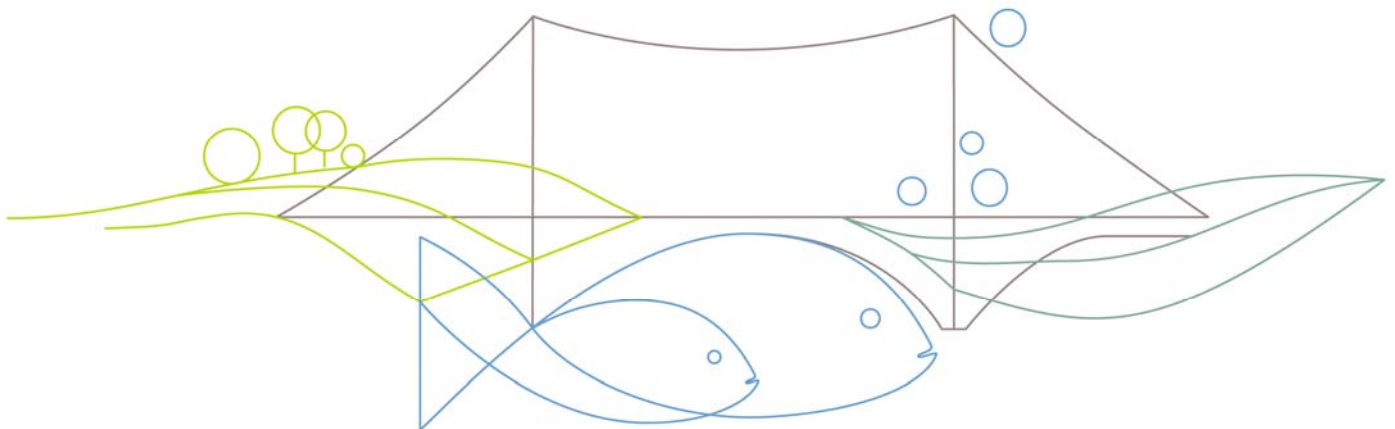


Nr. 28

Mitteilungen

Possibilities to improve the ecological status of
Federal waterways in Germany

A collection of case studies



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Koblenz, March 2009

Fachliche Bearbeitung in der Bundesanstalt für Gewässerkunde

Compiled and edited by the Federal Institute of Hydrology

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**Unter Mitwirkung des Bundesministeriums für Verkehr, Bau und
Stadtentwicklung (BMVBS)**

*In cooperation with the Federal Ministry of Transport, Building and
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1 Motivation and objective

The mission of the German Federal Waterways and Shipping Administration (*WSV*) is the development and new construction as well as the maintenance of Federal waterways as transportation routes. However, being surface waters, Federal waterways also have a multitude of functions in the natural balance, and they are - last but not least - habitats of plants and animals that deserve being protected.

The Act on Federal Waterways (*WaStrG*) stipulates that in waterway maintenance, development and new-construction projects the requirements of the natural balance have to be taken into account, and the appearance of the water landscape and its recreational value must be considered. The natural foundations of life must be preserved, and the management objectives of the Water Framework Directive have to be considered (see § 8 (1) and § 12 (7) *WaStrG*).

Moreover, the *WSV* has to observe the legislation on the protection of nature in the administration of the Federal waterways. To mention the most important: the regulations on interventions into nature (§§ 18 ff *BNatSchG* [*Federal Nature Conservation Act*]), the protection of areas and species pursuant to the Habitats Directive (FFH), and the national legislation on the protection of species. In application of these regulations, the *WSV* may be obliged to implement measures for compensation or for the protection of the overall coherence of Natura 2000 areas (see § 34 *BNatSchG* on FFH compatibility assessment and § 42 *BNatSchG* on species protection).

Another legal basis for projects reaching beyond the transportation purpose is the *WSV*'s responsibility as the owner of the Federal waterways even for the maintenance for water management purposes, provided regulations of the Federal States do not rule otherwise (see § 29 (1) *WHG*). The extent of the maintenance for water management purposes is defined in Article 28 of the Federal Water Act (§ 28 *WHG*) and the applicable legislation of the Federal States. Pursuant to Article 28 *WHG*, the maintenance for water management purposes of a water body comprises its care and development. It has to be based on the management objectives of the EC Water Framework Directive (WFD), must not threaten the achievement of these objectives, and must meet the requirements of the programmes of measures.

Because of the partially decade-long practice of handling these requirements, the *WSV* has long experience with pertinent ecologically oriented measures on Federal waterways. These experiences result primarily from the implementation of the regulations of interventions pursuant to the Federal Nature Conservation Act (*BNatSchG*) in the framework of new-construction and development projects, but also from the practice in maintenance. Projects whose compatibility with uses is proven may serve as examples in the implementation of programmes of measures according to WFD for Federal waterways, and some of them have been included in a documentation of case studies of the European Commission for good management practice (*EU-Kommission, 2006*). Furthermore, these projects may also be

employed for nature-conservational objectives like management plans pursuant to the Habitats Directive to eliminate deficits of riverine habitats.

In order to document and bundle this mostly de-centrally existing experience-based knowledge and to make it useable for future projects, also with view to the requirements of maintenance for water management purposes, the "collection of case studies" described in the following shall also serve as an aid in the implementation of the WFD, but also for issues of nature conservation or landscape management. It addresses the *WSV*, the authorities of water-resources management and nature conservation as well as thematically involved third parties.

2 Background

Streams and rivers - as essential habitats and lifelines of the balance of nature - have experienced for long times significant modifications in their natural diversity of forms by transformation for navigation purposes and other uses like e.g. hydropower generation, flood defence as well as urbanization. The consequence of these modifications is a continuing impoverishment of biological diversity through impairments or losses of the typical habitats. In waterways this affects in the first line fish and macrozoobenthos, but also other groups of animals like birds, amphibians, and water-dependent mammals as well as the vegetation. Stresses of water quality play today a more subordinated role for the biological colonization of Federal waterways. On the contrary, it is the structural impoverishment of the waters that is held responsible for the biological deficits.

Characteristic changes in the diversity of forms of running waters have been systematically identified and documented in the past few years with campaigns of structural mapping for the German network of waters. Typical modifications of Federal waterways affect first and foremost the function complexes "morphology" and "hydrology":

- > Changes in planform (cut-offs, rectifications)
- > Fixing of the riverbed (bank stabilization, groynes, dams)
- > Changes in geometry (width-depth ratio and variability by fairway design, deepening and levelling of the riverbed)
- > Change of hydrological characteristics (construction of impoundment facilities, water diversions)
- > Changes in flow conditions (increasing the flow velocity by narrowing the riverbed, reducing the flow velocity by impoundment, levelling the flow patterns)
- > Changes in the substrate conditions (bedload management, impoundment, bottom sills, bank fixations, fairway design)
- > Removal of vegetation stands typical of waters, river banks, and floodplains (aquatic plants, reeds, riparian woods, floodplain-forest stands)

In addition to the structural changes, operational stresses from navigation, like e.g. wave impacts of ships, contribute to the deterioration of living conditions for the water-typical native animal and plant communities.

Further stresses of the aquatic ecosystem are caused by uses such as hydropower generation, pleasure cruising and leisure-time utilization, flood-defence measures, buildings, cooling-water use, wastewater discharges and intensive agricultural uses near the waters.

