Federal Ministry
Republic of Austria
Sustainability and Tourism

Flood Risk Management in Austria

Objectives – Measures – Good practice

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Vienna 2018

Publishing information

Media owner, general editor and publisher:
Federal Ministry for Sustainability and Tourism
Stubenring 1, A-1010 Vienna
+43 1 71100-0
www.bmnt.gv.at
Text, editing and design: Marian Unterlercher, Revital - Integrative Naturraumplanung GmbH; supported by the Federal Water Engineering Administrations in the Provinces (Selection and description of the example projects)
Proofing: Clemens Neuhold, Drago Pleschko, Franz Schmid, Heinz Stiefelmeyer, Martin Wenk
Image sources: Air Media/ Karl Strauch (p. 42 right), Amt der Kärntner Landesregierung Abt. 12 (p. 13, p. 16 right, p. 17 top left, bottom left, bottom right, p. 45), Amt der NÖ Landesregierung - Abteilung Wasserbau (p. 50), Amt der Salzburger Landesregierung Abt. 7 (p. 24-25, p. 30-31), Amt der Tiroler Landesregierung BBA Reutte (p. 45), Amt der Vorarlberger Landesregierung (p. 48 (2), Amt der Vorarlberger Landesregierung/Walter Häusler (p. 6), BMNT/Paul Gruber (p. 5), BMVIT/Martin Stippel (p. 13 bottom), BMNT (p.27, p.41), Autonome Provinz Bozen-Südtirol Abt. 30 Wasserschutzbauten (p. 15 left), Bundesheer/Kermer (p. 7), Bundesheer (p. 10 left, right , p. 18 right), Bundesheer/Mario Berger (p. 11), Bundesheer/Günther Filzwieser (p. 12, p. 15 right), Bundeswasserbauverwaltung Burgenland (p. 46 top right, left), Bundeswasserbauverwaltung Steiermark/zepp-cam/Graz (p. 38), BWV Steiermark (p. 44), Forsttechnischer Dienst für Wildbach- und Lawinenverbauung Sektion Kärnten (cover image; p. 13 left, p. 17 top right, p. 33 bottom right), Hydroingenieure (p. 14 li.), Gunz ZT GmbH (p. 43), ICPDR (p. 34), Internationale Rhein Regulierung IRR (p. 37 (2), Land Oberösterreich (p. 19 top left), MA45 – Wiener Gewässer (p. 47 right), Marktgemeinde Hard (p. 9 bottom middle), Marktgemeinde Leopoldschlag (p. 39), ÖAMTC/Christophorus 16 (p. 47 bottom right), PID/Houdek (p. 47 left), Schwaiger (p. 9 bottom right), Schwarzl (p. 18 left), Revital (p. 8, p. 9 left, p. 14 right., p. 16 left., p. 19 top right, p. 26, p. 29, p. 32,p. 33 top, p. 33 bottom left, p. 34, p. 35, p. 36 (2), p. 40, p. 51, p. 54), Viewcopter/Rudi Schneeberger (p. 42 left)
Translation: Christina Orieschnig, Florian Kaiselgruber, Clemens Neuhold, Martin Wenk
Printed by: Oberdruck
Vienna 2018

Inhalt

Floods: From Protection to Management

Floods in recent years have shown that even flood protection measures cannot guarantee full safety against extreme events. Having this vulnerability in mind, many people show increased awareness of flood hazard and risk.

One of the most important lessons learnt from the Danube flood in 2002 was, that flood protection is not enough - it needs a more holistic approach. This integrated management approach has been since then developed in Austria and at EU level. Integrated flood risk management is nowadays implemented in accordance to the EU Floods Directive. For the Federal Ministry for Sustainability and Tourism (BMNT), the main responsibilities and priorities are both flood prevention and protection. In close cooperation with spatial planning, building regulations and emergency management, land uses in areas prone to floods need to be adapted to reduce or even avoid future potential damages. In order to achieve this, hazard zone plans are elaborated and flood conveyance roots are identified and communicated in the frame of an integrated risk assessment.

As a step forward, flood risk management shall be increasingly supported and achieved by measures of spatial planning and building regulations. However, at the same time it is still of high importance that settlements and areas of high priority are protected by structural measures against floods. Integrated flood risk management also needs close coordination with ecology and, therefore, the goal achievement in accordance with the EU Water Framework Directive.

Elisabeth Köstinger
Federal Minister for
Sustainability and Tourism

1 Water – hazard and potential

1.1 In brief

Owing to its location in the Alpine range and its climatic conditions, Austria is at substantial risk from natural hazards. Floods and landslides threaten mountainous regions with their destructive power while long-lasting and extensive floods have adverse impacts on living environment and economic areas in flat and hilly regions. Without flood risk management, wide areas of Austria's river valleys would be unhabitable.

In order to protect settlements and important industrial and commercial areas, flood protection structures were built in the past and will again be built in the future where necessary. Outside of these intensively used zones, the emphasis is on developing measures for retention of water and the construction of retention basins. Wherever possible, the use and management of flood prone areas is adapted and adjusted by means of non-structural ("passive") measures. Spatial planning, building regulations, emergency management and measures to raise the awareness are of high importance. Ecological requirements and goals are taken into account in the frame of all interventions. Methods shall be used in a way that water bodies are protected and landscapes are preserved as much as possible.

In the future, flood risks are to be reduced significantly by means of an integrated approach referring the the EU Floods Directive by implementing bundles of measures consisting of structural and non-structural measures. Close coordination with spatial planning, building regulations, emergency management and measures to increase awareness plays an important role. The elaboration of flood hazard plans and designation of flood conveyance routes shall serve as basis for spatial planning and information of the population about natural hazards.

