

## **The Nature Oriented Flood Damage Prevention (NOFDP) Project**

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**Abstract:** It has become evident that with regard to flood damage prevention and ecological improvement the implemented measures can be either complementary or conflicting.

During the last century flood damage prevention was based on purely technical structures to control water levels. After several severe floods in the early 90's the International Commission for the Protection of the Rhine (ICPR) developed the "Action plan on flood defence". Restoring the former natural floodplains and increasing natural water conservation in the entire catchment a first approach was introduced towards an equitable consideration of economical, ecological and spatial planning aspects in the management of water-systems. A basic future requirement is the development of catchment wide integrated planning methodologies for soil, water and infrastructure systems.

The overall objective of the Nature Oriented Flood Damage Prevention (NOFDP) project is to develop an information and knowledge base as well as decision support tools to assist in making optimum decisions for riverine planning considering flood damage prevention, spatial development and ecological improvement for river corridors. The active involvement of planning authorities contributing potential investment projects to the NOFDP project will ensure a project outcome that is feasible for real world application.

To facilitate the decision making process NOFDP will develop eco-hydrological software to forecast and evaluate the ecological and hydrological effects of planning scenarios on river corridors. Herein it is important to assess the effect of small and medium scale measures as part of integrated river basin management. While the effect of a single small-scale flood defence measure on downstream flood water levels is known to be minimal, whereas a network of measures might have significant effects. Therefore an integrated view, both in the hydrologic and the environmental sense, is most important. It is significant to convince the local population of the necessity to improve both spatial flood storage and the ecological state of river corridors. It is essential to further develop the common sense of upstream and downstream regions to do whatever is feasible technically and economically being socially and ecologically positive at the same time.

Funding is being requested under the INTERREG IIIB NWE programme. As a preliminary result the proceeding, methodology and organisational structure of the NOFDP project will be presented as being demonstrated in the application form that will be submitted for the 4th call in autumn 2003.

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## INTRODUCTION - FLOOD DAMAGE PREVENTION AND THE ASPECT OF ECOLOGY

The importance of the ecological status of the water body, adjacent riverine ecosystems and catchments has increased with the implementation of the EU Water Framework Directive (EU-WFD). In article 1 the EU-WFD demands the prevention of further deterioration as well as protection and enhancement of the status of the aquatic ecosystem and, with regard to their water needs, of terrestrial ecosystems and wetlands directly depending on the aquatic environment.

Logically, the ecological functionality and resulting value of riverine ecosystems will be affected by technical structures such as weirs, dams, dikes, the river morphology itself and in interdependence with these driving forces by corresponding water quantity and quality. Spatial water conservation is complementary to flood damage prevention. Technical measures in stream channels and also in riverine morphological structures, however, often have considerable conflict potential with regard to nature preservation and improvement.

EU member states have to achieve the objectives of good status of water bodies by defining and implementing necessary measures within integrated river basin management plans. As there are evident functional interdependencies between flood damage prevention measures and riverine ecological status one logical sub-issue of the EU-WFD should be the combined consideration of flood damage prevention strategies together with the ecological status of surface water body and adjacent riverine ecosystems concerning their hydrological, hydraulic and morphological characteristics. This combination, however, has not been formulated in the EU-WFD yet.

Optimum decision making – the NOFDP approach

Decision making with respect to both flood damage prevention and ecology is a multi-objective task that leads to complex planning processes with a high degree of political cross sector integration. The description of the water system by hydraulic parameters only such as maximum discharge or water level is not sufficient in this respect. Introducing the good ecological status of the water body and adjacent ecosystems as target values the future status of the ecological system due to changing hydraulic conditions must be considered and thus predicted. A first step towards ecological flood damage prevention was the restoration of former natural floodplains along the River Rhine after the severe floods in the early 90's (ICPR 1995). Furthermore, spatial planning instruments and their impact on the future use of river corridors have a significant impact on former purely technically oriented flood damage prevention strategies (IRMA-SPONGE 2002).