In the assessments required according to the WFD for the biological quality elements, like e.g. fish macrozoobenthos or aquatic plants, the biological status of the Federal waterways proves to be essentially unsatisfactory. In the framework of programmes of measures to be established by the Federal States in agreement with the WSV, suitable measures have to be fixed to reduce the ecological deficits.

Due to the long years of experience of the WSV with planning, implementing, and monitoring of compensation measures for impairments of the balance of nature and the landscape scenery, there is comprehensive knowledge about cause-effect relations of river-engineering measures. The compensation measures implemented by the WSV possess particular suitability for the attainment of environmental objectives on Federal waterways, because these are measures whose implementation is in harmony with navigational use, whose ecological effectiveness has often been studied and proven¹ and that meet the requirements of nature conservation.

Besides the compensation measures, also the measures implemented in the course of the regular maintenance may unfold positive consequences for aquatic ecology. The present collection of case studies should structure the broad experiences available in the WSV and, in particular, make it also useable for the responsibility arising from the ownership of Federal waterways for maintenance for water management purposes.

Beyond this, the examples are nevertheless also useable for purposes of nature conservation, maybe in the framework of management plans for Natura-2000 areas on Federal waterways or measures of the Federal States for the improvement of floodplain habitats.

3 Method

In a first step, an inventory of known projects was made in the *BfG*, since here, because of the permanent involvement in the planning of projects on Federal waterways; a good overview exists on Federation-wide existing compensation and other projects. In doing so, about 100 projects were listed, which had been implemented roughly since 1990 in the development and new construction, but also in the framework of waterway maintenance and of research projects.

¹ *Inter alia* long-term monitoring campaigns were made on the River Mosel (BfG, 2007)

For the structured collection of the projects and the measures they comprise, a systematic scheme was applied *inter alia* for the position in the river profile and a typification of measures was made. Five categories were made up:

- > Continuity/passability
- > Bank and adjacent riverbed
- > Bank and adjacent floodplain
- > Bedload balance
- > Special measures (to safeguard existing species)

Altogether 33 types of measures were assigned to these five categories (see data collection sheet in the Annex). The types of measures are closely harmonized with activities at Federal State level for the establishment of programmes of measures (*PEWA; Senatsverwaltung für Gesundheit, Umwelt und Verbraucherschutz*, 2008), concepts for the development of the River Rhine in Rhineland-Palatinate (Landesamt für Umwelt, Wasserwirtschaft und Gewerbeaufsicht, 2008), Hesse and North Rhine-Westfalia.

Other relevant information given: Waterway, purpose of project, local reference, project developer, presence of protected areas, year of execution, ecological objectives, information on monitoring, assessment of ecological effectiveness, impairment of the effectiveness, use-relevant consequences of the project, and additional information (illustrations, references, contacts).

So far, 50 projects have been included. These are the very projects for which the required information is available in the *BfG*. For the other measures of the above-mentioned list, the information is with the project developers. It is envisaged to have these included in a next step.

4 Technical implementation

The registration and presentation of the projects is done web based via the portal "WasserBLiCK"², so that accessibility can be provided for a wide range of users, while the access remains under control. At present any WSV staff member can have access to the data collection form to generate datasets and to the datasets available on the projects in the database. The registration effort per project is convenient, it takes about 30 minutes. The form is flexible for supplementations and additional information and is easy to handle. The maintenance effort after establishment is estimated as relatively low, because one need not expect a large number of new cases in short intervals. After completion, the system will offer numerous query options for targeted search for projects and for evaluations for statistical purposes. It is planned to make access possible in the future to wider groups of users (especially the water-management administration of the Federal States, nature-conservation administration).

² WasserBLiCK: www.wasserblick.net

5 Preliminary analyses

First evaluations of the present database are presented in the following. Because of the still incomplete registration of the projects, the map of waterways (Figure 1) shows currently an uneven distribution of registered projects.

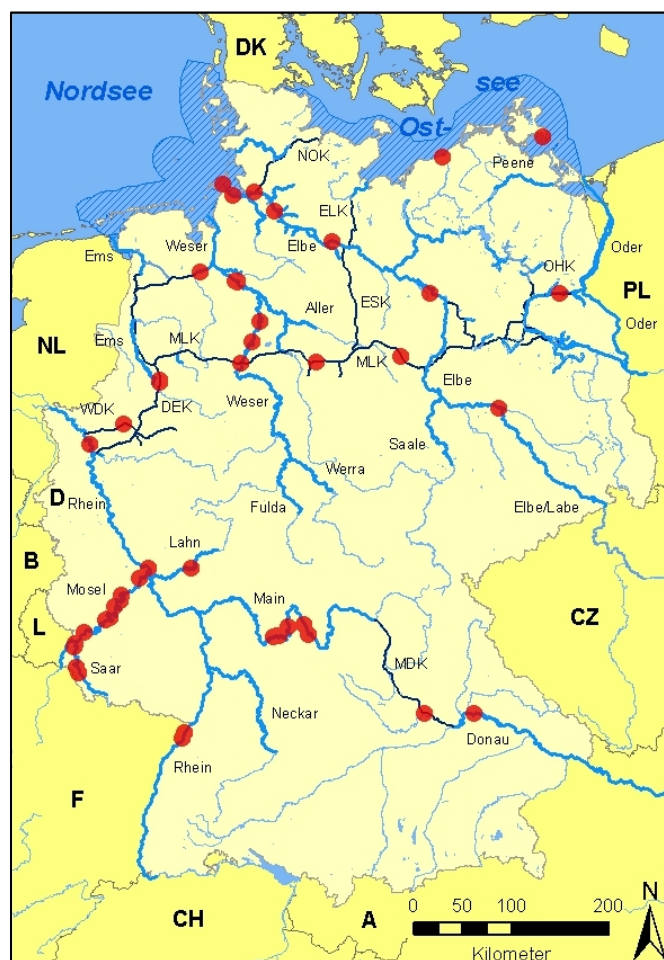


Figure 1: Distribution of the available datasets in the network of Federal waterways

The following bar diagrams represent selected aspects of the available data. Figure 2 shows the listing of the types of measures according to categories. By far the most types of measures were mentioned in the two categories „Bank and adjacent riverbed“ and „Bank and adjacent floodplain“. For the category „Bank and adjacent riverbed“ the respective types of measures are shown in the Figure 3. The fact that more types of measures are mentioned here than projects are registered is due to multiple listing, as the projects are often complex projects and thus comprise several types of measures.