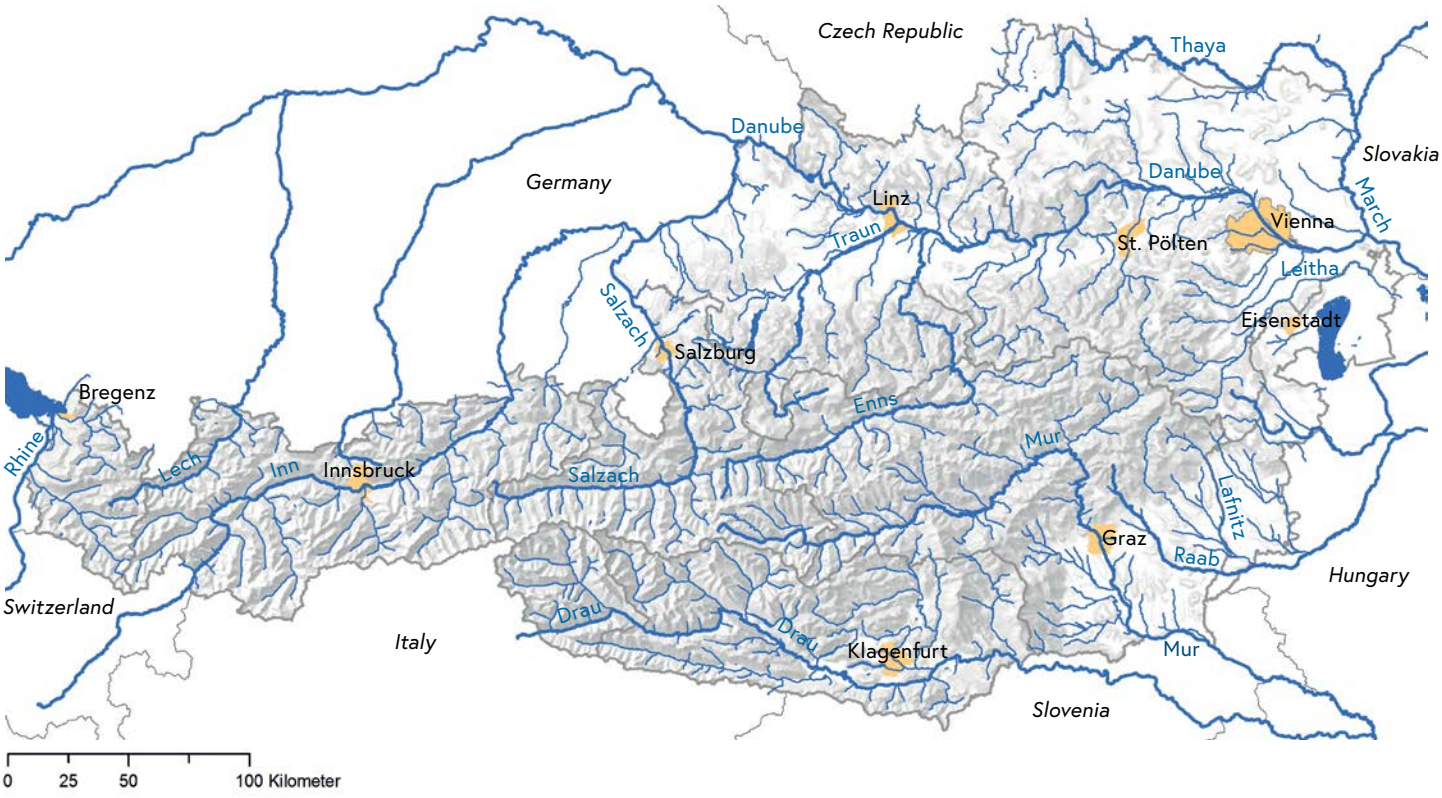
Flood protection through river widening at the Bregenzerach (Vorarlberg).

1.2 Water in abundance

Water is an essential resource, influencing our way of life and economy considerably. Worldwide it is becoming a more and more important subject. Austria – a mountainous country in the middle of Europe – is fortunate to be among the regions with the most abundant water resources in the world.

As it is located in the temperate climatic zone of Central Europe at the interface between Atlantic, continental and Mediterranean influence, it experiences moderate temperatures and relatively favourably distributed precipitation, on average 1190 litres per square metre and year. Spread over the total area of Austria, this is equivalent to around 100 billion cubic metres of precipitation. Of these, around 43 billion cubic metres evaporate. The rest drains into the ocean through aquifers, streams and rivers. Combined with the inflow from neighbouring countries (around 30 billion cubic metres), water available to Austria amounts to approximately 87 billion cubic metres annually. This is equivalent to almost twice the amount of water in Lake Constance!

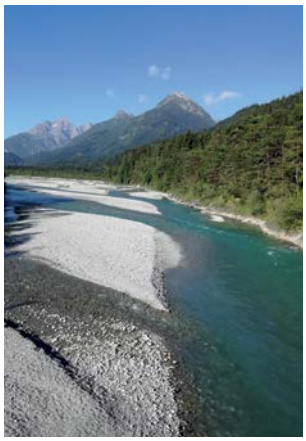
Water is abundant in Austria. Precipitation and inflow minus evaporation amount to around 87 billion cubic metres of water available in Austria annually. Around 3% (2.6 billion cubic metres) are used. With this amount, the Attersee could be filled to two thirds of its capacity.



Austria's streams and rivers run through the country like veins.

1.3 Rivers and streams – our country's lifelines

Streams, rivers and lakes are much more than transport routes for water draining away. They are our country's "lifelines". Altogether, about 100,000 km of rivers and streams flow through Austria, along with 25,000 bodies of standing water – 62 of these are large lakes. They shape the landscape and have large potential as habitats and retreat areas for fauna and flora rich in species. They are linking paths, contribute to the self-purification of water and make an important contribution to the regeneration of groundwater. Near-natural rivers and streams also provide opportunities for outdoor experiences and recreation.



Rivers are our country's "lifelines". They form habitats, improve ground water and capture people's attention.

1.4 Floods - hazard and risk

Floods are natural phenomena and as such part of the natural water cycle. They usually occur after long-duration precipitation, heavy rainfalls or snowmelt in combination with unfavourable conditions concerning groundwater, soil and vegetation. Floods arise when the natural – or modified – system for draining water is no longer able to convey the water. Rivers, streams and lakes, therefore, temporarily cover land by water which is normally not covered by water.

Floods turn into risks where transport infrastructure, settlements or people are affected. The risk increases the more frequent floods and the higher the potential negative effects (damage) are.

For sure, there is no absolute safety against floods. Even though protective measures for settlements or other important areas are designed for floods that statistically only occur every 100 years, floods must still be reckoned with – for example in the case of overload, when even greater floods than estimated occur, or when protective measures fail, for instance when dams break. This is true even for areas with existing flood protection. Thus, residual risk always remains.

Left image:
Flood in the lowlands. Long-lasting and extensive floods have adverse consequences for the settlements and economic areas in flat and hilly regions (Mauthausen, 2002).

Right image:
Floods in the mountains. Floods and landslides threaten valley floors in mountainous areas with their enormous destructive power (Paznauntal, August 2005).

1.5 Are floods becoming more extreme in Austria?

Without flood protection, Austria's areas of permanent settlement, especially in river valleys, would be even more limited as they are today. Related to the variability of meteorological and hydrological processes intense rainfall events on it's own or combined with snowmelt can cause flood events anytime.

After the extreme floods of 2002 and 2005, another large-scale flood occurred in Austria at the beginning of June in 2013. In a span of only 11 years, flood events claimed several human lives and caused billions' worth of damage.

The hydrological extremes of local intensive rainfall events currently still match the historical variation. However, it becomes ever more likely that they are a consequence of global climate change.

These developments are to be followed closely and - if necessary - need to be taken strongly into consideration in the future.

The flood event in 2013 (image: Schärding post-flood) showed in a dramatic way the significant vulnerability in Austria.

