et al. (2005): Integrált árvizvédelmi koncepció – Integrated flood protection concept
HU20_Development-Networking-Coordination-Concept	Varga, L. et al. (2005): Együttmüködési, koordinációs koncepció – Development of a networking and co-ordination concept
HU21_Coordination-Concept-Agriculture	Varga, L. et al. (2005): Együttmüködés a mezógazdasági földtulajdonosokkal – Coordinational concept with agricultural stakeholders

Transnational working group

Report_Basics-River-Modelling	Haimerl, G. (2006): Report on the model techniques and experiences of SUMAD – "Good practice guide"

Other reports

Report_Impact-Vegetation-Runoff-Capacity	Hartlieb, A. (2006): Impact of vegetation on runoff capacity

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