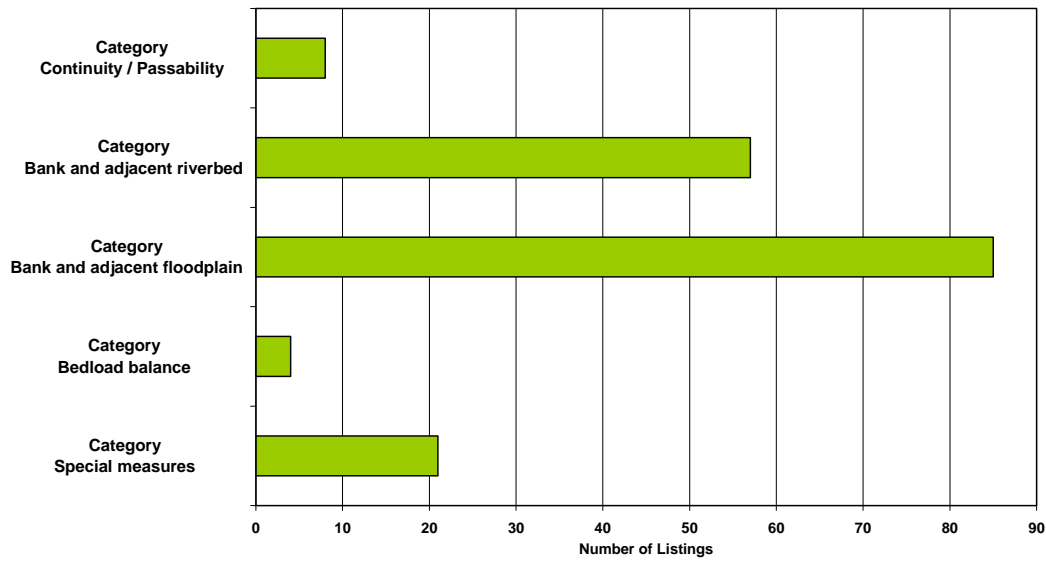


Figure 2: Types of measures according to categories (as in January 2009)

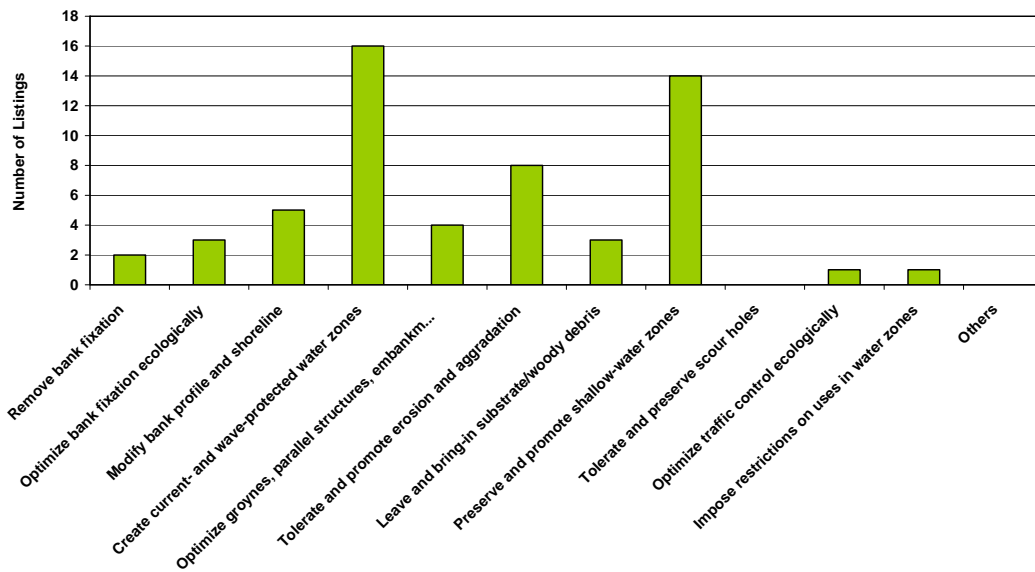


Figure 3: Types of measures in the category „Banks and adjacent riverbed“ (as in January 2009)

The following Figure 4 shows that - as could be expected - most of the projects included aim at improving the living conditions of the biotic components "fish", "bank vegetation", and "macrozoobenthos". Conversely, there are relatively few projects that are explicitly directed at improvement of abiotic components, although these are the components that are mostly directly influenced.

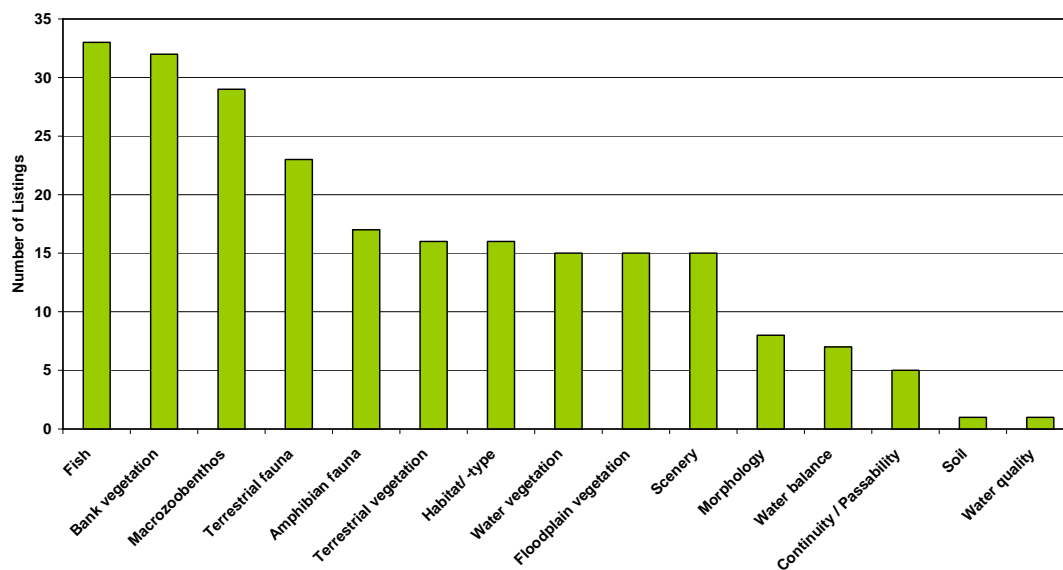


Figure 4: Objectives of the examined projects (as in January 2009)

- > In the further implementation of this study the following questions should also be investigated, the answers to which are urgent for the future implementation of improvement projects:
- > Are there types of projects/measures that are particularly suitable for certain categories of waters, biological quality components etc.?
- > Are there particularly efficient combinations of types of measures?
- > How many projects, in which dimension, and which surrounding conditions are needed to achieve perceptible improvements within one water body?
- > Which possibilities of optimization can be derived from the experiences? (e.g. site selection)

6 Case studies

The 13 case studies presented here were selected by the following criteria (although not all criteria need apply in every example):

- > all types of waterways should be represented (free-flowing, impounded, canal),
- > examples from development and new-construction projects, maintenance, applied research,
- > representative spectrum of projects,
- > joint projects with third parties,
- > positive ecological effects largely proven by evidence/assessable,
- > pictures are available.

The sequence is oriented at the categories of the types of measures. However, in the category "Bedload balance" no project has been registered yet that meets the above-mentioned criteria.

6.1 Fish pass Geesthacht/River Elbe

A good example in the category "Continuity/passability" is the nature-like by-pass channel at the impoundment weir Geesthacht. It enables migrating fish coming from the tidal reach of the river Elbe to reach their spawning grounds in the middle and upper reaches of the river and in tributaries, so that the ecological effectiveness of the fish pass is rated high. Nevertheless, recent investigations found that a second fish pass is needed at this site.



