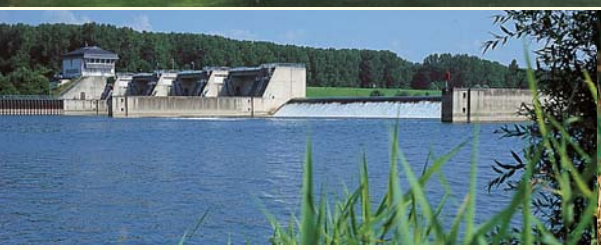
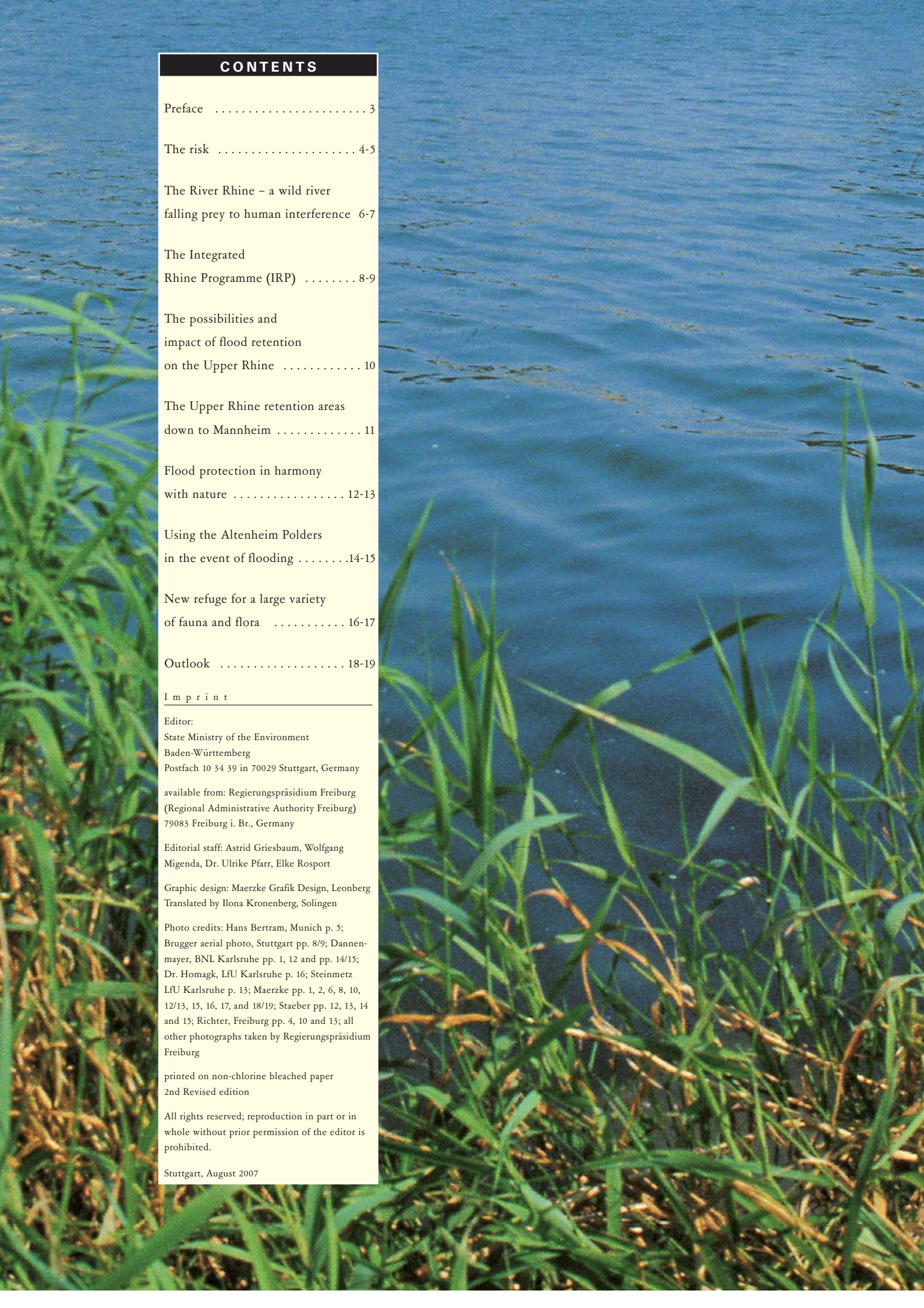


The Integrated Rhine Programme

Flood control and restoration of former floodplains along the Upper Rhine

Baden-Württemberg

UMWELTMINISTERIUM



CONTENTS

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Stuttgart, August 2007

Floodings concern every single one of us!

Again and again, flood events like those experienced in Baden-Württemberg in December 1993 as well as in April and June 1994 result in catastrophic inundations.

During the flooding that occurred in May 1999, the Upper Rhine area was only spared the worst due to the fact that the existing flood retention facilities were used.

Moreover, we should also recall the devastating floods along the River Oder back in July 1997 and those along the River Elbe in August 2002.

Time and again, these flood disasters clearly emphasise one thing: Floodings concern every single one of us. They destroy livelihoods, property and, if the worst comes to the worst, even claim human lives.

Due to climate change, we need to brace ourselves for more frequent heavy downpours in the future, a development which will lead to mounting flood hazards. This gives more significance to comprehensive flood control.

We cannot prevent flooding, as it is a natural phenomenon. Nonetheless, knowing about the risks enables us to take the necessary decisions to minimise or at the very least alleviate the ensuing damage by means of bespoke flood protection measures.

In this respect, the Integrated Rhine Programme can make a substantial contribution. It provides the right concept for flood control and the restoration of former floodplains along the Upper Rhine. On several occasions, the existing facilities have demonstrated their impact and efficiency in terms of flood protection. The Altenheim Polders have already witnessed the re-development of floodplain communities.

Now it is imperative to swiftly continue implementing the Integrated Rhine Programme within the next years. To achieve this objective, all of us have to join forces. The federal state, the Federal Government, the municipalities and the population are required to take action.
For this purpose, we need a broad consensus among society and politics which is to be promoted by means of this brochure.

Tanja Gönner

Minister of the Environment of the Federal State of Baden-Württemberg

The risk

In its present state, the River Rhine only has a limited conveyancing capacity for floodwater downstream of Iffezheim along the barrage-regulated stretch of the River. Thus, the conurbations of Karlsruhe, Mannheim/Ludwigshafen and Worms must brace themselves for considerable damage caused by flooding when the River overtops its embankments and inundates the areas behind the levees. The total damage resulting from a major flooding (1 in 200-year flood) in the Upper Rhine plain between Iffezheim and Bingen is estimated to amount to more than 6 billion euros. Moreover, it is expected that such an event will also result in human casualties.

Altrip (left) Mannheim (right)

Foto: Sascha Kopp

Floods on the Upper Rhine pose a threat to 95 towns and municipalities with a total population of
- **700,000**
- **ca. 350,000 jobs**
- **covering a surface area of ca. 1,000 km²**

THE CAUSES

Until the 70s, prior to the construction of the dams on the Upper Rhine between Kembs and Iffezheim, the situation proved to be less dramatic. At that time, the number of natural floodplains along the southern section of the Upper Rhine was still sufficient, allowing the retention of water while reducing the river flood conveyance along the northern stretch of the Upper Rhine to an acceptable level. With the construction of the dams, the floodplains were cut off from the natural discharge regime of the Rhine. Today, flooding events involving comparable flood volumes generate larger river discharges that can no longer run off between the local main dams of the Rhine along the northern stretch of the Upper Rhine downstream of Iffezheim.

THE SOLUTION

As illustrated by the example of the River Rhine, it was not so long ago that people were trying to protect the wetlands taken away from the rivers by means of dams which were rising higher and higher. Today we know that this tremendously exacerbates the flood hazards for downstream areas. For this reason, raising the dams along the vulnerable section of the Upper Rhine beyond their current height must be ruled out in terms of a potential solution to the problem. Thus, the only feasible solution to attenuate critical flood peaks embraces the creation of floodplains. On the Upper Rhine, there is still a possibility of doing so in quite a number of areas. In former times, prior to the construction of the dams, these areas were always subject to inundation; today, they are mainly used for forestry purposes, with a small proportion set aside as farmland. Many of these areas still bear witness to the past, as they embrace remainders of the typical floodplain landscape which existed along the Upper Rhine.