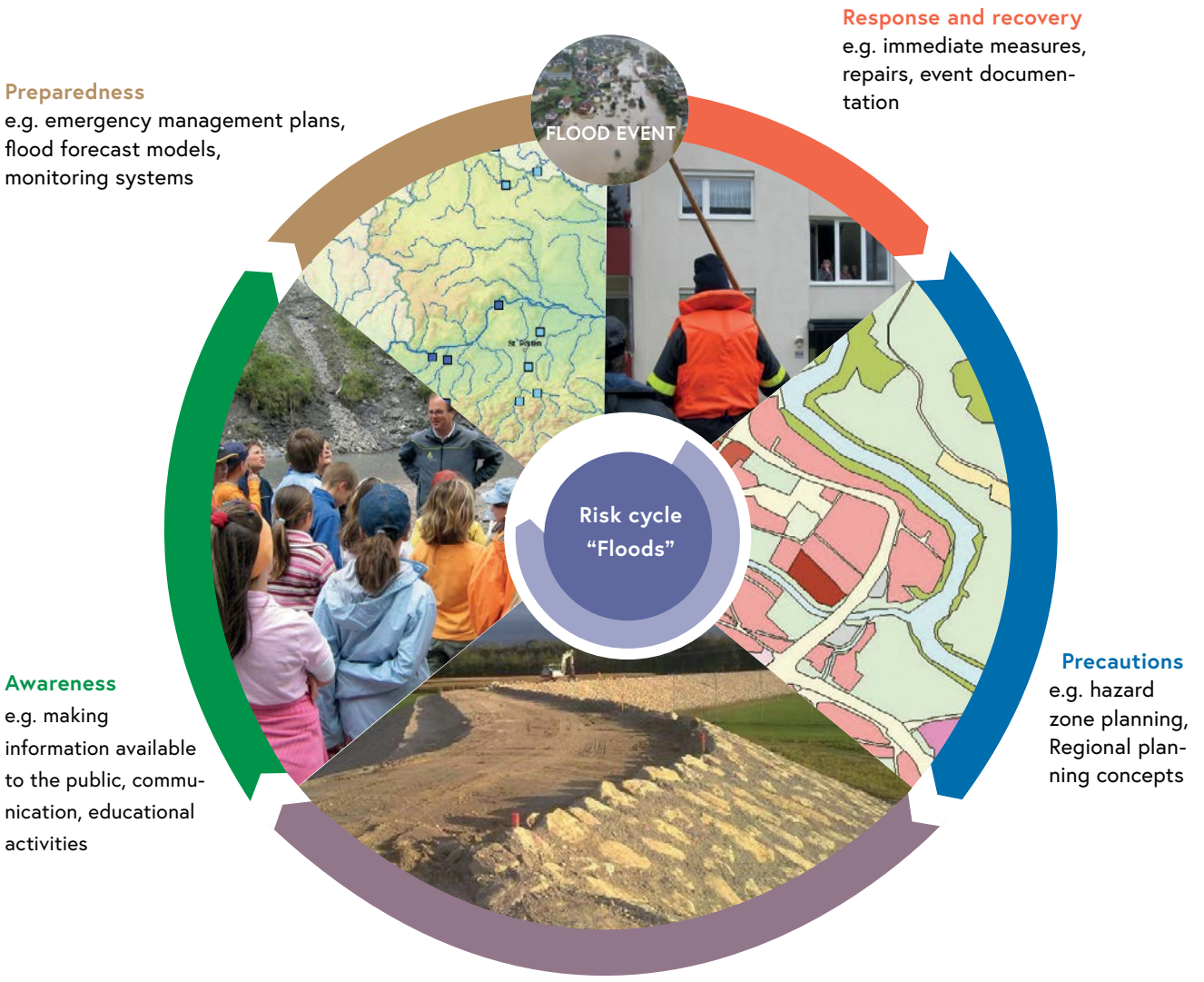
2
Flood risk management

2.1 How to understand flood risk management

Flood events in recent decades have proven that despite all protection efforts, residual risk always remains. In accordance with Austrian standards flood protection measures are designed - if possible - against a 100-years flood event, however, due to overload by even larger floods or failure of structural measures they do not guarantee total safety.

Based on lessons learnt, a strategy for integrated flood risk management comprising of appropriate objectives and measures had been developed with a focus on coordination with all relevant stakeholders including the participation of potentially affected people.

Risk cycle "Floods": Integrated flood risk management according to the EU Floods Directive is concerned with an interdisciplinary program of measures, spanning preparedness, protection, awareness-raising, provisions, response and recovery. Flood protection becomes a societal task. Everybody can contribute to risk reduction.



2.2 Objectives for Austria

Objective 1: Avoiding new risks

The focus to achieve objective one is on planning measures and non-structural measures, such as hazard zone planning, zoning, settlement development and building regulations. This means that potential hazards and risks are pointed out, and that this information is communicated to those potentially affected. Through integrated and holistic planning – from zoning planning to "flood-aware" object planning, risks can often be avoided before they even arise.

Objective 2: Reducing existing risks

The reduction of existing risks shall be achieved by adapting existing objects at risk, building protective structures or by removing damage potentials from the area at risk. By applying an anticipatory planning approach, the right bundle of measures can be identified. By means of structural measures, those are prioritised which are improving retention capacities over longitudinal structures such as dykes. The planning of non-structural measures are also of high importance to flood-adapted land use and the development of potential inundation areas.

Left image:
Protective structures will continue to be necessary in the future.

Right image:
The limits of flood protection and the value of individual preparedness have to be communicated.

Objective 3: Strengthening resilience

The coordination with emergency management by providing planning basis such as flood hazard and flood risk maps results in the significant reduction of damage. Emergency planning with its instruments “warning”, “alerting” and “operation” are of high priority.

Objective 4: Increasing awareness

The flood events in recent years have shown that a high awareness of risks and hazards is important in order to react properly in case of an event. The past, however, has also shown that this awareness decreases rapidly after an event, even among those directly affected, and reaches its former, low level after a maximum of 10 years. Targeted measures in the areas of information, consulting, participation and education help to raise flood risk awareness to a high level and maintain it.

Right image:
Flood disaster response coordinated between the emergency response organisations, experts and those affected helps to minimise damage.

Left image:
Large-scale flood and civil defence exercises improve hazard awareness and prepare for the case of emergency.

2.3 An integrated approach

Integrated flood risk management means that the overall objective – minimising flood risk – is to be reached through the coordination of flood protection, water management, spatial planning, building regulation, organisational and awareness-raising measures. The bundle of measures comprises of preventive measures and ranges from protective structures and measures in the catchment areas to spatial planning, awareness-raising, preparation and finally individual responsibility. Based on this holistic approach the reduction of the damage potential in the long term should be achievable. The emphasis is on reduction, because total protection is economically and technically not possible.

Prevention comprises the flood aware coordination with spatial planning, building regulations and operational regulations. This mostly involves flood modelling, developing hazard zone plans (see chapter 4.3) and communicating these to the municipalities and the affected population.