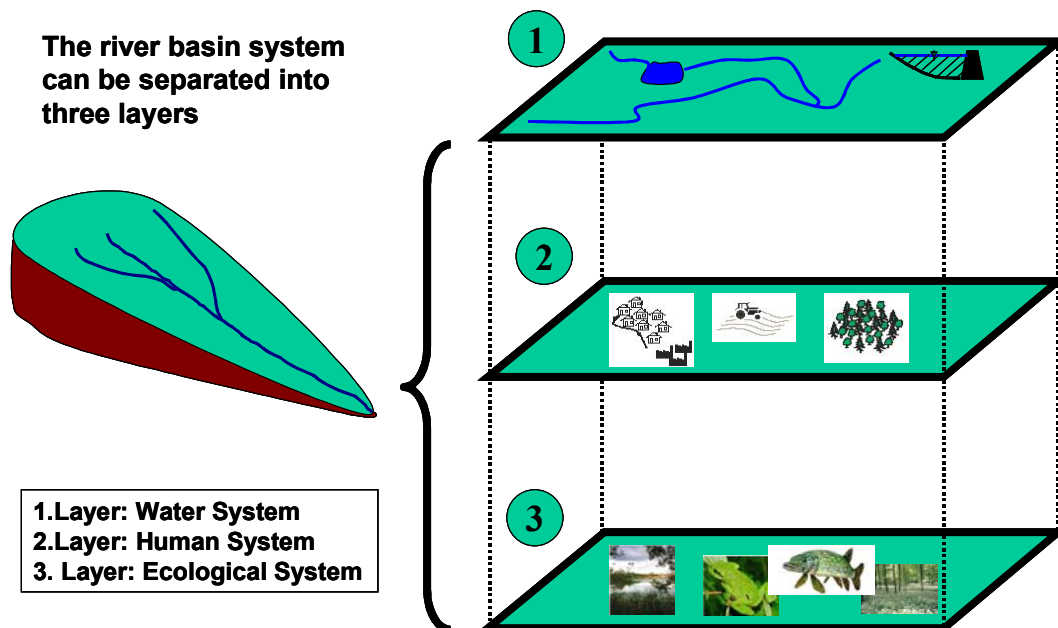


Figure 1: The three layers approach

Within NOFDP a three layer approach is introduced. The first layer represents the water system itself, the second the human infrastructure inclusive land use and the third layer integrates the status of ecosystem functionality of the whole river ecosystem. This system is embedded in a political framework of decision making. For this reason decision making process with respect to integrative flood damage prevention is linked with assessing the possible future status of the three layers.

Therefore, target values must be defined, assessed and evaluated taking into consideration the objectives “flood damage”, “ecological damage” and “spatial development”. Considering this variety of target values a multi-sectoral as well as a multi-objective planning approach must proceed the decision making process as shown in Fig. 2.