Reclaiming these areas for flood control purposes and developing semi-natural floodplains is the objective pursued by the Integrated Rhine Programme (IRP), the Baden-Württemberg concept of flood control and restoration of former floodplains along the Upper Rhine.

THE PLAN IS FULLY WORKING OUT

According to current estimates, the costs incurred in connection with the Integrated Rhine Programme total around 775 million euros; in contrast, the anticipated losses exceed an amount of 6 billion euros plus the potential loss of human life. Subsequent to the completion of all flood retention facilities on the Upper Rhine, the measures embraced by the Integrated Rhine Programme will prevent almost all of the above-mentioned losses, even in the event of a 1 in 200-year flood. So this is a really worthwhile investment!

Besides, things will also work out for nature. There will be a rise in the small number of remaining natural floodplains that constitute the original habitats of a rich diversity of fauna and flora which used to be typical of the upper Rhine plain in former times. In addition, this will also be beneficial to humankind. In many locations, man's living environment will become more natural and attractive.

PREVENTION IS BETTER THAN CURE

The flood retention measures carried out on the Upper Rhine merely constitute repair work and will by no means suffice as stand-alone measures. Human interventions undertaken along the river have to be reversed. Housing estates and industrial areas are still being built on potential floodplains. As a consequence, the flood hazard will not recede, but increase. Flood protection can never be absolute. People living in the immediate proximity of the river must always be prepared for the worst. A reduction in unavoidable losses also forms part of efficient flood control. The respective precautions as well as reliable flood forecasting and warning systems effectively help lower the losses, even during major flood events.

Taking stock of floodlosses:
The economic damage caused by a major flood event on the Upper Rhine totals approx. 6 billion euros. The measures taken within the framework of the Integrated Rhine Programme help reduce these losses.

Housing estates, industrial zones and farmland are threatened by flooding.

The River Rhine – a wild river falling prey to human interference

Prior to the 19th century, the River Rhine was still a wild river by and large untouched by man. Subsequent human intervention strongly altered the stream and resulted in a loss of floodplains. This increased the exposure to flood hazards.

In 1817 J.G. Tulla started regulating the river that had remained in its natural state up to the 19th century. The Upper Rhine plain which had been a marshy alluvial zone until that point in time was subsequently reclaimed by man.
An important habitat for flora and fauna typical of floodplains was lost due to the expansion measures that were carried out.

THE WILD RIVER RHINE – A NATURAL RIVER UNTIL THE 19TH CENTURY

About 200 years ago, the Rhine still used to be a wild river. In the section located between Basle and Lauterburg (furcation zone), the main channel of the Rhine bifurcated into many side arms. Each flooding changed the course of these numerous shallow channels. Sometimes their course shifted inland, sometimes more into the direction of the riverbed of the Rhine. Along this reach, the floodplains along the River Rhine were 2-3 km wide.

The next section of the river between the estuary of the River Lauter and the city of Worms (meander zone) had a shallow gradient and the Rhine adopted a meandering course through the Upper Rhine plain by forming wide loops in a by and large enclosed riverbed.

This particular section of the floodplain area covered a surface of 10 – 12 km wide. Back then, floods were able to inundate the terrain without coming across any major obstacles. However, the people settling in the plains along the River Rhine perceived this scenario as a threat. Every now and then, permanently recurring floods engulfed whole estates, inundating the vital fields for weeks in a row. The alluvial floodplains with their great diversity of fauna and flora were still in a by and large natural condition.

Prior to the first development and expansion measures the floodplains had retained their natural state.

View of the Upper Rhine furcation zone from the Isteiner Klotz

THE CORRECTION OF THE RIVER RHINE

First corrections by Johann Gottfried Tulla

The first correction of the River Rhine was carried out between 1817 – 1880 according to master plans by Johann Gottfried Tulla, engineer and lieutenant colonel in the former duchy of Baden. For this purpose, numerous channels of the river in the furcation zone were combined to form one main bed with a width of 200 m to 240 m, while the wide meander loops were cut through. As a result, the Rhine received a new riverbed which has essentially remained the same until today. The length of the Rhine section between Basle and Worms was reduced from 354 km to 273 km. From then onwards, floods were only able to inundate an area that was about 1-2 km wide.

A navigable river down to Basle – all year round

By implementing these measures Tulla created settlement areas and converted the marshy Upper Rhine plain into an area suitable for farming and forestry purposes. Thus, people living in the immediate proximity of the Rhine enjoyed a higher level of protection against floods. From 1906 onwards, Max Honsell continued Tulla's work in his capacity as Director of the Grand Ducal Building Authority located in Karlsruhe. By putting up riprap, so-called groynes, he reduced the channel cross-section size of the Rhine, with the water concentrating in the main channel of the river. The establishment of a permanent navigation channel (depth: 2 m, width: 75 m - 100 m) provided the possibility of travelling up to Basle all year round.

First adverse effects on the floodplains

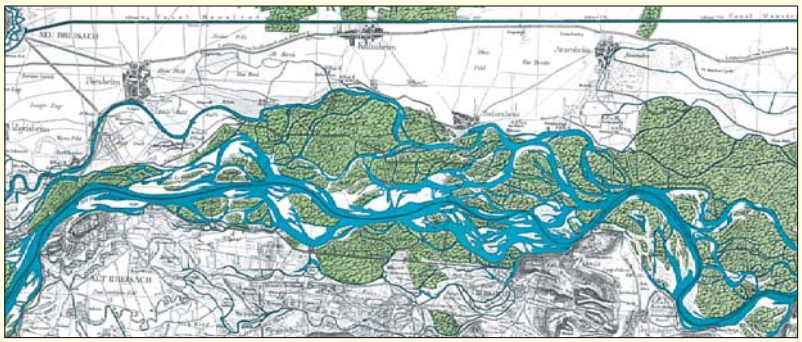
All in all, the correction of the Upper Rhine resulted in a major loss of natural wetlands and brought about a reduction in the frequency of floods in the areas bordering the river. The mere construction of the dam between Märkt near Basle and Karlsruhe entailed a floodplain loss of 660 km^2. The increased erosion of the Rhine in the South brought about the loss of another 80 km^2 of floodplains. Communities typical of the floodplains that required

regular inundation were destroyed. As opposed to the current situation, the floodplains on the Upper Rhine were still in a semi-natural state and networking amongst the biotopes functioned better despite the adverse changes which had already occurred by then.

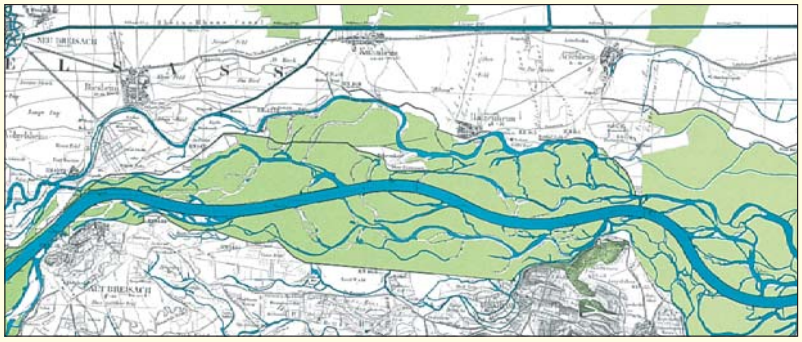
THE SYSTEMATIC DEVELOPMENT OF THE UPPER RHINE