Figure 5: Nature-like by-pass channel at the weir Geesthacht/River Elbe (from: Nöthlich, BfG, 1998)

Name of waterway	River Elbe (main channel)
Type of waterway	Free-flowing Impounded
Category of water WFD	River / lake
Waterway stationing [km]	585.9
Local reference	Left bank
Project developer	WSA Lauenburg
Remarks on developer	Partner in planing: ARGE Elbe, Funding: (about DM 4 Mio by BMVBS, riparian Federal States, and the environmental foundation of the <i>Hamburgischen Elektrizitätswerke - HEW</i> (Hamburg electric power utility)
Presence of protected areas	No
Purpose of project	Others (see "remark on the project type")
Area / length	Length of by-pass channel channel: 216 m, Difference in height: up to 3 m at low tide, discharge of the by-pass: ca. 6.3 m ³ /s
Year of execution	1998
Pre-project status	Malfunction of the old fish-pass built in the 1960s
Category "Continuity/passability"	Build a nature-like by-pass channel
Remarks on measure type	Replacement of an old, less functional fish-pass by a near-natural, generously dimensioned
Targets	Continuity/passability Fish Macrozoobenthos
Remarks on targets	The fish-pass will enable migratory fish that used to be frequent in the Elbe river basin, such as salmon, lamprey, and burbot, to reach their spawning grounds upstream of the weir.
Monitoring	Yes
Remarks on monitoring	Test catches of migrating fishes in fish-traps
Assessment of ecological effectiveness	High
Impairments of the project	Because the River Elbe at Geesthacht is very wide, the fishes can be seen "queuing up" in front of the weir at the right-hand bank opposite of the fish-pass, so that experts recommend to build a (second) fish-pass there. The by-pass channel is probably not suitable for the sturgeon, that is being re-introduce to the Elbe since 2008. If existing plans of hydropower generation will be implemented, significant harm to migratory fish by turbines has to be expected.
Use-relevant consequences of the project	Others
Remarks on use-relevant consequences	Maintenance required (e.g. removal of floating debris/flotsam)
General remarks	The nature-like by-pass channel at Geesthacht connects the tidal reach of the Elbe with the 620-km stretch of the free-flowing Middle and Upper Elbe and the tributaries. Thus, the construction of this fish pass is one prerequisite for successful projects of species re-introduction into the river system of the Elbe (e.g. salmon in Saxony) and for the natural recovery of migrating species (like the lamprey, of which thousands have been using the by-pass every year since its completion).
Sources	Schubert, H.-J. (2008): <i>Kontrolluntersuchungen im Fischaufstieg am Elbewehr bei Geesthacht. - Abschlussbericht im Auftrag der Wassergütestelle Elbe</i> , 12 S.
Contact	Christian von Landwüst, BfG, landwuest@bafg.de

6.2 Groyne fields and parallel structure Koborn-Gondorf/River Mosel

A very successful project on riverbanks is the parallel structure in the River Mosel at Koborn-Gondorf. It protects five interconnected groyne fields against the impacts of ship-induced waves. By now, dense stands of aquatic plants have established that are used by several fish species as spawning grounds.



**Figure 6: Groyne fields behind a parallel structure at Koborn-Gondorf
(from: von Landwüst, BfG, 1999)**

Name of waterway	River Mosel (main channel)
Type of waterway	Impounded
Category of water WFD	River/lake
Waterway stationing [km]	from 15.5 to 16.0
Local reference	Riverbed, left-hand side
Project developer	WSA Koblenz
Presence of protected areas	None
Purpose of project	Compensation
Remarks on purpose	To compensate impairments to fisheries due to the impoundment of the River Mosel in the 1950s and 1960s; groyne fields become protected against wave impacts by dumping a parallel structure, and thus the conditions as a fish nursery improve.
Area/length	About 2.5 ha water surface and aggradation zones
Year of execution	Before 1992
Pre-project status	Groyne field without protecting parallel structure
Category "Bank and adjacent riverbed"	Optimize groynes, parallel structures, embankments (breakwaters) ecologically
Remarks on measure	Five interconnected groyne fields are separated from the

type	navigation fairway in the River Mosel. A small opening connects the complex of groyne fields with the river.
Targets	Fish
Monitoring	Yes
Remarks on monitoring	Fish-stock inventories by electro-fishing in 1999, 2000, 2005, 2007
Assessment of ecological effectiveness	Very high
Use-relevant consequences of the project	Waterway maintenance
Remarks on use-relevant consequences	Maintenance of the parallel structure; groyne fields need very little maintenance, because they have no noteworthy tendency to aggradation.
General remarks	Because of the good screening against ship-waves, dense stands of aquatic plants have developed that are preferred for spawning by fish species that deposits their eggs on water plants, such as pike, carp, and tench. Moreover, green frogs are abundant. Occasionally, the rare dice snake was observed.
Sources	Unpublished information of the Bundesanstalt für Gewässerkunde (BfG)
Contact	Christian von Landwüst, BfG, landwuest@bafg.de

6.3 Parallel structure Walsum-Stapp/River Rhine

The parallel structure at Walsum-Stapp in the free-flowing Rhine is another example of the Category "Bank and adjacent riverbed". The structure itself is a nesting and resting site of several bird species; the arm behind is connected to the river and serves as a fish nursery.



Figure 7: Parallel structure in the river Rhine at Walsum-Stapp (from: Mockenhaupt, BfG, 2005)

Name of waterway	River Rhine (main channel)
Type of waterway	Free-flowing
Category of water WFD	River/lake
Waterway stationing [km]	from 793.5 to 795.0
Local reference	Right-hand bank
Project developer	WSA Duisburg-Rhein
Presence of protected areas	Yes
Purpose of project	Extension, upgrading
Area/length	10 ha
Year of execution	1997
Pre-project status	Bank of the River Rhine without parallel structure
Category "Bank and adjacent riverbed"	Optimize groynes, parallel structures, embankments (breakwaters) ecologically
Remarks on measure type	The arm behind the parallel structure is connected to river flow
Targets	Fish Macrozoobenthos
Remarks on targets	-
Monitoring	Yes
Remarks on monitoring	Macrozoobenthos, fish, vegetation
Assessment of ecological effectiveness	High
Impairments of the project	The openings in the parallel structure lead to impairments by ship-wave impact of parts of the water areas and bank sections behind.
Use-relevant consequences of the project	Waterway maintenance
Remarks on use - relevant consequences	Waterway maintenance, e.g. maintenance of the parallel structure
General remarks	The connected arm behind the parallel structure serves as fish nursery; the parallel structure itself provides nesting and resting grounds for several bird species.
Sources	NZO (2005): Fischbiologische Untersuchung am Parallelwerk Walsum-Stapp, Teil A. Jungfische und Querder. U4-592 RÜTTEN, M. (2005): Faunistische Erhebungen (aquatische Makrofauna) im Rahmen der Beweissicherung Parallelwerk Walsum-Stapp (Rhein-km 793,0 - 795,5) Abschlussbericht. U4-504. Proilingheuer, T. (2004):Parallelwerk Walsum-Stapp, Vegetationsmonitoring, Gutachten im Auftrag des WSA Duisburg-Rhein.
Contact	Dr. Franz Schöll, BfG, schoell@bafg.de; Christian von Landwüst, BfG, landwuest@bafg.de

6.4 Ecological modification of groynes/River Elbe

In the context of waterway maintenance, alternative shapes of groynes were tested in the River Elbe in order to stabilize and enhance the diversity of species and of morphological riparian features. The comprehensive investigations that accompanied the project and their evaluation are not yet finalized.