The construction of *protective measures* is based on planning on catchment scale, general projects and detailed projects (see chapter 4.2). Protective measures are, for example, flood dykes, retention basins etc., for which maintenance also has to be planned. Wherever possible, aspects of hydro-ecology and recreational functions are also taken into consideration.

Integrated flood risk management requires *awareness-raising*, information, participation and education, taking into account that individual and state responsibility needs to be distinguished. Targeted public relations work accompanying all planning processes and projects can make a significant contribution.

Left image:
Protection measures are an important part of integrated flood risk management in Austria.

Right image:
Hazard zone plans are used for zoning plans.

To be *prepared for flood events*, coordinated emergency plans, emergency management plans, forecasting models and alarm plans are needed to reduce potential damages significantly. This requires reliable data provided by hydrological and hydraulic studies as well as operative regulations for protection measures, including technical provisions in case of exceedance. Another contribution is the organisation and training of immediate disaster relief measures.

Post flood measures are of high importance by means of clean-up operations, documentation of the event, evaluation of protection measures and, if necessary, their repair, improvement or extension based on gained knowledge.

Image top right:
The school project "Hazard zone plan for Kids" aims to raise awareness of natural hazards.

Image top left:
Example of a flood operational plan.

Image bottom right:
Fast reconstruction of protective structures.

Image bottom left:
Event documentation after a flood.

Left image:
Protecting areas with high damage potential has priority.

Right image:
Fields, meadows and forests are to be preserved for flood retention purposes.

2.4 Planning principles

General guidelines

Flood protection measures eligible for funding must be in line with the objectives described above, must be of public interest and must be in accordant to integrated flood risk management.

Levels of protection

- The protection of areas in Red Hazard Zones and/or having a high damage potential are of priority, e.g. settlement cores, high-value cultural assets or structures which are important economically or for infrastructure. These areas shall, if efficient and feasible, be protected against a 100-years flood event i.e. the flood statistically occurs once in every 100 years.
- Assets with particularly high social, cultural or economic value and areas with high damage potential can also be protected against even higher flood events (for example Vienna).
- In justified cases (technical feasibility, proportionality of costs), it is permissible to lower the protection level to HQ30, i.e. a 30-year flood.
- Agricultural and forest areas are to be preserved as retention areas and thus are not protection against floods.

Creation and protection of conveyance routes and retention areas

Measures increasing discharge and/or flow velocity are to be avoided. Areas without objects and constructions are to be preserved for conveying or retaining water.

Left image:
Flood near Ansfelden after a dyke breach. Planning also has to consider residual risk, i.e. the case that protective structures are overtopped or or in case of failure.

Right image:
The measures of protective water management must conform to the natural characteristics of the water body (example Upper Drava).

River basin management

When constructing flood protection measures, the minimisation of interference with the water body and its surroundings has priority. The ecological status of the water body is to be maintained or developed towards a good ecological status or a good ecological potential.

Sediment regime

A balanced sediment regime has to be maintained. Such a sediment regime prevents or reduces aggradation and bed erosion, as well as maintaining or improving the long-term stability of flood protection measures.

Planning hierarchy and coordination

Measures are to be determined and selected based on general planning tools on catchment scale (GE-RM, general project, preliminary study, see chapter 4.2).

Risk and residual risk

In case of exceedance of flood protection measures (beyond their design level) or in case of failure, measures to reduce residual risk need to be considered, planned and implemented.

Hierarchy

The selection of measures is prioritised by following principles:

- Passive (non-structural) flood protection measures are preferred over structural flood protection measures
- Retention measures are preferred over linear protection measures
- Natural retention is preferred over structural retention measures
- Natural and near-natural methods of construction are preferred over engineering methods or those improper for the water body type

3 Responsibilities and legal framework

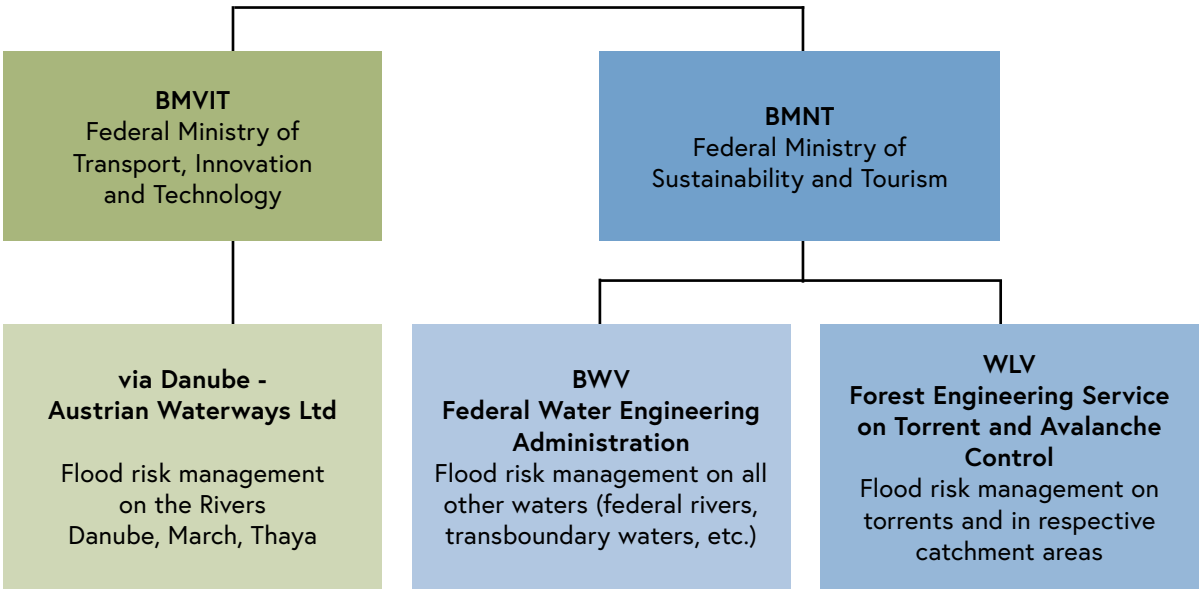
3.1 Organisation

The organisation of flood risk management in Austria is divided amongst three authorities. This is due to the legal requirements, the diversity in landscapes and topography, and regionally different responsibilities (see also the chapter contacts and competent authorities at the end of this brochure):

The waterways of Danube and March, but also stretches of the rivers Thaya, Enns and Traun are in the responsibility of the Federal Ministry of Transport, Innovation and Technology (BMVIT).

Torrents where boundaries are defined by ordinance are in the responsibility of the Torrent and Avalanche Control (WLV) in the Federal Ministry of Sustainability and Tourism, Section III.

Water bodies which are neither torrents nor waterways are in the responsibility of the Federal Water Engineering Administration (BWV). This task is fulfilled by the Federal Ministry for Sustainability and Tourism (Section I - Environment and Water Management) together with the federal provinces.