The Treaty of Versailles and its implications for the River Rhine

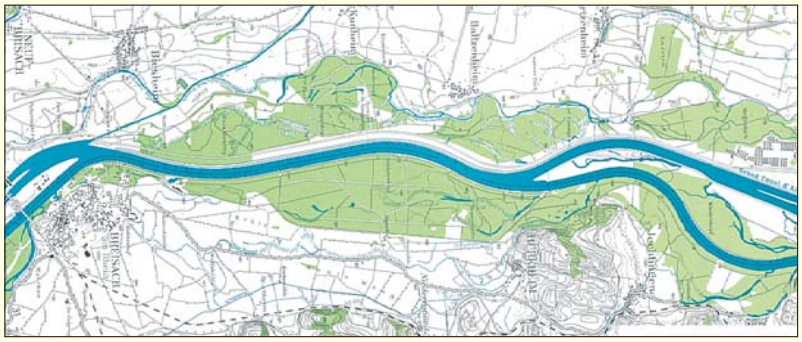
The Treaty of Versailles concluded back in 1919 constituted the point of departure for further substantial changes along the Upper Rhine. In Article 358 France was conferred the right to divert water from the Upper Rhine and harness the power from water for generating electricity. Between 1928 –1977, a total of 10 dams were constructed within the framework of three development phases. First of all, the Grand Canal of Alsace (Grand Canal d'Alsace) between Märkt and Breisach with the Kembs, Ottmarsheim, Fessenheim and Vogelgrün dams was constructed. Between 1959 and 1970, the expansion of the Upper Rhine progressed and brought about 4 loops located between Breisach and Strasbourg, with dams close to Marckolsheim, Rhinau, Gerstheim and Strasbourg. By 1977, the river had lived to see the construction of the probably last dams at Gambsheim and Iffezheim which are located directly in the river.



Topographic map dated 1828. Detail of the so-called "Rheingränzkarte" (Rhine border map). Prior to its correction by Tulla, the Rhine used to be a wild river in the so-called furcation zone, flowing along by forming various river loops and arms surrounding a multitude of isles and gravel banks by continuously changing its course.



Topographic map dated 1872. Subsequent to the correction by Tulla, the numerous river arms were combined to form a closed river bed which was 200m wide and able to discharge about twice the volume of water during mean flow conditions. In the event of higher discharge levels, the river overtopped its banks, inundating the alluvial forests right up to the inland flood defen-



Topographic map dated 1963. The systematic development of the Upper Rhine entailed the construction of the Grand Canal of Alsace up to Breisach from where the so-called „loop solution" was performed. For the Marckolsheim Dam depicted in this illustration, a weir for ensuring the discharge of water into the canal loop near Burkheim was constructed, with the embankments being directly moved to the edge of the riverbed. As a consequence, the riparian forest located between Breisach and Burkheim is no longer subject to any flooding.

Loss of important habitats for fauna and flora

The systematic development of the Upper Rhine resulted in a loss of 130 km² of previously flooded floodplains entailing the loss of important habitats of rare animals such as kingfishers, beavers and black storks. It is true that the systematic development of the Upper Rhine did not entail the complete disappearance of the semi-natural habitats typical of floodplains, but the floodplains that were still subject to inundation also experienced a shift towards more and more human management. Instead of a complete mosaic of alluvial biotopes which form part of a river floodplain network within a wider system of biotopes, what is left are only small isolated remnants of the natural floodplains of the River Rhine.

Increased flood hazards

As a direct consequence of dam construction, the risk of flooding downstream of Iffezheim along the developed stretch of the River Rhine has considerably mounted.

The loss of natural floodplains has given rise to distinctly higher flood waves. Moreover, due to the shortening of the river, the flood waves of the Rhine coincide with the higher discharge volumes of its tributaries such as the River Neckar and the River Main.

The Treaty of Versailles gave France the right to generate energy by using the hydropower of the River Rhine. Between 1928 and 1977 a total of ten hydroelectric plants in combination with locks for cargo ships were built along the Rhine. This resulted in a major loss of natural floodplain biotopes. The flood hazard downstream of Iffezheim along the systematically developed stretch of the river increased considerably.

The Integrated Rhine Programme (IRP)

The goals pursued by the Integrated Rhine Programme include flood control as well as the preservation and/or restoration of the Upper Rhine plains. Following the example given by nature, today's floodplain protection is tomorrow's flood control.

IRP OBJECTIVES: FLOOD CONTROL AND THE RESTORATION OF FLOODPLAINS

The Integrated Rhine Programme proposes the creation of flood retention areas at 13 sites located in the alluvial floodplains on the Baden-Württemberg side of the Rhine; moreover, it aims at achieving the preservation and restoration of the alluvial floodplains on the Upper Rhine to the largest possible extent.

The prime goal of these measures is to increase flood protection along the non-developed stretch of the Rhine between Iffezheim and Worms as quickly as possible and, in particular, to enhance the protection of the conurbations of Karlsruhe and Mannheim/Ludwigshafen. The ultimate goal entails attaining the level of flood protection that existed prior to the construction of the hydroelectric plants and locks.

According to the present framework concept pertaining to the Integrated Rhine Programme, this would require a retention volume of approximately 167.3m m^3 on the Baden-Württemberg side of the Rhine.

Essential elements for ensuring environment-friendly flood control are the preservation and creation of semi-natural floodplain biotopes.

Rhinau loop near Taubergießen (left)

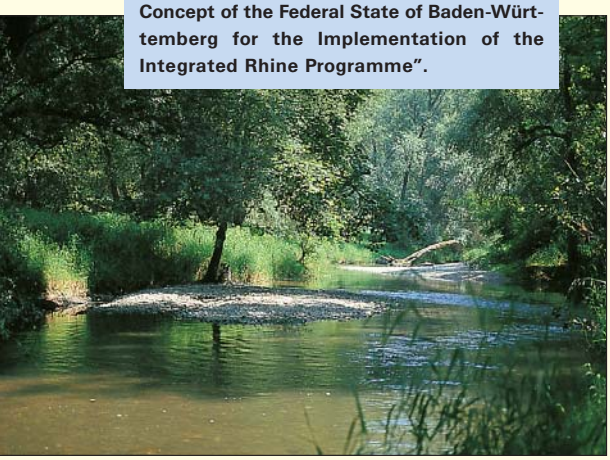
A PROJECT EMBRACING INTERDISCIPLINARY COOPERATION

Commissioned by the state government, the programme was framed by the state environmental management body in interdisciplinary cooperation with other departments and third party experts. It is devised as a framework programme so that the proposed measures may be planned and implemented step by step. The entire scheme as well as the local implementation in the administrative district of Freiburg is taking place under the lead management of the Regierungspräsidium Freiburg (Regional Administrative Authority Freiburg). Local implementation in the administrative district of Karlsruhe is ensured by the Regierungspräsidium Karlsruhe (Regional Administrative Authority Karlsruhe).

INTEGRATED During the planning stage it became evident that not only water management requirements as such should be allowed to take priority, but that it was also imperative to take ecological concerns into account. For this reason, ecological objectives were integrated into the flood control concept that had only embraced technical aspects at the very beginning.

RHINE The measures taken in the context of the Integrated Rhine Programme cover the Baden-Württemberg side of the Rhine between Basle and Mannheim. Furthermore, flood control measures are also implemented in Rhineland-Palatinate and France; in conjunction with the Integrated Rhine Programme, they bring about extensive flood protection on the Upper Rhine.

PROGRAMME The overall IRP scheme comprises a plethora of individual measures. All of them are based on the "Framework Concept of the Federal State of Baden-Württemberg for the Implementation of the Integrated Rhine Programme".



IMPORTANT STAGES LEADING TO THE IRP

As early as in 1968, the "International Commission on the Hydrology of the Rhine", which comprised representatives from France, Switzerland, Austria and Germany as well as representatives from the federal states of Baden-Württemberg, Rhineland-Palatinate and Hesse, conducted a study on the impact of the systematic development of the Upper Rhine.
The findings of the Commission underlined the necessity of restoring the level of flood protection that existed prior to the systematic development of the Upper Rhine.

THE FRANCO-GERMAN AGREEMENT

Subsequently, the above requirement was incorporated into the Franco-German Agreement concluded in 1982. This agreement on the systematic development of the Rhine between Kehl/Strasbourg and Neuburgweier/Lauterburg listed measures deemed necessary for the purpose of flood control at that particular point in time.