Figure 8: V-notch groynes in the River Elbe (from: Anlauf, BfG)

Name of waterway	River Elbe (main channel)
Type of waterway	Free-flowing
Category of water WFD	River/lake
Waterway stationing [km]	From 439.2 to 446.0
Local reference	Left-hand bank
Project developer	WSA Magdeburg
Presence of protected areas	Yes
Name/Code protected area(s)	Natura 2000 area Elbe floodplain Beuster-Wahrenberg, EU 3036-301
Purpose of project	Maintenance
Remarks on purpose	New arrangement or modification of built structures in the context of waterway maintenance/repair
Area/length	9 groyne fields
Year of execution	2004
Pre-project status	Test groynes were completed 2001-2004 and have been tested since.
Category "bank and adjacent riverbed"	Optimize groynes, parallel structures, embankments (breakwaters) ecologically.
Remarks on measure type	The new groyne types are favourable for renewal of degraded groynes or newly built structures when no costly re-arrangement is necessary. Local conditions must be considered.

Targets	Morphology Fish Macrozoobenthos Terrestrial fauna Bank vegetation
Remarks on targets	Fish, macrozoobenthos, ground-beetles; vegetation: stabilization and improvement of species- and river-morphological diversity and enhancement of character species; halting the long-term aggradation of the groyne fields
Monitoring	Yes
Remarks on monitoring	3-year study at the groyne fields and comparison with conventional groynes; references: hydromorphology, fish, macrozoobenthos, ground-beetles, vegetation
Assessment of ecological effectiveness	Uncertain
Impairments of the project	Interfering land-uses (e.g. cattle trampling on the bank), effectiveness analyses are distorted by impacts of flood events (deposits of sediment and debris) or weather influences (irregular annual river discharge)
Use-relevant consequences of the project	Waterway maintenance
Remarks on use-relevant consequences	Observation of the structural stability of the V-notch groynes in the context of regular field inspections
General remarks	Investigations and their evaluation are not yet finalized; end of monitoring in 2008 and project end in 2009.
Sources	List available on request from contact
Contact	Dr. Andreas Anlauf, BfG, anlauf@bafg.de

6.5 Test reach Stolzenau/River Weser

Back in 1988/1989, a test reach with alternative, biotechnical methods of bank stabilization was established on the River Weser near Stolzenau. Sections of this river reach were used to test the removal of existing bank-stabilization structures, the flattening of the bank slope, and the stabilization of the bank by planting willows and reeds. In contrast to the initial status, the present vegetation of the test reach is a complex of typical bank habitats of high value in nature-conservational terms.



Figure 9: Biotechnical bank stabilization at Stolzenau (from: Bauer, BfG, 2006)

Name of waterway	River Weser (main channel)
Type of waterway	Impounded
Category of water WFD	River/lake
Waterway stationing [km]	From 241.55 to 242.30
Local reference	Right-hand bank
Project developer	WSA Verden
Presence of protected areas	None
Purpose of project	Compensation
Area/length	750 m
Year of execution	Before 1992
Pre-project status	The bank zones were locally used as pasture down to the waterfront.
Category "Bank and adjacent riverbed"	Remove bank fixation Optimize bank fixation ecologically Modify bank profile and shoreline
Remarks on measure type	Establishment of a test reach with alternative, biotechnical bank stabilization (autumn and winter 1988/1989)

	The project consists of the sub-sections (a) removal of the bank fixation above the static pool level in the impoundment, (b) flattening the bank slope, and (c) stabilization of the bank by planting willows and reeds.
Targets	Terrestrial fauna Bank vegetation Habitat/-type Scenery
Remarks on targets	Ecological enhancement of bank habitats for vegetation, fauna, and improvement of the scenic beauty by removing the rip-rap embankment
Monitoring	Yes
Remarks on monitoring	Mapping campaigns of vegetation were made in the years 1989, 1992, 1999, 2005, and 2006, and those of macrozoobenthos in 2006, of fishes in 2006, and of avifauna in 2006.
Assessment of ecological effectiveness	High
Impairments of the project	Temporary disturbances, probably by anglers
Use-relevant consequences of the project	None
Remarks on use-relevant consequences	No maintenance has been necessary since the establishment of the test reach. In the future, the wood stands will need some care and maintenance.
General remarks	On the whole, the test-reach developed successfully. Under the prevailing hydraulic conditions, the introduced reeds and willows have developed so that they can provide good protection against bank-slope erosion. In contrast to the initial state, the present vegetation in the test reach is a complex of typical bank habitats of high value in nature-conservational terms.
Sources	<i>BAW / BfG: Untersuchungen zu alternativen technisch-biologischen Ufersicherungen an Binnenwasserstraßen. Teil 2: Versuchsstrecke Stolzenau / Weser km 241,550 - 242,300, BfG-Bericht Nr. 1579.</i>
Contact	Hubert Liebenstein, BfG, liebenstein@bafg.de ; Petra Fleischer, BAW, petra.fleischer@baw.de

6.6 Dice snake (*Natrix tessallata*) habitat at Dieblich/River Mosel

The dice-snake habitat near Dieblich is a project of the nature conservation agency that is supported by the competent local Waterways and Shipping Office (WSA). The habitat of the local population of the dice snake (*Natrix tessallata*) on the banks of the River Mosel was enlarged by creating favourable living conditions.



Figure 10: Dice snake (*Natrix tessallata*) habitat at Dieblich/River Mosel (from: S. Lenz, 2007)

Name of waterway	River Mosel (main channel)
Type of waterway	Impounded
Category of water WFD	River/lake
Waterway-stationing [km]	From 16.3 to 18.1
Local reference	Riverbed, right-hand side
	Right-hand bank
Project developer	WSA Koblenz
Remarks on developer	Project developer is the Deutsche Gesellschaft für Herpetologie und Terrarienkunde. The WSA supports the BfN E+E Project under participation of the Ministry for the Environment, Forests and Consumer Protection of Rhineland-Palatinate, The habitat is maintained by the local government authority for nature protection (SGD Nord).
Presence of protected area(s)	Yes
Name/Code protected area(s)	NSG Moselufer (Nature Reserve, Bank of the River Mosel) between Niederfell and Dieblich, VO 8.8.2003 - LK MYK
Purpose Purpose of project	Others

Remarks on purpose	Nature-conservation project to safeguard the local dice-snake population
Area/length	16.9 ha
Year of execution	2001
Pre-project status	Camping ground, leisure-time activities
Category "Bank and adjacent riverbed"	Create current- and wave-protected water zones Preserve and promote shallow-water zones
Category "Bank and adjacent floodplain"	Impose restrictions on uses in floodplain and riparian corridor.
Remarks on measure type	Enlarge the habitat of the threatened local dice-snake population
Targets	Amphibian fauna
	Terrestrial fauna
	Habitat/-type
Remarks on targets	The dice snake and characteristic animal species (e.g. ground-beetles) of river-bank habitats with poor vegetation and gravel substrate
Monitoring	Yes
Remarks on monitoring	Enhancement of the dice-snake population
Assessment of ecological effectiveness	High
Impairments of the project	None
Use-relevant consequences of the project	None
Sources	Entwicklung und Vernetzung von Lebensräumen sowie Populationen bundesweit bedrohter Reptilien am Beispiel Würfelnatler..., Natur und Landschaft (2006), Heft 3, S. 152-157.
Contact	Dr. Axel Schmidt, SGD Nord, axel.schmidt@sgdnord.rlp.de Dr. Sigrid Lenz, lesch-lenz@t-online.de; Monika Sommer, BfG, sommer@bafg.de

6.7 Improving riparian structure at Klosterwiesen-Uisbach/River Main

The project Klosterwiesen/Uisbach on the River Main comprises the river banks and the adjacent floodplain area. Here, shallow- and still-water zones were supplemented with a belt of floodplain-forest character.