National organisation of flood risk management in Austria.

3.2 Funding

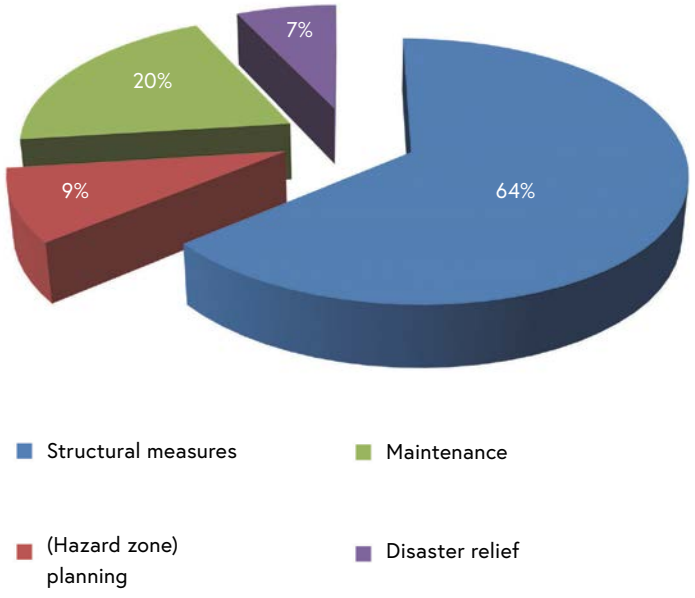
The *Hydraulic Engineering Assistance Act* states the prerequisites for granting public funds and provides the basis for planning and implementing measures in the frame of flood risk management. These are funded primarily by the federal state (around 56%) and the provinces (around 28%), but beneficiaries and stakeholders such as municipalities, water associations or cooperatives are also required to provide funds (around 16 %).

Since the 2002 flood event, the federal state has been investing around 200 million Euro per year into protection against natural hazards. The majority is used for structural measures and maintenance, another share for (hazard zone) planning and the compensation of flood damages. In total, around 400 million Euro are invested per year in flood risk management measures.

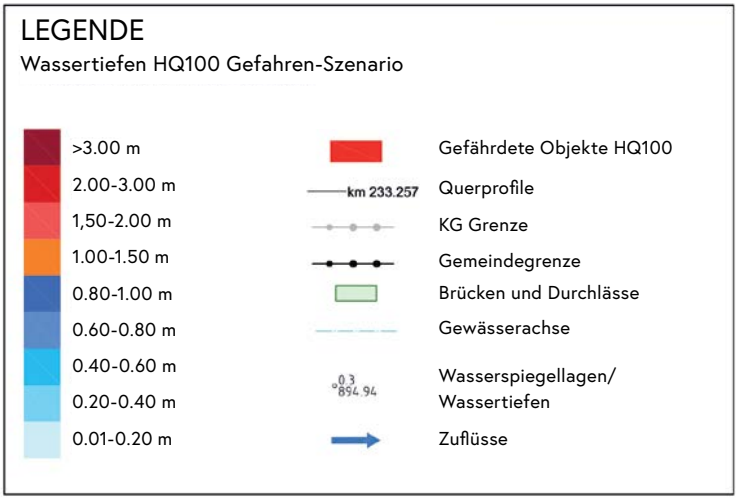
The *Disaster Relief Fund* has been a proven funding tool for flood risk management for 50 years. It was created to provide additional funding of measures to prevent future damages and to compensate those which occur. The Disaster Relief Fund also partially funds emergency apparatus for fire brigades and the warning and alarm system, as well as subsidising hail insurance premiums.

Affected private individuals can file a request for benefits out of the Disaster Relief Fund directly at their municipal office. The size of the benefits is determined by province guidelines.

Around 200 million Euro are invested into protection measures against natural hazards annually. These funds are mostly used for preventive structural measures and maintenance. The remainder is used for planning and for disaster relief.



3.3 Main legal framework

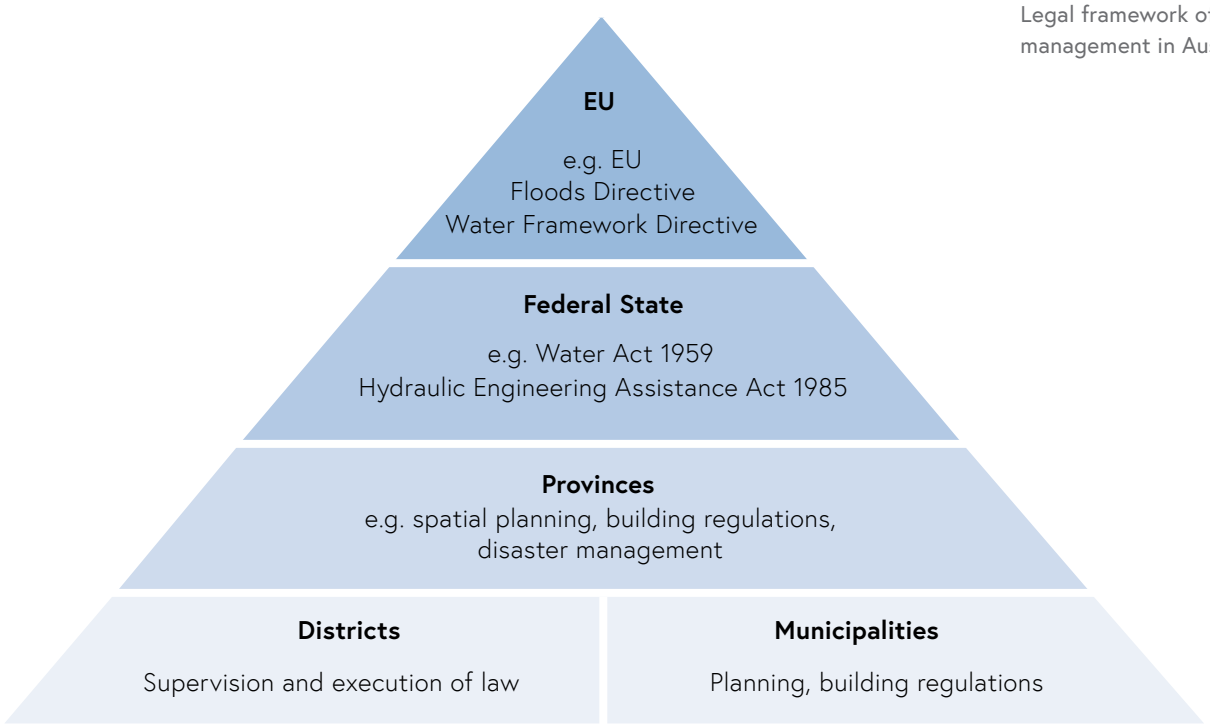


From the legal point of view, flood risk manageme
is dealt with in both federal and provincial law. U
higher level, by means of the Water Framework D