Apart from the emergency operation of the power stations, the measures to be taken on German territory included a weir at Rhine kilometre 220.5, two weirs at Breisach and Kehl, the Altenheim and Söllingen Polders as well as further polders downstream of the Franco-German border. Pursuant to this agreement, France contributes to the restoration of flood protection by assuring the emergency operation of the power plants on the Rhine and by operating the Moder and Erstein Polders.

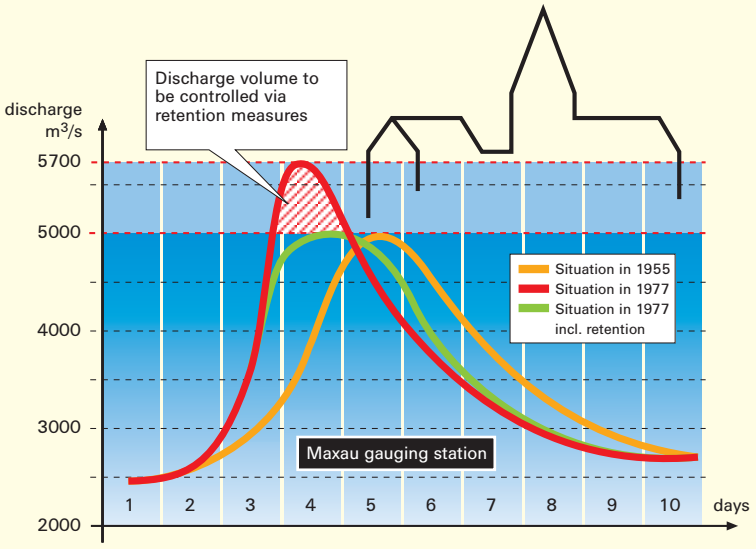
THE FRAMEWORK CONCEPT BRINGS CLARITY

During the planning stage it became evident that it was impossible to carry out the measures as originally planned due to technical problems which occurred during implementation and on account of new intelligence gleaned from environmental impact assessments that had already been completed by then.

It became obvious that ecological concerns had to be increasingly taken into consideration and that the number of sites proposed in the Franco-German Agreement would not suffice.

The Baden-Württemberg State Government responded by commissioning the then Ministry of the Environment to draw up a framework concept for restoring flood protection (Framework Concept, Part I) as well as the alluvial floodplains on the Upper Rhine (Framework Concept, Part II).

Finally, in 1996, the State Government adopted the „Framework Concept of the State of Baden-Württemberg for the Implementation of the Integrated Rhine Programme".



In order to attain the same level of flood protection that existed prior to the development of the Upper Rhine, the 1 in 200-year flood peaks at the Maxau gauging station must be reduced by 700 m³/s via retention measures.

Important events:

1919 Treaty of Versailles

1928-77 Systematic development of the Upper Rhine

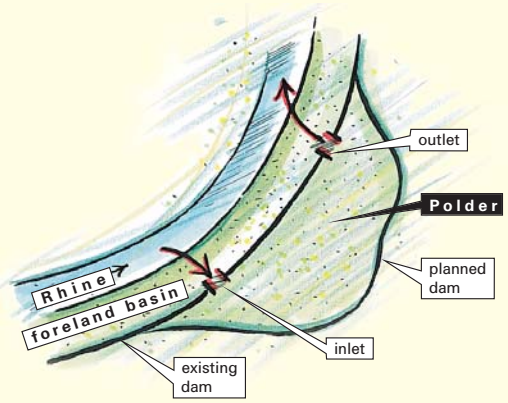
1968 Establishment of the „International Commission on the Hydrology of the Rhine"

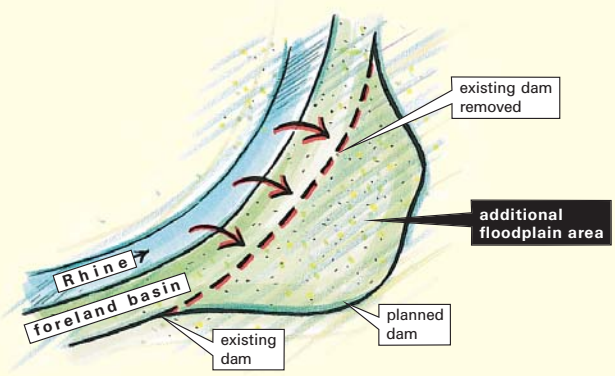
1982 Franco-German Agreement on the systematic development of the Rhine

1988 Decision in favour of the development of a framework concept by the State Government of Baden-Württemberg

1996 Adoption of the Framework Concept for the Implementation of the Integrated Rhine Programme by the State Government of Baden-Württemberg

The possibilities and impact of flood retention on the Upper Rhine





Floods on the Upper Rhine may be retained by way of polders, dike relocations, weirs and the emergency operation of the power stations located on the Rhine.

All areas combined provide protection against a 1 in 200-year flood – the statistical mean measured at the Maxau gauging station.

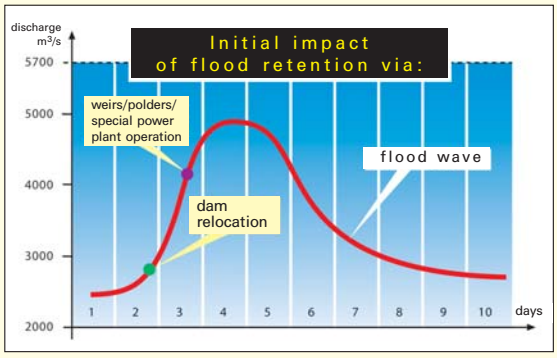
POLDERS

In the event of increased discharge volumes of the River Rhine, which are specifically stipulated within the framework of existing rules and regulations, polders are artificially flooded via inlets. This flooding is controlled in such a way that the water of the Rhine keeps flowing through the polders without interrupting its course, while the water eventually returns into the Rhine with a delay via the corresponding outlets. Since both the timing of artificial flooding and the level of flood retention may be controlled to a large degree, polders may be used in a targeted and highly efficient way.

DAM RELOCATIONS

Subsequent to a dam relocation, the Rhine may once again rely on a larger number of natural floodplains enabling the river to overtop its banks without meeting any obstacles. The higher the rise in the water level of the Rhine, the more water will inundate the area and return into the Rhine with a time lag. As a consequence, the mounting flood wave is already reduced at an early stage when discharge volumes are still fairly uncritical.

Flooding cannot be controlled and this implies that the retention volume may not be utilised in a targeted way. This type of flood retention is closest to natural conditions.

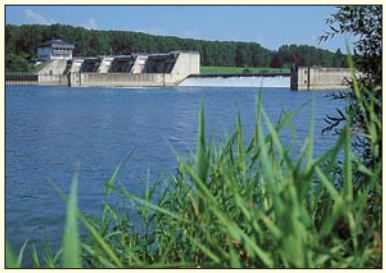


Controllable retention measures may be specifically targeted at mitigating flood peaks, while the alleviating impact of uncontrolled flooding starts earlier.

EMERGENCY OPERATION OF THE POWER STATIONS ON THE RHINE

Along the systematically developed stretch of the Rhine between Basle and Strasbourg, the water of the River Rhine is divided and channelled into the loops that hold the power stations and/or the Grand Canal of Alsace as well as the original channel of the river. In the event of a flood, the so-called „emergency operation of the Rhine power stations" reduces the discharge conveyance of the loops to a minimum, trying to ensure that nearly 100% of the Rhine's total discharge volume is channelled through the old river bed. This brings about a rise in water level along this particular reach.

This way, the river is allowed to overtop its banks and the water may freely inundate the adjacent floodplain forests. Due to its controllability, the emergency operation of the power stations on the Rhine may be used in a targeted and highly efficient way. Its impact is comparable to that achieved by polders and weirs.