Figure 11: Improved riparian structure at Klosterwiesen-Uisbach/River Main
(from: BfG, 2008)

Name of waterway	River Main (main channel)
Type of waterway	Impounded
Category of water WFD	River/lake
Waterway-stationings [km]	From 181.93 to 182.40
Local reference	Left-hand bank
Project developer	WNA (Office for Waterway New Construction) Aschaffenburg
Presence of protected area(s)	None
Purpose of project	Compensation
Remarks on purpose	Compensation for relocation of the river bank in the course of the development of the River Main as a waterway in the stretch from Aschaffenburg to Würzburg
Area/length	2.5 ha
Year of execution	1997
Pre-project status	Meadows in intensive agricultural use
Category "Bank and adjacent riverbed"	Create current- and wave-protected water zones. Tolerate and promote erosion and aggradation. Preserve and promote shallow-water zones.

Category "Bank and adjacent floodplain"	<p>Preserve, re-activate, establish, connect cut-off meanders, floodways, lateral branches, small ephemeral waters, artificial branches, tidal gullies</p> <p>Preserve, promote, and maintain near-naturally tall perennial herbs/reed stands</p> <p>Preserve, promote, and maintain near-naturally woods/riparian woods/floodplain forest</p> <p>Tolerate/promote natural growth of vegetation</p>
Remarks on measure type	Establishment of shallow- and still-water zones, supplemented with a belt of floodplain-forest character
Targets	<p>Amphibian fauna</p> <p>Terrestrial fauna</p> <p>Water vegetation</p> <p>Bank vegetation</p> <p>Floodplain vegetation</p> <p>Scenery</p>
Monitoring	Yes
Remarks on monitoring	<p>Inventories of vegetation and habitat types from 1998 to 2008</p> <p>Survey 1999: Fish</p> <p>Survey 2003: Birds, dragonflies, ground-beetles, spiders</p>
Assessment of ecological effectiveness	High
Impairments of the project	Leisure-time activities, rod fishing
Contact	Detlef Wahl, BfG, wahl@bafg.de

6.8 Wetland habitat near the mouth of the River Saar (compensation measure)

In the reach near the mouth of the River Saar a lateral branch was established, including shallow-water zones, islands, irregular shoreline, and gravel- and pebble- covered areas. The shallow-water zone should serve, in the first line, functions for young fish, and the bank structures for typical riparian avifauna.



**Figure 12: View of the newly created wetland habitat near the mouth of the River Saar
(from: BfG, 1993)**

Name of waterway	River Saar (main channel)
Type of waterway	Impounded
Category of water WFD	River/lake
Waterway-stationing [km]	From 0.7 to 1.6
Local reference	Left-hand bank
Project developer	WSA Saarbrücken
Remarks on developer	Project planning by BfG in coordination with WSA Saarbrücken, WSD Südwest, and Federal State authorities
Purpose of project	Compensation
Remarks on purpose	Compensation for losses of bank structures and shallow-water zones during the development of the River Saar as a navigable waterway
Area/length	5.2 ha
Year of execution	1992
Pre-project status	Mainly grassland, small brook, reed initials in wet depression, and riparian stands of perennial herbs along the River Saar
Category "Bank and	Modify bank profile and shoreline

adjacent riverbed"	Create current- and wave-protected water zones Preserve and promote shallow-water zones
Category "Bank and adjacent floodplain"	Preserve, re-activate, establish, connect cut-off meanders, floodways, lateral branches, small ephemeral waters, artificial branches, tidal gullies Tolerate/promote natural growth of vegetation
Category "'Special measures"	Provide refuge, breeding grounds etc. for animals
Remarks on measure type	Creation of an old-arm-like lateral branch, including shallow-water zones, islands, irregular shoreline, and gravel- and pebble-covered areas; connection to the River Saar over two bottom sills
Targets	Fish
	Macrozoobenthos
	Amphibian fauna
	Terrestrial fauna
	Water vegetation
	Bank vegetation
	Floodplain vegetation
	Habitat/-type
Remarks on targets	Shallow-water zone mainly for young fish, bank structures (gravel banks and bluffs) as breeding habitats for riparian avifauna
Monitoring	Yes
Remarks on monitoring	Vegetation 1993-1997
Assessment of ecological effectiveness	Uncertain
Impairments of the project	Silting, covering gravelly habitats, shallow-water zones were reduced.
Use-relevant consequences of the project	Navigation, management
Remarks on use-relevant consequences	Management path had to be relocated for the establishment of the compensation area.
General remarks	The monitoring was ended in 1997 because of lack of personnel. The final evaluation is still to be made.
Contact	Dr. Andreas Sundermeier, BfG, sundermeier@bafg.de

6.9 Renaturation of the former dredged-material spoil field Gager/Island Rügen

An example of a project in coastal waters is the renaturation of the former dredged-material spoil field Gager on the island of Rügen. The dams of the unused spoil field were removed and the natural dynamics of inundation was restored.



Figure 13: Aerial view of the former dredged-material spoil-field Gager/Island Rügen (from: BfG, 2002)

Name of waterway	Baltic Sea
Category of water WDF	Coastal water
Local reference	Island
Project developer	WSA Stralsund
Remarks on developer	Coordination with the office of the National Park Rügen and municipal authorities
Presence of protected areas	Yes
Name/Code of protected area(s)	Biosphere Reserve Südost-Rügen (simultaneously Protected Landscape L84), N189d NSG Mönchgut: Salzwiesen bei Middelhagen, EU Bird-sanctuary DE 1747-402, FFH area DE 1648-302 Küstenlandschaft Südostrügen (coastal landscape South-East Rügen)
Purpose of project	Compensation
Remarks on purpose	Compensation for the extension of the eastern approach to the harbour of Stralsund, The project is one activity in the context of the landward relocation of dykes planned by non-WSV organizations.
Area/length	18 ha
Year of execution	1999
Pre-project status	Several forms of reed stands, ruderal grassland on dams; small water bodies that formed in borrow-pits of the dam construction material.