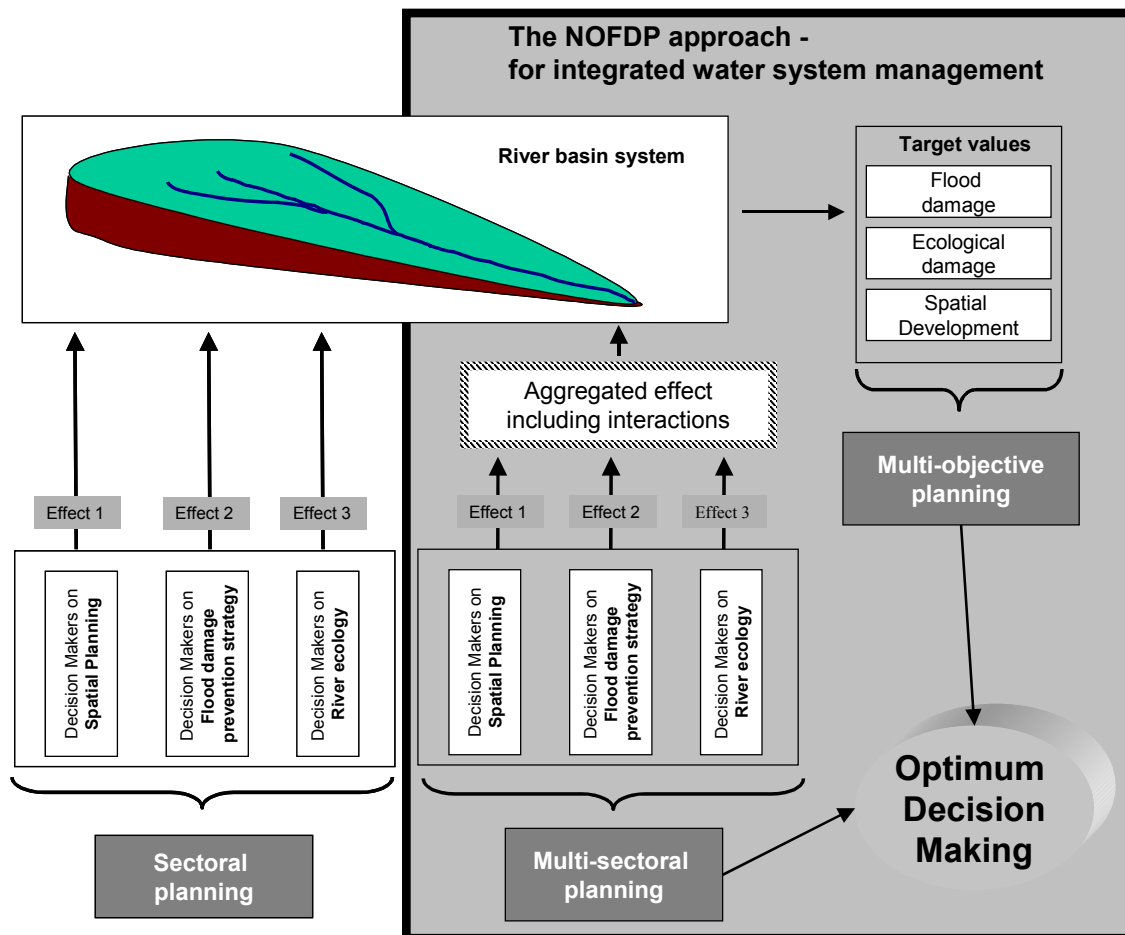


Figure 2. The NOFDP approach for optimum decision making

Each decision will consequently cause an anthropogenic impact with direct and feedback effects on the three layers system. This requires an integrative planning process involving knowledge on ecosystem interrelations and including those decision makers having control of the river system by planning measures. Following this concept the future development of river systems can be understood and positively influenced.

## NOFDP PROJECT - CONCEPT

NOFDP stands for Nature Oriented Flood Damage Prevention and was launched in November 2002 by the following group of partners:

- Darmstadt University of Technology (Germany) / Department of Engineering Hydrology and Water Resources Management
- Federal Institute of Hydrology (Germany) / Section Ecological Interactions

- Provincie Noord-Brabant (The Netherlands) / Watersection

Later on this consortium was joined by

- Ministry for the Environmental, Agriculture and Forestry in Hesse (Germany)
- Provincie Vlaanders (Belgium) / Watersection
- Royal Haskoning b.v. (The Netherlands) / Spatial Planning

Funding is applied for from the INTERREG IIIB NWE Programme that has the objective to achieve a more cohesive, balanced and sustainable territorial development in the Community and better territorial integration. The INTERREG IIIB NWE Programme follows up from the INTERREG IIC NWMA (North-Western Metropolitan Area) Programme implemented over 1998-2001. The application form will be submitted for the 4th call in autumn 2003.

The overall objective of the NOFDP project is to develop an information and knowledge base as well as decision support tools to assist Member States of the NWE-Region in making optimum decisions for riverine planning considering flood damage prevention, spatial development and ecological improvement for river corridors. NOFDP will concentrate on the assessment of the role and effect of small and medium scale measures as part of integrated river basin management. While the effect of a single small-scale flood defence measure on downstream flood water levels is known to be minimal, an integrated view, both in the hydrologic and the environmental sense, is most important.

There are two mayor expected deliverables from NOFDP. The first is a decision support tool and as a consequence thereof the development of a suitable model base. The second mayor one is the realisation of several real world investment project according to the NOFDP approach.

## **IDSS**

Each decision making process is based on the valuation of target values using an evaluation scheme. To assess these values a suitable model-base as well as an evaluation scheme must be available.

To integrate the objective of ecology into the decision making process the NOFDP project develops eco-hydrological software to forecast and evaluate ecologic effects of planning scenarios on river corridors. Ecological response to flood damage prevention scenarios will be forecasted by ecological models calculating water dependent habitats of selected ecosystem elements due to abiotic site factors. Main driving force (model parameter) of the ecological model will be hydrologic parameters (e.g. duration of flooding, water stage) provided by the model TALSIM. The TALSIM model is a generic model for the hydrologic simulation of water resources systems. Developments of the Integrated Floodplain Response Model INFORM (BfG 2003) and TALSIM (Sydro Consult 2000) will be the main part of the model-base of the decision support tool. As validity of ecological models sometimes is limited to regional scale, existing models have to be adjusted to the natural set up and ecological pattern of investment project areas. To accompany and assist investment projects during the planning process, future scenarios comprising a set of alternative flood damage prevention measures will be analysed in terms of ecological and hydrological impact caused by each planning alternative.