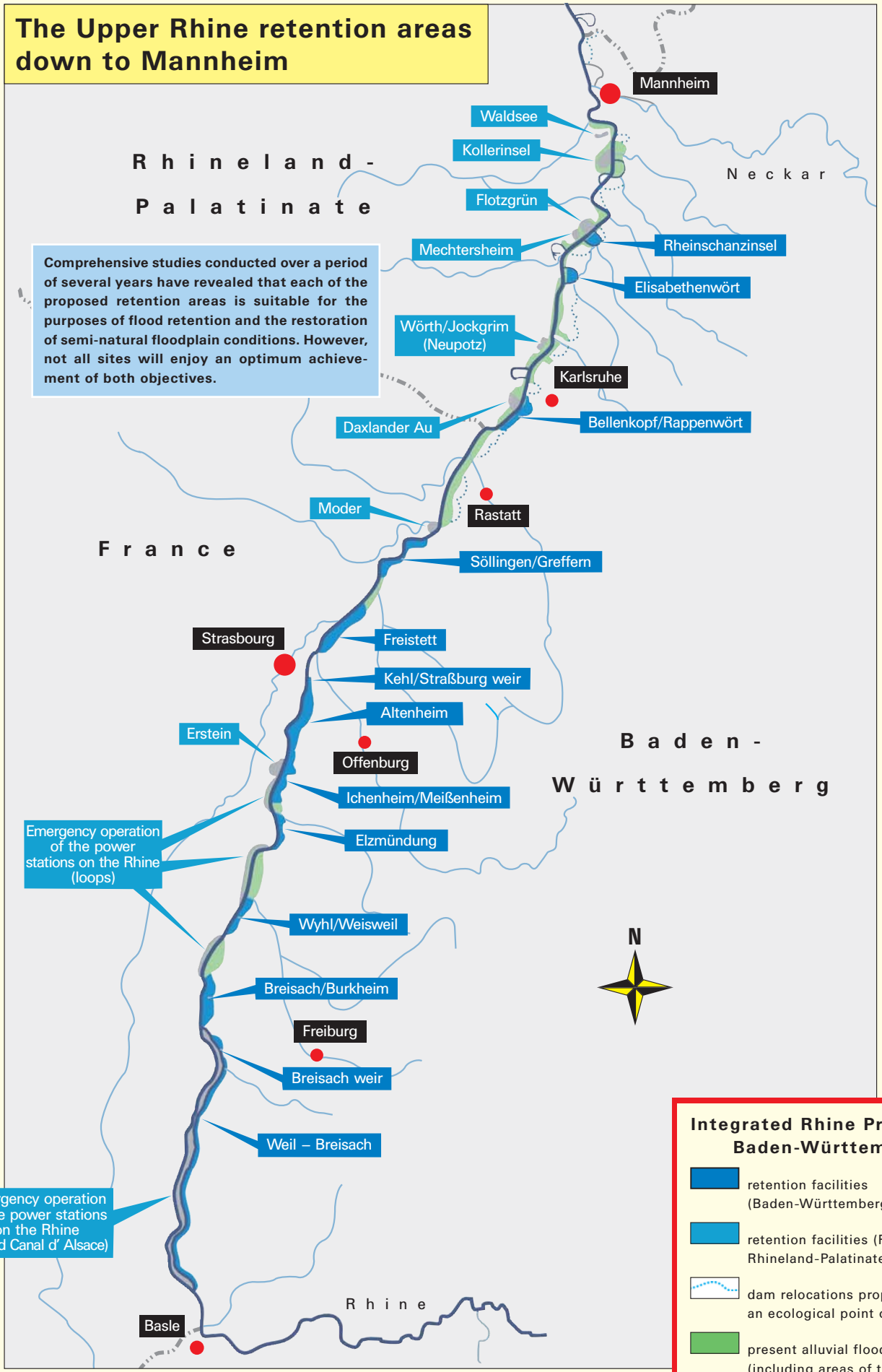


WEIRS

With the help of the weirs located on the Rhine, the water level of the main channel and that of the floodplains upstream of the weir may be controlled in accordance with a stipulated set of rules and regulations. First of all, the floodwater is retained by the weir itself, whereupon it is allowed to spill into the adjacent floodplains due to the increased water levels upstream of the weir.

After opening the weir gates, the water is removed from the retention area. Like polders, weirs may be utilised for the purpose of flood retention in a targeted and highly efficient way.

The Upper Rhine retention areas down to Mannheim



Comprehensive studies conducted over a period of several years have revealed that each of the proposed retention areas is suitable for the purposes of flood retention and the restoration of semi-natural floodplain conditions. However, not all sites will enjoy an optimum achievement of both objectives.

A mathematical flood discharge model was used for the purpose of verifying whether the measures laid down in the Framework Concept of the Integrated Rhine Programme – in conjunction with the measures taken in France and Rhineland-Palatinate – would actually entail the requiredlevel of efficiency.
The relevant findings speak for themselves and underline the importance of achieving the set targets.
For this purpose, all sites embracing an overall volume of 167.3 m m³ which are proposed in the Framework Concept for the Integrated Rhine Programme, will be required.

Integrated Rhine Programme Baden-Württemberg

- retention facilities (Baden-Württemberg)
- retention facilities (France and Rhineland-Palatinate)
- dam relocations proposed from an ecological point of view
- present alluvial floodplains (including areas of the emergency operation of the power stations south of Straßburg)

0 10 20 30 km

© Regierungspräsidium Freiburg, August 2007

Flood protection in harmony with nature

(Framework Concept, Part I)

Flood protection must be achieved in an environment-friendly way. This is stipulated in the Nature Conservation Act. The latter requires that any change entailing a considerable adverse impact on the efficiency and functional capabilities of intact habitats and their respective fauna and flora (intervention) is to be avoided, mitigated or offset.

Semi-natural Rhine floodplains are able to fulfil their important landscape-ecological functions. Floodplains provide natural space for flood control.

Like in the past, the Upper Rhine plain becomes a semi-natural landscape by means of the Integrated Rhine Programme. Ecological floodings turn the flood retention areas into flood tolerant habitats. Existing floodplain biotopes are protected, preserved and further developed.

GENTLE ADAPTATION TO FLOODING STRESS

The former floodplains along the River Rhine, which are to be re-flooded, must be smoothly and slowly readjusted to this changed environment in order to allow the typical alluvial forests to redevelop. Semi-natural floodplain forests embrace flood-tolerant communities able to survive larger damage.

For this reason, the task of the Integrated Rhine Programme goes beyond flooding the retention areas during major flood events – i.e. every 10, 20 or 30 years – by raising the water level to a height of several metres; in addition, it is to ensure that the areas are exposed to water even if the discharge volume of the River Rhine is lower.

HYDROLOGICAL BALANCE TYPICAL OF FLOODPLAINS

Fluctuations in groundwater levels typical of floodplains as well as flood-induced sediment transfer processes are to be restored and/or allowed whenever possible.

Ecological flooding as such will not suffice to restore the entire mosaic of natural biotopes in the Rhine floodplains. Dam relocations provide optimum conditions for the development of a semi-natural floodplain landscape. This is the only way the multitude of interactions between the river and the floodplains may develop without any interference from outside.

ENVIRONMENT-FRIENDLY FLOOD CONTROL VIA ECOLOGICAL FLOODING

The IRP reintegrates areas which have not been exposed to flooding for several decades into the natural flood regime of the Rhine. Fauna and flora currently populating the future floodplains are not adjusted to inundations. They would not survive a flooding without suffering badly. Thus, inundations during flood events result in changes that constitute interventions in existing habitats as defined in the Nature Conservation Act.

For mitigating losses in future retention areas, it is necessary to create the prerequisites for the development of intact, floodplain-like ecosystems.

Intact floodplain communities need regular inundation. However, flood retention-related inundations occur fairly rarely. Their statistic mean is approx. every 10 years or even less frequently. But intact ecosystems will only develop if regular flooding is ensured. As a consequence, such regular inundations (called ecological floodings) embrace the mandatory action aimed at mitigating the effects of human intervention.