Category "Bank and adjacent riverbed/ seafloor"	Tolerate and promote erosion and aggradation.
Category "Bank and adjacent floodplain/seashore"	Open, break-up, relocate, remove dykes Preserve, re-activate, establish, connect old arms, floodways, lateral branches, small ephemeral waters, natural and artificial branches, tidal gullies Preserve, promote, maintain near-naturally tall perennial herbs/reed stands Tolerate/promote natural growth of vegetation
Remarks on measure type	Removal of the dams of the spoil field and restoration of the natural flooding dynamics
Targets	Water balance
	Morphology
	Amphibian fauna
	Terrestrial fauna
	Bank vegetation
	Terrestrial vegetation
	Habitat/-type
	Scenery
Remarks on targets	Reed development, ground-beetle, birds, amphibians
Monitoring	Yes
Remarks on monitoring	Vegetation, ground-beetle, birds, amphibians
Assessment of ecological effectiveness	High
Use-relevant consequences of the project	Waterway maintenance
Remarks on use-relevant consequences	The renaturated spoil field is not useable any more for the disposal of dredged material.
General remarks	The spoil field had been prepared for dredged-material disposal, but was never used.
Sources	Woidig, S. (2006): Die Vegetation des ehemaligen Spülfeldes Gager mit dem Deichvorland - Endbericht. Bearbeitungszeitraum 2000 bis 2004. Bericht im Auftrag des WSA Stralsund.
Contact	Dr. Andreas Sundermeier, BfG, sundermeier@bafg.de

6.10 Shallow-water zone Kleinensielier Plate/Lower Weser River

The shallow-water zone Kleinensielier Plate is an example of a project on an transitional water body, in this case in the brackish-water reach of the Lower Weser. A landscape-typical succession of habitats with tidal waters, reed belts, floodplain shrubs, and large-scale grassland was created here.



**Figure 14: The shallow-water zone Kleinensielier Plate/Lower Weser River
(from: WSA Bremerhaven)**

Name of waterway	River Weser (Lower Weser UWe-km 0.00 to 85.25)
Type of waterway	Free-flowing
Category of water WFD	Transitional water body
Waterway-stationing [km]	from 53 to 55
Local reference	Left-hand riparian environs
Project developer	WSA Bremerhaven
Presence of protected areas	Yes
Name/Code protected area(s)	Part of the FFH area 2316-331 " <i>Unterweser</i> "
Purpose of project	Compensation
Area/length	58 ha
Year of execution	2000
Pre-project status	Sandy area created by artificial accretion with terrain elevations between 3.0 m and 3.8 m above MSL; land uses: arable land and grassland

Category "Bank and adjacent floodplain"	<p>Preserve, re-activate, establish, connect cut-off meanders, floodways, lateral branches, small ephemeral waters, artificial branches, tidal gullies</p> <p>Preserve and promote grassland and its extensive use</p> <p>Preserve, promote, maintain near-naturally tall perennial herbs/reed stands</p> <p>Tolerate/promote natural growth of vegetation</p>
Remarks on measure type	<p>On an area of 58 ha of a former dredged-material dumping site, a landscape typical succession of habitats was established including tidal waters, reed belts, floodplain shrubs, and large-scale grassland.</p> <p>The core area is a shallow-water zone, i.e. a tidal water body of about 10.5 ha permanent water surface. The new supplementary water area will be a permanent water surface with reduced tidal range. Three bottom sills at 0.50 cm (hightened in 2005) below the mean tidal high water (<i>MThw</i>) provide the connection with the tidal cycle in the River Weser and the branch Treuenfelder Arm and ensure a minimum water level of 2 m. Fish species of the brackish-water habitat like eel, flounder or pikeperch as well as amphipods, tubificidae, tube-dwelling worms or plankton organisms are expected to colonize the new waterbody. On another area of 9.3 ha a reed stand should establish.</p>
Targets	<p>Fish</p> <p>Macrozoobenthos</p> <p>Terrestrial fauna</p> <p>Bank vegetation</p> <p>Habitat/-type</p>
Monitoring	Yes
Remarks on monitoring	Vegetation (2001, 2005, 2010), avifauna (2002, 2005, 2010), aquatic fauna (2002, 2007)
Assessment of ecological effectiveness	High
Impairments of the project	<p>Heavy siltation, because it is located in brackish-water zone.</p> <p>Attempted solution: Clearing the silt in parts of the area in the winter 2004/2005 and hightening the overflow sills in 2005.</p>
Use-relevant consequences of the project	None
Sources	http://www.wsa-bremerhaven.de/weserausbauten/14m_Ausbau/kompensation/kleinensieler_plate/index.html
Contact	Regina Kurth, WSA Bremerhaven, Regina.Kurth@wsv.bund.de

6.11 Shallow-water zone Bülstringen/Mittelland Canal

A very successful project on a canal is the shallow-water zone at Bülstringen. The shallow-water zone is connected to the Mittelland Canal, the bank is covered with reed stands and shrub. In the waters that are shielded against the impacts of ship-induced waves, large stands of water plants and reeds have developed. Fish are found in many species and large quantities, so that an increase in value of the neighbouring canal reaches can be expected.



Figure 15: The shallow-water zone Bülstringen/Mittelland Canal
(from: Mockenhaupt, BfG, 2007)

Name of waterway	Mittelland Canal (main channel)
Type of waterway	Canal
Category of water WFD	Artificial water
Waterway-stationing [km]	From 292.2 to 292.6
Local reference	Left-hand bank
Project developer	WNA Helmstedt
Purpose of project	Compensation
Area/length	About 5 ha, mainly water surfaces
Year of execution	1997
Pre-project status	Ploughland
Category "Bank and adjacent floodplain"	Preserve, re-activate, establish, connect cut-off meanders, floodways, lateral branches, small ephemeral waters, artificial branches, tidal gullies
Remarks on measure type	Shallow-water zones in connection with the Mittelland Canal, banks with reed stands and shrubs, thorn hedges shield against interferences from a neighbouring path
Targets	Fish Macrozoobenthos Amphibian fauna Terrestrial fauna Water vegetation Bank vegetation Floodplain vegetation Terrestrial Vegetation
Remarks on targets	Habitat for water- and bank vegetation, habitat and nursery of amphibians and fish in waters protected against impacts of ship-

	induced waves
Monitoring	Yes
Remarks on monitoring	Macrozoobenthos, fish
Assessment of ecological effectiveness	Very high
Impairments of the project	To some extent leisure-time activities, such as rod fishing
General remarks	Large stands of water plants and reeds have developed in the shallow-water zone. Fish are found in many species and large quantities. The colonization of adjacent canal reaches can be expected.
Sources	<i>BfG Koblenz, Ökologische Funktionskontrollen an Flachwasserzonen am Mittellandkanal. Zwischenbericht 2003, BfG-Bericht Nr. 1440.</i>
Contact	Christian von Landwüst, BfG, landwuest@bafg.de

6.12 Restructuring a poplar-tree stand on the island Niederwerth/River Rhine

A stand of poplar trees on the Island of Niederwerth in the Middle Rhine is successively restructured into a natural hard-wood floodplain forest. Single old poplar trees are cut, and the gaps are either left to natural rejuvenation or are planted with new trees.