On national level, the legal framework mainly cons
and the Waterways Act. They define the tasks of
WLV) and BMVIT described earlier. Two additiona
hazard zone plans. Technical guidelines regulate
flood protection measures. Added to this are th
ments, the Disaster Relief Fund and the Hydraulic

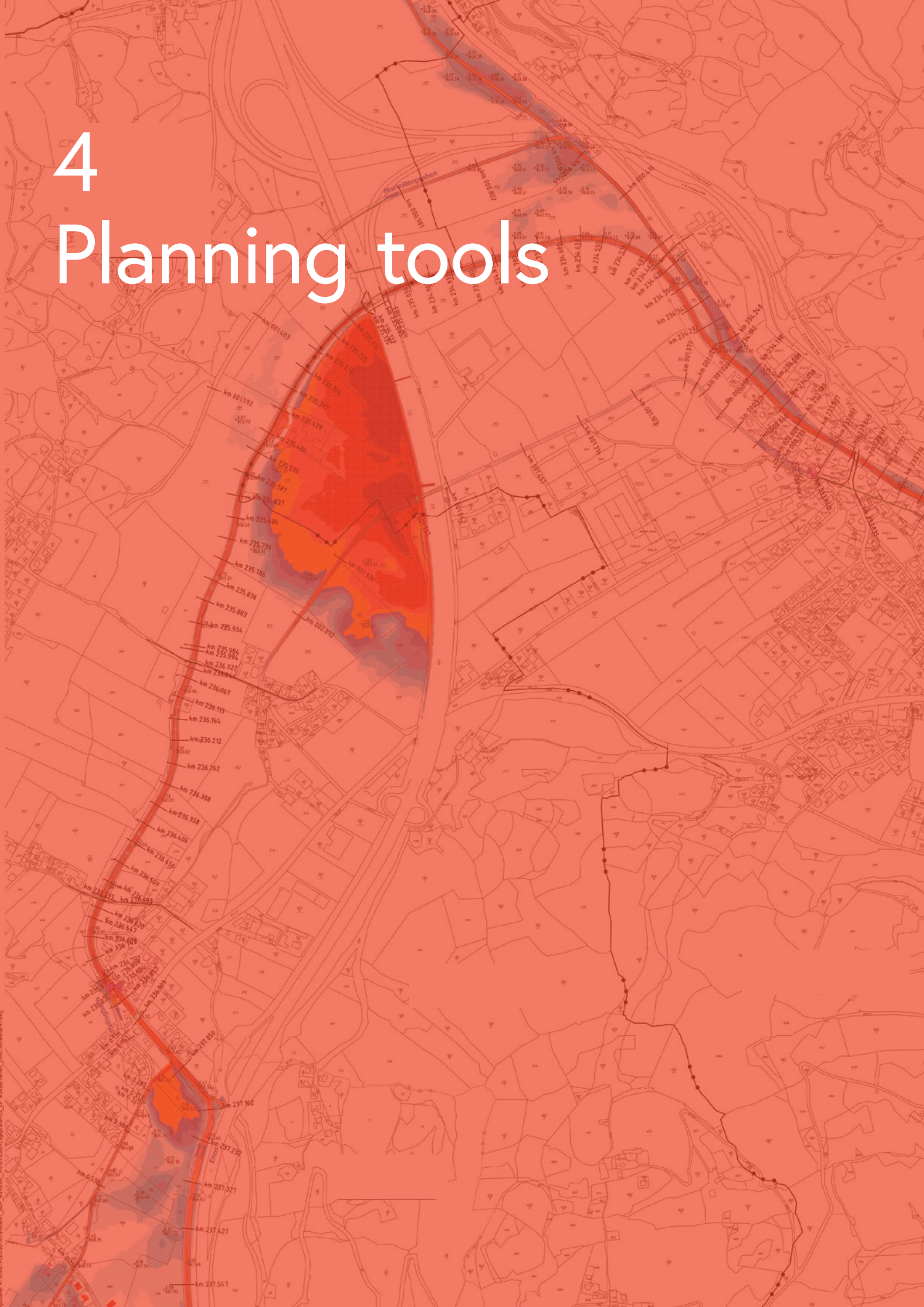
The legal framework for flood risk management is completed by the Provincial laws on spatial planning (ROG) and emergency management as well as building regulations.

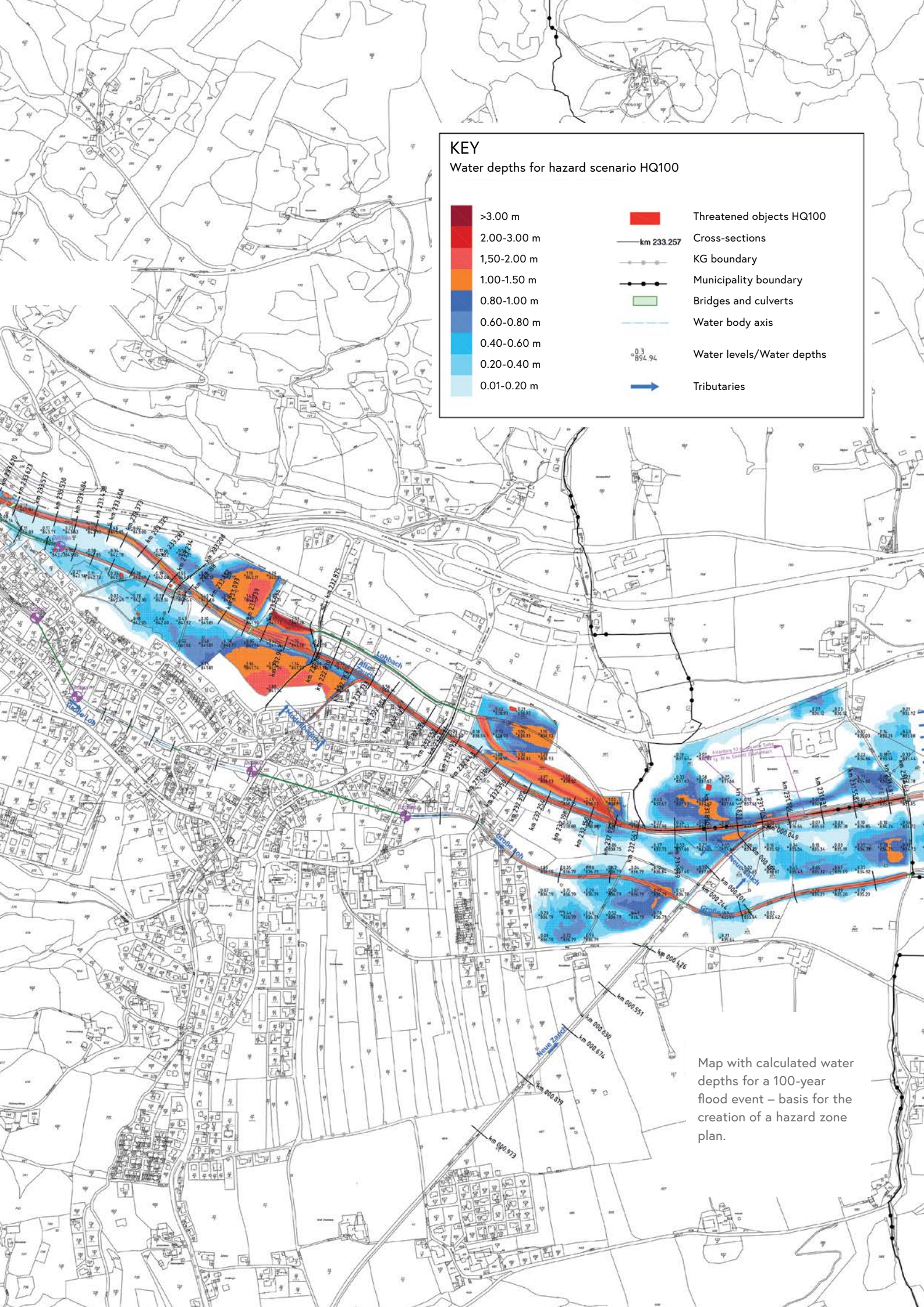
While the districts and the respective provincial governments are responsible for the execution and supervision of the provincal laws (as building authority or the supervising authority of the municipalities), the municipalities have a degree of autonomy for initiatives regarding flood risk management, for instance in zoning planning and issuing building permits.