If the retention areas were only subject to irregular flooding, they would mainly attract fauna and flora unfit to handle inundations during the periods between individual flood events. To ensure that these areas are regularly exposed to water, a low Rhine discharge volume gives rise to ecological flooding. Thus, the flooding of floodplain habitats, fluctuations in groundwater levels and flood-induced soil shifts are restored and/or approved as far as possible. In accordance with available studies and experiences regarding the Altenheim Polders, ecological flooding represents the key measure for avoiding and/or mitigating losses which will occur as a result of flood retention.

Measures

Dam relocations will allow increasing discharge volumes of the River Rhine to freely inundate former floodplains.

The discharge regime in the foreland basin of the Rhine will be improved. For ensuring the unimpeded flow of water, specific measures including the reconnection of dead arms to the Rhine will be taken.

Tributaries will be restored, e.g. by building fish ladders. This enables fish, such as the salmon, to reclaim their spawning grounds.

Biotope networking will be performed by incorporating sites located out-side the retention areas. This results in the restoration of natural habitats for fauna and flora.

Drained and previously marshy or boggy areas located in the Upper Rhine basin at the foot of the escarpment will be reconverted into wetlands, e.g. by dispensing with the further maintenance of drainage channels.

There are still remnants of alluvial woodlands on the Upper Rhine.
They should be preserved and protected.

Using the Altenheim Polders in the event of flooding

„And now let's turn our attention to the weather: the heat will persist at higher altitudes. Just like the past few days, today will bring sustained heavy rainfall to southern Germany and Switzerland. For the rest of the week, there is no change in sight."

This could be the rough wording of a forecast by the German Meteorological Service. As a consequence, the Altenheim Polders would be used for the purpose of flood retention as described below:

Stage 1: Due to heavy rainfall, the discharge volume of the Upper Rhine exceeds the flood alert level of 8m at the Hauenstein gauging station. Flood alert levels are also exceeded at other gauging stations located on the Black Forest tributaries as well as on the River Neckar.
The Central Flood Forecasting Office ("Hochwasservorhersagezentrale" – HVZ) of the Federal State of Baden-Württemberg, which permanently monitors the discharge regimes of the key water bodies of the federal state by means of a computer-controlled system, has already started to provide its round-the-clock service. From now onwards, the HVZ office computes flood forecasts for the most important gauging stations of the federal state which are hourly updated and based on water level and precipitation data as well as rain forecasts provided by the German Meteorological Service.
The extrapolations made by the HVZ office predict the occurrence of a major flood event along the River Rhine: The discharge volume at the Maxau gauging station in Karlsruhe will exceed both the level of 3,800 m^3/s and 4,200 m^3/s. The use of the Altenheim Polders for flood retention purposes is prepared. There is a permanent exchange of updated information between the Central Flood Forecasting Office, the Ministry of the Environment and the operator of the Altenheim Polders.

Stage 2: Via loudspeaker announcements the general public is notified of the flooding and asked to leave the retention areas. The staff of the operating company, the workers of the municipal building control offices, the police and the volunteer fire brigade are working 24-hour shifts. In the meantime, the Altenheim Polders and their immediate vicinity are cordoned off. People are no longer allowed to access the polders in order to give the animals a chance to withdraw without being disturbed. The body in charge of the entire operation and responsible for permanent monitoring is the central control station located at the weir between Kehl and Strasbourg.

Stage 3: When the decision in favour of flood retention measures is taken, the polders are flooded. Up to 150 m^3/s of Rhine water are forced to enter the polders via inlets and culverts. In these locations, water levels keep rising until the river overtops its embankments and inundates the entire area. Once the planned retention water level elevation is reached, the polders retain a total water volume of 17.6 m m^3.

Stage 4: In order to prevent the negative impact of rising groundwater in the adjacent Altenheim area, the specific protection measures (Altenheim pumping station and inlet/outlet control) are implemented simultaneously with the operation of the Altenheim Polders. These measures ensure that the groundwater levels in the Altenheim region do not deteriorate due to the retention of flood water. During flood retention periods, the local fire brigade keeps checking the dams. Equipment and materials for securing seepages are available.

Stage 5: Declining water levels of the Rhine result in a termination of water retention measures and polder drainage is commenced. For this purpose, the polder outlets are fully opened. Afterwards, cleaning-up operations by the operating company are required.

In conjunction with the weir between Kehl and Strasbourg and the Söllingen/Greffern Polder, this type of flood control operation helps retain 67 m m^3 of water. An operation of this kind may last up to 5 days. Once all retention areas are ready for use, they are operated in accordance with rules and regulations stipulated at an international level, always subject to the respective flooding event. On the Baden-Württemberg side of the river, a total of 167.3 m m^3 of water may be retained subsequent to the completion of the Integrated Rhine Programme. Moreover, the flood wave of the Rhine may be reduced by a further 120 m m^3 of water once flood retention measures in France and Rhineland-Palatinate are completed.

New habitats for a large variety of fauna and flora

(Framework Concept, Part II)

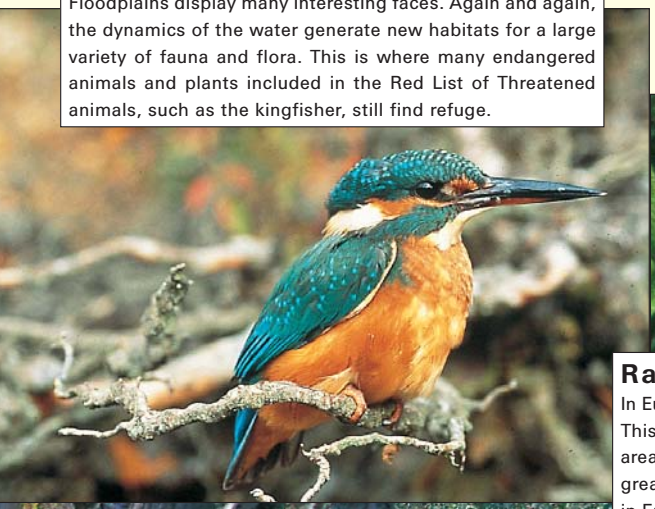
The protection, conservation, development and preservation of the remaining semi-natural floodplain biotopes constitute important prerequisites for the restoration of the Upper Rhine plain.

This goal may be achieved by way of designating protection areas and by establishing and implementing preservation, development and networking schemes. Intensively managed areas are to be reconverted into a semi-natural state by means of appropriate measures. In the Upper Rhine floodplains, this is brought about by reconnecting parts of the former floodplains to the discharge regime of the River Rhine, engaging in the extensification of intensively managed farmland and the gradual reconstruction of forest stands, to name but a few examples.

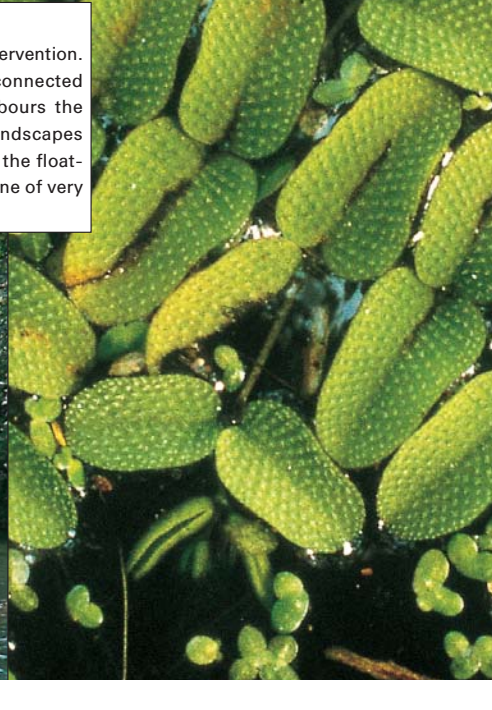
These ecological measures are instrumental in improving the situation of the entire Rhine basin. The IRP helps putting into practice the objectives and fundamental principles of nature conservation in the natural environment of the "northern and southern Upper Rhine lowlands". These goals are in line with the provisions laid down in the national and international agreements for the protection of the Upper Rhine lowlands. In many ways, both fauna and flora on the Upper Rhine are already benefiting from the measures taken in the context of the Integrated Rhine Programme. Initial successes have been attained in the Rhine basin north of Iffezheim.