Relevant data and results will be stored in a GIS, as part of the information system. Together with existing hydraulic and groundwater models a suitable model-base will be provided to be integrated into an Information and Decision Support System (IDSS) as indicated in figure 3. Furthermore NOFDP develops an evaluation scheme adopted to the needs of an multi-sectoral as well as multi-objective planning process. Therefore, future scenarios of flood damage prevention measures will be computed demonstrating hydrological and ecological impacts followed by an evaluation of the modelled scenarios giving feedback to the planning process.

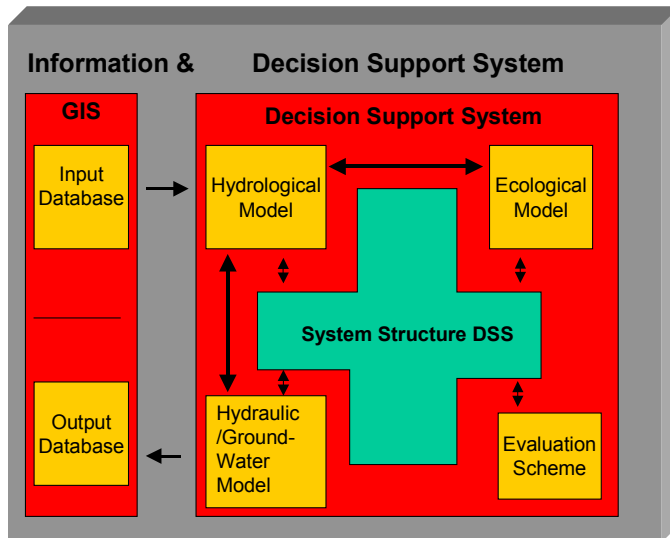


Figure 3. IDSS structure

## Investment Projects

Planning authorities will be actively involved in the development of the IDSS by the integration of several real world investment projects, located in Flanders (Belgium), Region Noord Brabant (the Netherlands) and South Hesse (Germany). First this selection of location aims at the integration of experiences with different national administrative structures and regional distinctions into the overall generic concept of NOFDP. The application of the IDSS to the NOFDP real world project will foster the further development of the tool and on the other side will improve the status of planning with respect to ecosystem functionality. This is to ensure a project outcome that is feasible for real world application and in line with the NOFDP approach.

## Introduction

Downstream of the City of Breda / The Netherlands along the river Mark a polder is envisaged to be used as a storage basin for flood prevention of the city. The decrease in water level as a result of the storage basin is sufficient to attain a protection of the city against floods with a recurrence interval of 100 years. At present the area is mainly used for agriculture but also is part of the ecological development plan of the Province of Noord-Brabant. Except for a dairy farm no other buildings exist in the area.



Figure 4. Location of the polder project

### **Multi-objective planning**

The polder area envisaged as a flooding polder basin has a surface of 300 hectares. The flooding for flood control is estimated to occur 1/20 years. Then the area will be covered for only a limited number of days from 4 – 7 days. The short duration of the flooding which will occur in the winter period will not hamper the present agricultural practices in the polder during summer. Farmers will have to be compensated for using the area as a flooding polder basin.

There are also opportunities for nature-oriented farming and restoration of former meadows and wetlands. This could be combined with re-establishing the historical drainage canal patterns typical for the area before the land consolidation of the eighties. Re-excavating former meanders in the floodplain as biotope for aquatic species will restore the river ecosystem in that specific section. Furthermore, along the river natural flood banks, floodplain forests, flood plain grasslands and moors can be created as a restoration of the former natural situation. Cultural historic elements and structures such as former Merovingian settlement and the old dikes can be part of the landscape. Located near to the City of Breda cycle tracks and footpaths promote recreation in the area.

A preliminary design for the development of the Haagsche Beemden has been completed. Finalizing this design will require the cooperation between a large numbers of partners as Water boards (flood control, restoring river ecology), City of Breda (spatial planning, recreation), nature organizations (restoring of nature, recreation), Province of Noord-Brabant (spatial planning, nature, recreation), farmers (keepers of the landscape, nature management) and inhabitants of the city (recreation, nature).

### **NOFDP**

From the basic problem description and from the case study presented it becomes evident that some formalised generic planning and decision making approach is most desirable to tackle multi-objective problems with multi-criteria assessment criteria. The NOFDP concept has been developed to provide such a tool to assist planners in presenting feasible scenarios to decision makers effectively in a transparent manner to identify acceptable solutions for nature oriented flood protection.

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