Legal framework of flood risk management in Austria.

4 Planning tools





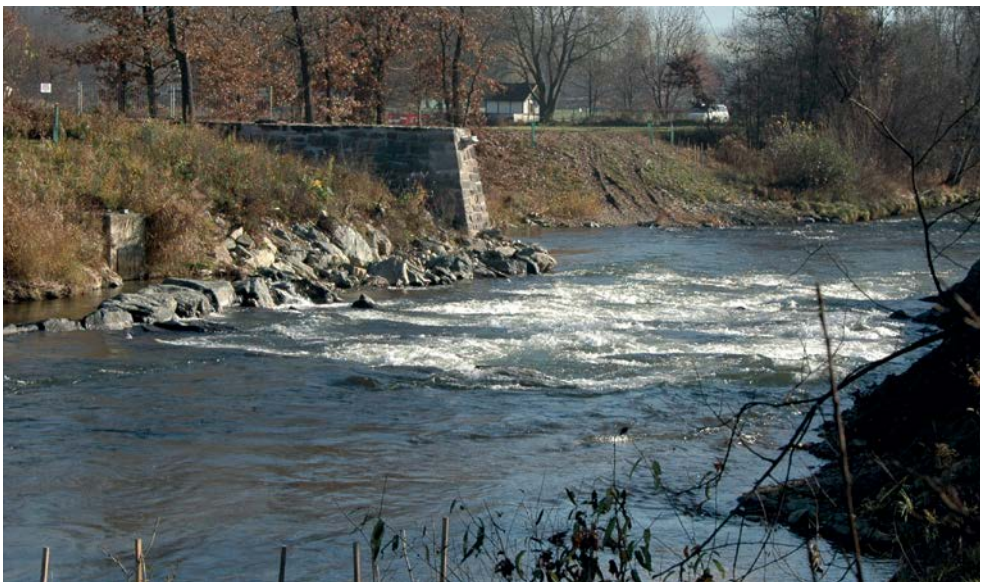
Map with calculated water depths for a 100-year flood event – basis for the creation of a hazard zone plan.

4.1 Planning at the national level

The *Flood Risk Management Plan* is the superordinate planning instrument in Austria. A National Flood Risk Management Plan is created for the entire federal territory in 6-year cycles. It includes particularly those areas which have been identified as Areas of Potential Significant Flood Risk (APSFR) in a preliminary risk assessment. Referring to elaborated flood hazard and flood risk maps appropriate objectives are defined, and measures for achieving the objectives are selected from the fields prevention, protection and preparedness. All steps of implementing the EU Floods Directive are coordinated by the Federal Ministry for Sustainability and Tourism in close cooperation with the Federal Provinces especially the departments for flood risk managment, water management, spatial planning, building regulations and emergency management also involving the public. The first National Flood Risk Management Plan for Austria was published in 2015.

The Flood Risk Management Plan needs to be coordinated with the *National River Basin Management Plan* (NGP). In accordance with the Water Framework Directive, the NGP is to be created for all river basins; its goals are the protection, improvement and sustainable use of the water bodies. Published every 6 years, the NGP defines how to attain the goal of "good status" or "good potential" of the water bodies.

The National River Basin Management Plan (NGP) is to be considered in flood risk managment projects. For instance, obstacles to migration in a water body are to be removed (example Lavant).