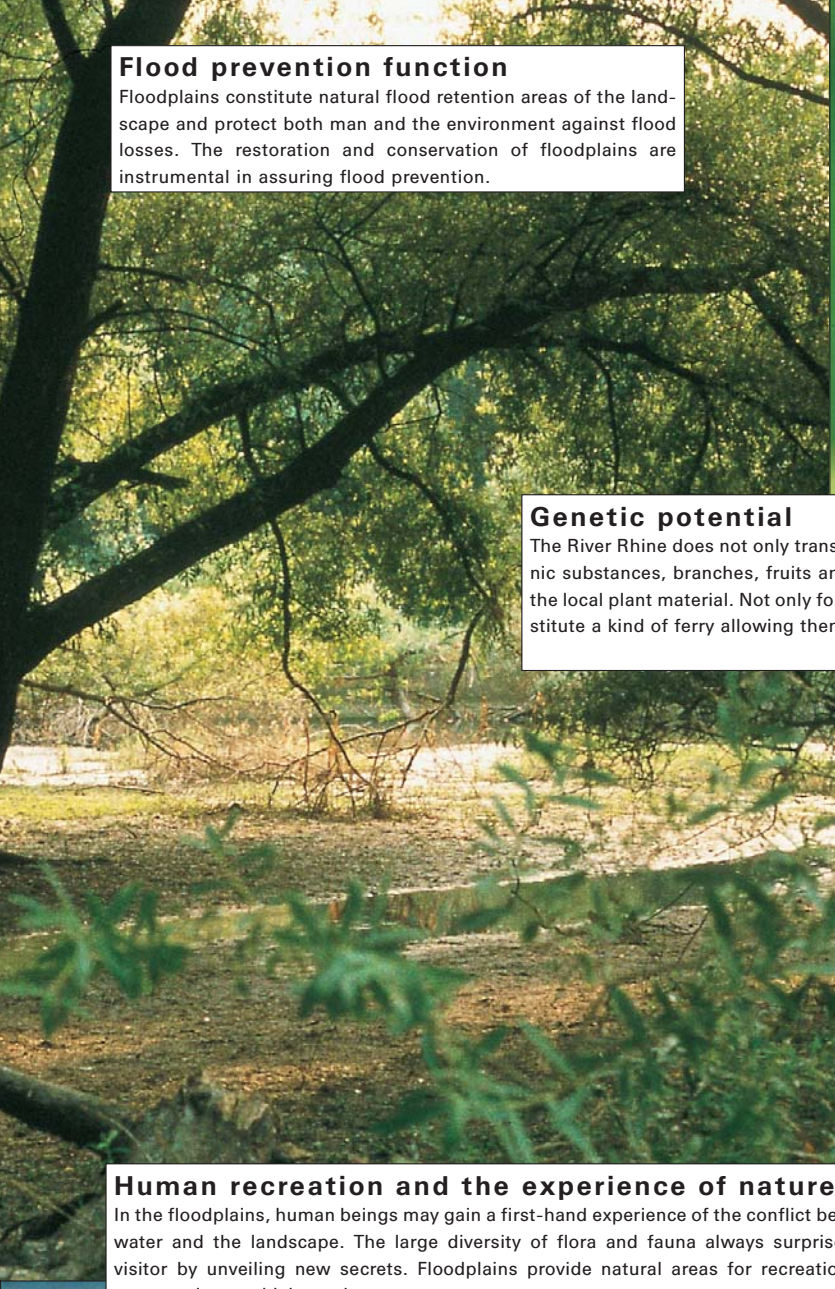
The alluvial floodplains are priceless. A mosaic of different habitats or biotopes forms an important ecosystem. This ecosystem does not constitute a confined area, but is characterised by permanent change and natural development. A multitude of factors, species, biotopes and communities generate the unique character of the floodplain ecosystem.

Species diversity and structural diversity
Floodplains display many interesting faces. Again and again, the dynamics of the water generate new habitats for a large variety of fauna and flora. This is where many endangered animals and plants included in the Red List of Threatened animals, such as the kingfisher, still find refuge.



Rarity
In Europe, many floodplains are destroyed by human intervention. This also applies to the Upper Rhine, where only few connected areas are left. The Integrated Rhine Programme harbours the great opportunity of preserving one of the last river landscapes in Europe. For some animal and plant species, such as the floating fern, the Upper Rhine area constitutes the only or one of very few habitats.



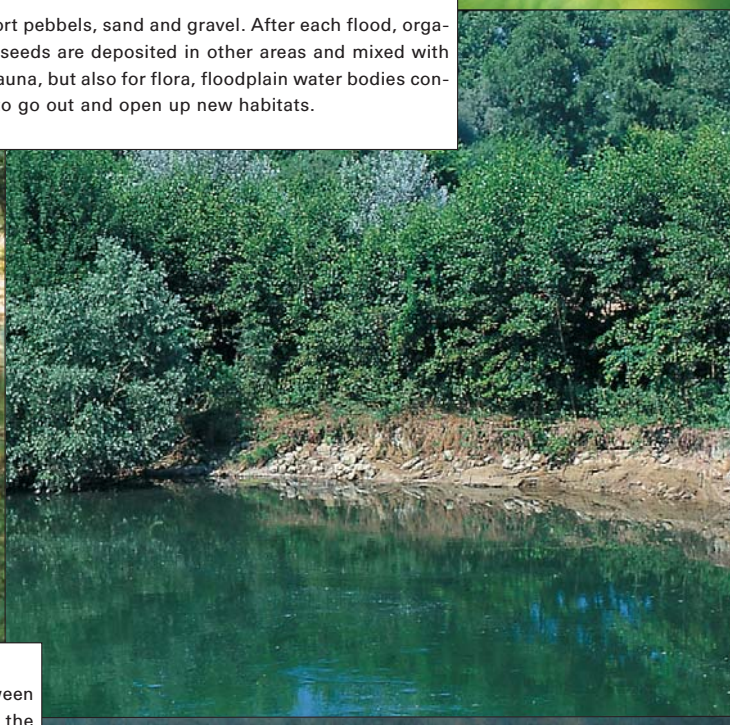


Flood prevention function

Floodplains constitute natural flood retention areas of the landscape and protect both man and the environment against flood losses. The restoration and conservation of floodplains are instrumental in assuring flood prevention.