Figure 16: Poplar-tree stand with an increasing portion of hardwood vegetation on the Island Niederwerth/River Rhine (from: BfG, 2006)

Name of waterway	River Rhine (main channel)
Type of waterway	Free-flowing
Category of water WFD	River/lake
Waterway-stationing [km]	From 595.30 to 595.70
Local reference	Right-hand bank Right-hand riparian environs
Project developer	BfG
Remarks on developer	The project is implemented on the BfG premises on the island of Niederwerth.
Presence of protected areas	None
Purpose of project	Compensation
Area/length	About 1 ha
Year of execution	2000

Pre-project status	Pure stand of hybrid poplars
Category "Bank and adjacent floodplain"	Tolerate/promote natural growth of vegetation Preserve, promote, re-structure, and maintain near-naturally woods/riparian woods/floodplain forest
Targets	Floodplain vegetation Scenery
Remarks on targets	Promote riparian hard-wood vegetation
Monitoring	Yes
Remarks on monitoring	Regular inspections of the state and implementation of the measures such as pruning/maintaining the hybrid poplars and the planting of new trees
Assessment of ecological effectiveness	High
Impairments of the project	Disturbances by playing children (damage to young growth of trees) and recreation activities on the area
Use-relevant consequences of the project	None
General remarks	More public-relation activities are needed.
Contact	Kerstin Wegener, BfG, wegener@bafg.de

6.13 Passage tunnel for otters/Havel-Oder Waterway

An example of a special-purpose project of preserving occurrences of plants and animals is the construction of a passage tunnel for otters on the Havel-Oder Waterway. A passage for otters was built under a new bridge-ramp to avoid the intersection of the migration route of the animals along the canal.



Figure 17: Passage tunnel for otters at the Havel-Oder-Waterway (from: WSA Eberswalde)

Name of waterway	Havel-Oder Waterway (main reach Havel-Oder Waterway, Alte Fahrt, northern part, around canal-km 67.9)
Type of waterway	Canal
Category of water WFD	Artificial water

Waterway-stationing [km]	Alte Fahrt, northern part, around canal-km 67.9
Local reference	Riverbed, left-hand side
Project developer	WSA Eberswalde
Presence of protected areas	None
Purpose of project	Compensation
Area/length	About 40 m
Year of execution	2008
Pre-project status	Federal waterway (BwaStr)
Category "Continuity/passability"	Others
Category "Special measures"	Build crossing-aid, guiding facility, by-passes, rescue islands, etc.
Remarks on measure type	Passage for otters under a newly built bridge-ramp
Targets	Water balance
	Continuity/passability
	Fish
	Amphibian fauna
	Terrestrial fauna
Remarks on targets	Multi-functional link - compensation of the intersection of the migration route of the otter as a species threatened with extinction - safeguarding the water supply to the canal reach "Alten Fahrt"
Monitoring	None
Assessment of ecological effectiveness	High
Impairments of the project	Possibly by sightseers, passers-by
Use-relevant consequences of the project	None
Contact	Hartmut Purr, WSA Eberswalde, Hartmut.Purr@wsv.bund.de

7 References

BfG (2007): Untersuchung zur ökologischen Wirksamkeit landschaftspflegerischer Kompensationsmaßnahmen an der Mosel. BfG-Bericht Nr. 1541.

BNatSchG: Bundesnaturschutzgesetz: Gesetz über Naturschutz und Landschaftspflege vom 25. März 2002 (BGBl. I S. 1193); zuletzt geändert Art. 2 G. vom 08.04.2008 BGBl. I S. 696.

Europäische Kommission (2006): Case Studies-potentially relevant to the improvement of ecological status / potential by restoration/mitigation measures. Separate document of good practice in managing the ecological impacts of hydropower schemes; flood protection works; and works designed to facilitate navigation under the Water Framework Directive.

FFH-RL: Flora-Fauna-Habitat-Richtlinie, Richtlinie 92/43/EWG vom 21. Mai 1992, Abl. EG L 206 S. 7, zuletzt geändert am 20. November 2006, Abl. EG L 363 S. 368.

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WaStrG: Bundeswasserstraßengesetz vom 23. Mai 2007 (BGBl. I S. 962); zuletzt geändert durch § 2 G. vom 18.03.2008 BGBl. I S. 449.

WHG: Wasserhaushaltsgesetz: Gesetz zur Ordnung des Wasserhaushalts vom 19. August 2002 (BGBl. I Nr. 59 vom 23.8.2002 S. 3245); zuletzt geändert durch Art. 2 G. vom 10.05.2007 BGBl. I S. 666.

WRRL: EG-Wasserrahmenrichtlinie (WRRL): Richtlinie 2000/60/EG des Europäischen Parlaments und des Rates vom 23. Oktober 2000 zur Schaffung eines Ordnungsrahmens für Maßnahmen der Gemeinschaft im Bereich der Wasserpolitik.

8 Annex

Data collection form for the acquisition of information about projects for the improvement of the ecological status of Federal waterways (Germany)

Project name	
Name of waterway	
Type of waterway	Free-flowing
	Canal
	Impounded
Category of water WFD	River/lake
	Transitional water
	Coastal water
	Artificial water
Waterway-stationing [km]	
Local reference	Riverbed, left-hand side
	Riverbed, right-hand side
	Island
	Left-hand bank
	Left-hand riparian environs
	Right-hand bank
	Right- hand riparian environs
	Others
Project developer	
Remarks on developer	
Presence of protected areas	
Name/Code protected area(s)	
Purpose of project	New construction
	Development
	Compensation
	Maintenance
	Others
Remarks on purpose	
Area/length	
Year of execution	
Pre-project status	
Category "Continuity/passability"	Remove weir, impoundment facility
	Replace bed-drop by ramp
	Build nature-like by-pass channel
	Build fish pass (downstream/upstream)
	Connect/renature (mouths of) tributaries
	Others

Category "Bank and adjacent riverbed"	Remove bank fixation
	Optimize bank fixation ecologically
	Modify bank profile and shoreline
	Create current- and wave-protected water zones
	Optimize groynes, parallel structures, embankments (breakwaters) ecologically
	Tolerate and promote erosion and aggradation
	Leave and bring-in substrate/woody debris
	Preserve and promote shallow-water zones
	Tolerate and preserve scour holes
	Optimize traffic control ecologically
	Impose restrictions on uses in water zones
	Others
Category "Bank and adjacent floodplain"	Re-wetting
	Open, break-up, relocate dykes
	Establish riparian corridors
	Preserve, re-activate, establish, connect cut-off meanders, floodways, lateral branches, small ephemeral waters, artificial branches, tidal gullies
	Preserve and promote grassland and its extensive use
	Preserve, promote, maintain near-naturally tall perennial herbs/reed stands
	Preserve, promote, re-structure, and maintain near naturally woods/riparian woods/floodplain forest
	Tolerate/promote natural development of vegetation
	Impose restrictions on uses in floodplain and riparian corridor
	Others
Category "Bedload balance"	Clear reservoirs
	Relocate bedload, sediment
	Add bedload
	Remove contaminated sediment
	Others
Category "Special measures"	Re-settle plants/animals, create suitable habitats
	Provide refuge, breeding sites, etc. for animals
	Build crossing-aid, guiding facility, by-passes, rescue island, etc.
	Combat neophytes
	Others
Remarks on measure type	

Targets	Soil
	Water quality
	Water balance
	Morphology
	Continuity/passability
	Fish
	Macrozoobenthos
	Amphibian fauna
	Terrestrial fauna
	Water vegetation
	Bank vegetation
	Floodplain vegetation
	Terrestrial vegetation
	Habitat/ -type
	Scenery
Remarks on targets	
Monitoring	
Remarks on monitoring	
Assessment of ecological effectiveness	Very low
	Low
	Medium
	High
	Very high
	Uncertain
Impairments of the project	
Use-relevant consequences of the project	Navigation, operation
	Waterway maintenance
	Others
	None
Remarks on use-relevant consequences of the project	
General remarks	
Sources	
Contact	