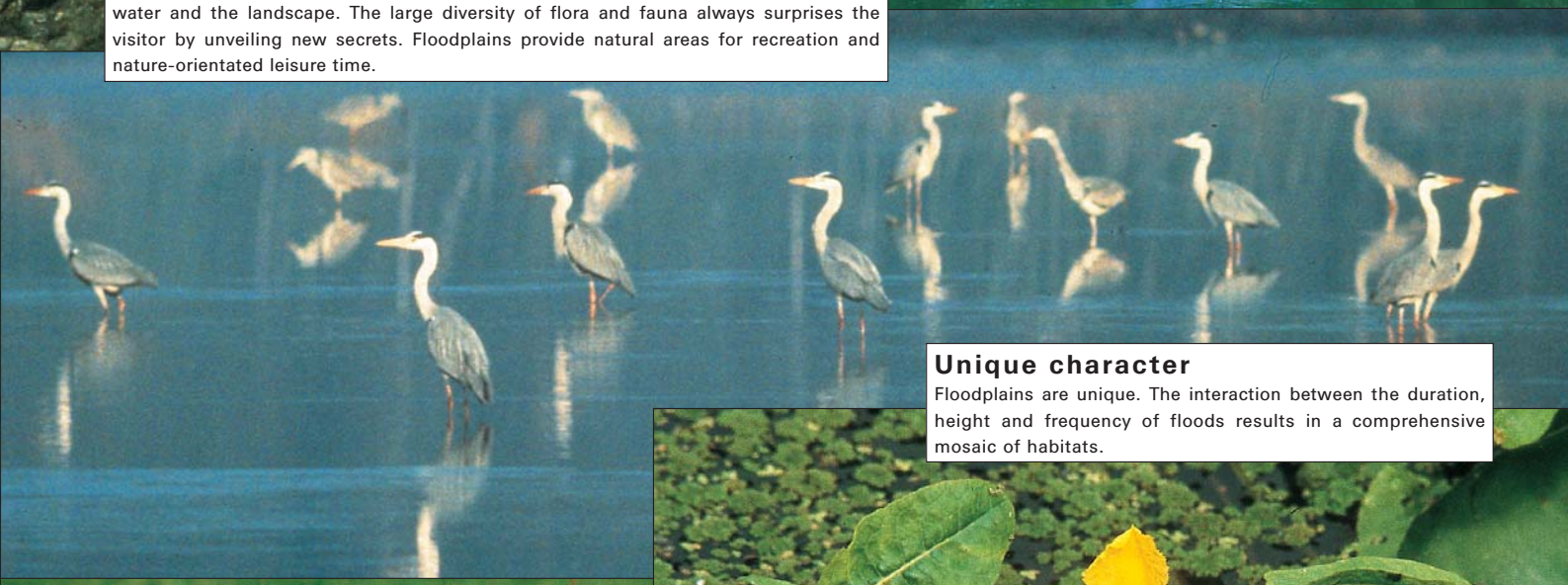
Genetic potential

The River Rhine does not only transport pebbels, sand and gravel. After each flood, organic substances, branches, fruits and seeds are deposited in other areas and mixed with the local plant material. Not only for fauna, but also for flora, floodplain water bodies constitute a kind of ferry allowing them to go out and open up new habitats.



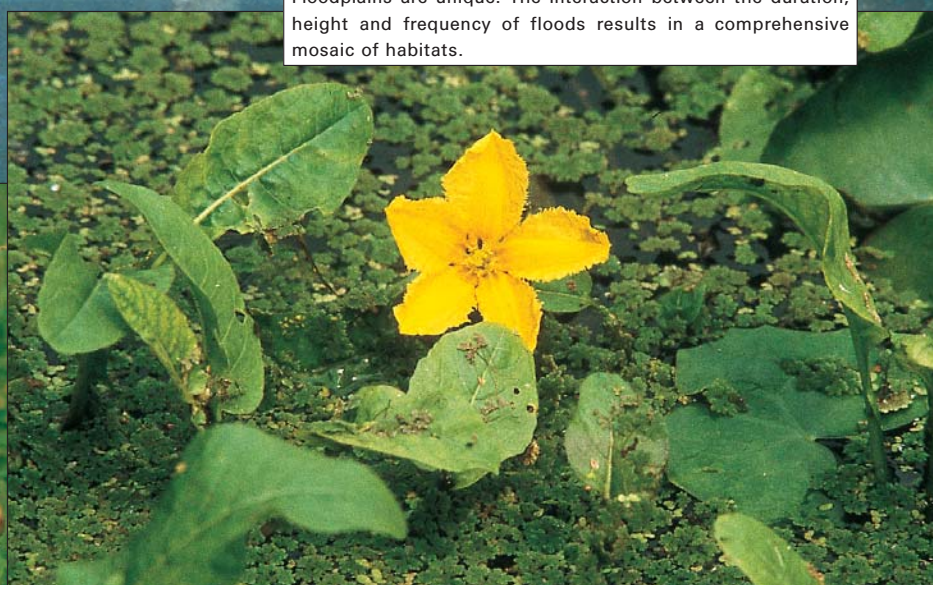
Human recreation and the experience of nature

In the floodplains, human beings may gain a first-hand experience of the conflict between water and the landscape. The large diversity of flora and fauna always surprises the visitor by unveiling new secrets. Floodplains provide natural areas for recreation and nature-orientated leisure time.



Unique character

Floodplains are unique. The interaction between the duration, height and frequency of floods results in a comprehensive mosaic of habitats.



Outlook

The successful implementation of the Integrated Rhine Programme depends on a multitude of individual measures.

Today, three out of a total of 13 planned IRP flood retention areas are completed. Two of them, the Altenheim Polder and the cultural weir near Kehl/Strasbourg have successfully operated for almost 20 years now.

The Söllingen/Greffern Polder was brought to completion in 2005 and the Rheinschanzinsel retention area is under construction.

Over the next years, further flood retention areas will be built.

The Integrated Rhine Programme can only be implemented when all stakeholders join forces and take joint action. In the long run, these efforts will pay off.

The Upper Rhine plain will benefit from the floodplain biotopes and their high level of species and structural diversity. At the same time, flood hazards are mitigated.

The IRP is the prerequisite for the reduction of losses generated by extreme flood events along the Upper Rhine.

FURTHER INFORMATION ON THE INTEGRATED RHINE PROGRAMME

Books

Flutungen der Polder Altenheim (Heft 1 + 2)
Band 3 Landesanstalt für Umweltschutz; 1. Auflage, 1991 EUR 5,--

Grundsatzpapier Auenschutz und Auenrenaturierung
Band 4 Landesanstalt für Umweltschutz, Oberrheinagentur; 2. unver. Auflage, 1995 EUR 5,--

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Band 7 Oberrheinagentur Lahr; 1. Auflage, 1996 EUR 8,--

Auswirkungen der Ökologischen Flutungen der Polder Altenheim – Ergebnisse des Untersuchungsprogramms 1993 - 1996
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Band 10 Landesanstalt für Umeltschutz Baden-Württemberg/Gewässerdirektion Südlicher Oberrhein/Hochrhein; 1. Auflage, 1999 EUR 25,--

Papers „Der Oberrhein im Wandel"

Alte Dämme fitgemacht
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2. ver. Auflage, 1993

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Heft 6 Landesanstalt für Umweltschutz Karlsruhe; 3. unver. Auflage, 1994

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Heft 12 Amt für Wasserwirtschaft und Bodenschutz Offenburg; 1. Auflage, 1994

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Heft 13 Amt für Wasserwirtschaft und Bodenschutz Offenburg; 1. Auflage, 1994

Polder Söllingen/Greffern
Heft 14 Oberrheinagentur Lahr; 2. Auflage, 1995

Broshures

Das Integrierte Rheinprogramm – Hochwasserschutz und Auenrenaturierung am Oberrhein
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(Bezug: Regierungspräsidium Freiburg, Abt. Umwelt)

Hochwasservorsorge – Alle sind gefordert (Faltblatt)
Ministerium für Umwelt und Verkehr; 1. Auflage, Stuttgart 2003

Hochwasser-Rückhalteraum Elzmündung (Faltblatt)
Gewässerdirektion Südlicher Oberrhein/Hochrhein; 1. Auflage, 2002

Hochwasser-Rückhalteraum Weil – Breisach (Faltblatt)
Gewässerdirektion Südlicher Oberrhein/Hochrhein; 1. Auflage, 2002

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Gewässerdirektion Südlicher Oberrhein/Hochrhein; 1. Auflage 1998

Hochwasserrückhalteraum Kulturwehr Breisach (Faltblatt)
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Der Polder Söllingen/Greffern (Faltblatt)
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Das Integrierte Rheinprogramm (Videofilm)
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Symposium „Das Integrierte Rheinprogramm im Jahr 2000 – Hochwasserschutz von Europäischem Standart" (CD-ROM)
Gewässerdirektion Südlicher Oberrhein/Hochrhein; 2000 EUR 5,--

Further information:

www.rp-freiburg.de
www.rp-karlsruhe.de

Baden-Württemberg
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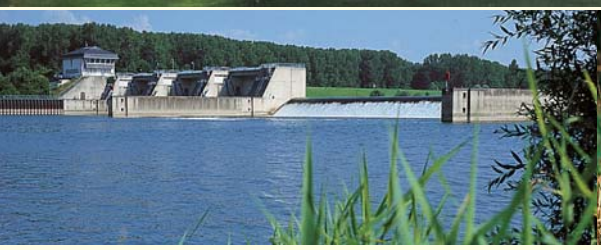

The Integrated Rhine Programme

Flood control and restoration of former floodplains along the Upper Rhine

Baden-Württemberg

UMWELTMINISTERIUM