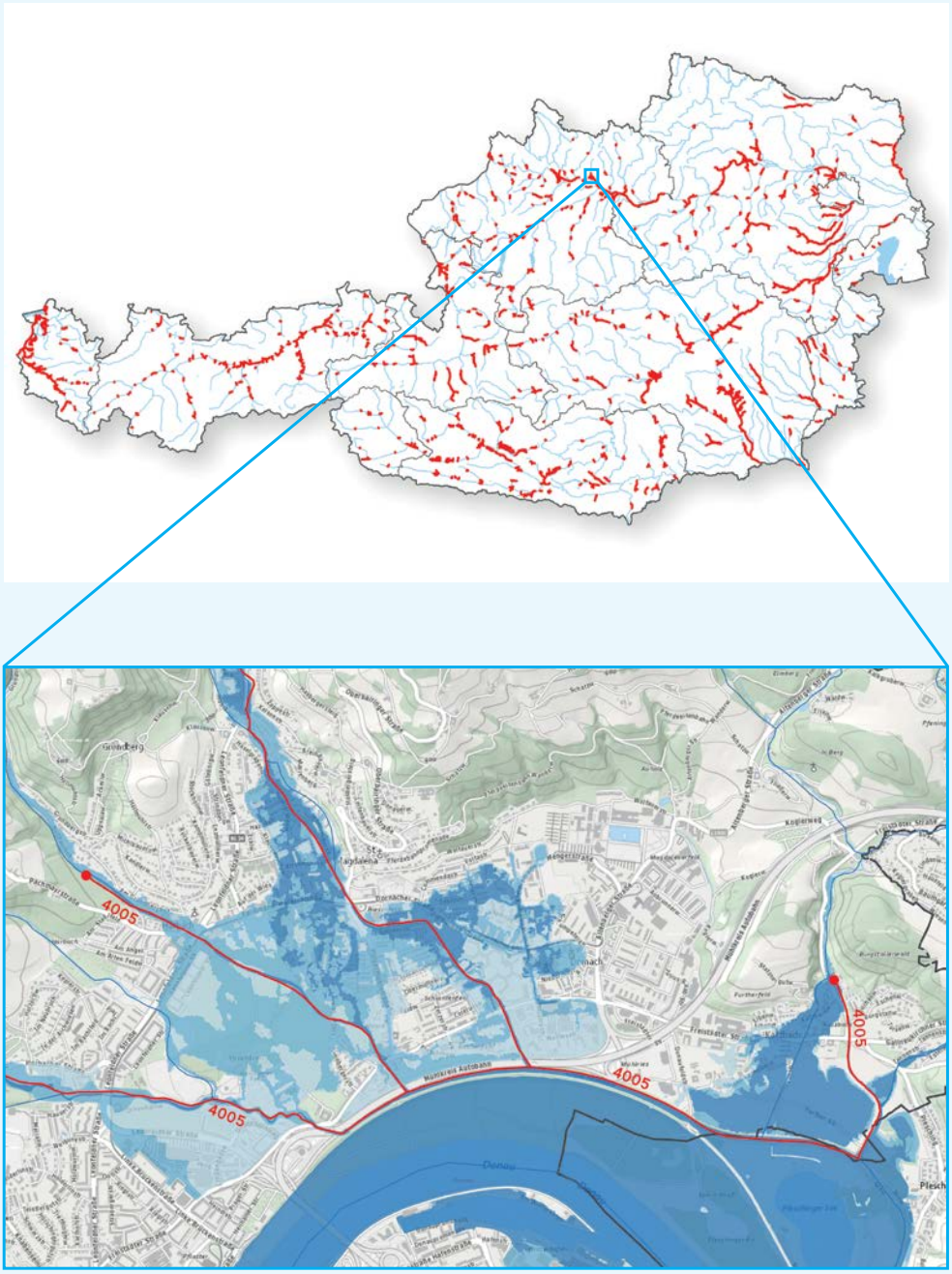
Information

on the current National River Basin Management Plan (NGP) can be found online in the Wasserinformationssystem Austria (WISA):

www.bmnt.gv.at/wasser/wisa/fachinformation/ngp/ngp-2015

Infobox: Flood Risk Management Plan

The Floods Directive specifies that the Flood Risk Management Plan has to be published in a 6-year cycle. After the first National Flood Risk Management Plan was published at the end of 2015, intensive work on the first revision is under way. The revision comprises 3 steps:



Step 1: The preliminary flood risk assessment for the first revision was completed in 2018 using updated data and a revised method.

All Areas of Potential Significant Flood Risk (APSFR) are shown in red.

In **Step 2**, the flood hazard maps and flood risk maps, which form the basis for Flood Risk Management Plans are created. These maps are currently being developed towards better user-friendliness.

The image on the left shows the inundation areas of 30-, 100- and 300-year flood events in different shades of blue.

The online maps (https://www.bmnt.gv.at/wasser/wisa.html) also show water depths, flow velocity and risk indicators.

Step 3 consists of the revision of the Flood Risk Management Plan until 2021.

4.2 Planning at the regional level

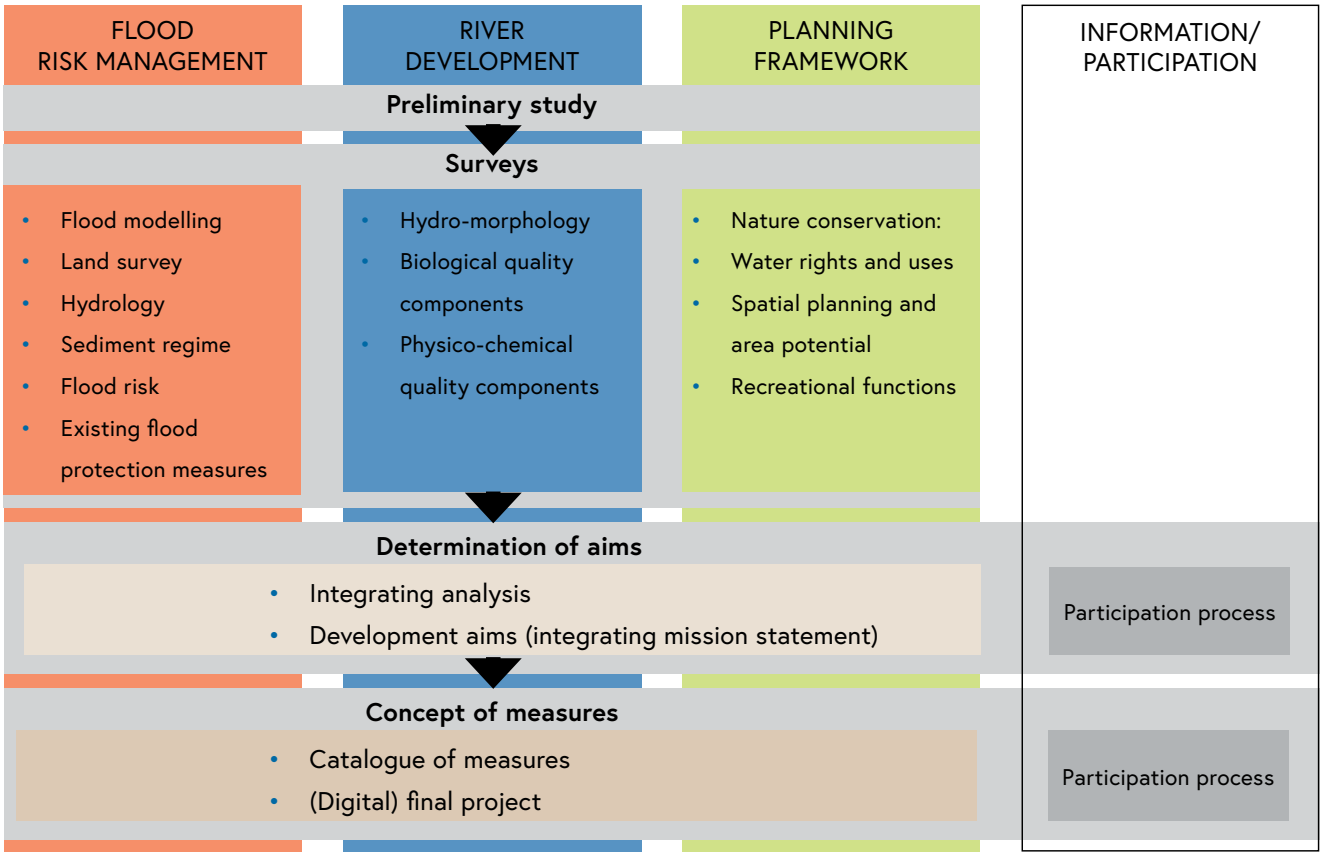
River Basin and Risk Management Concept (GE-RM)

A River Basin and Risk Management Concept (GE-RM) serves to coordinate possible measures in a catchment area or longer water body sections to identify potential synergies and to avoid conflicts.

It is coordinated with:

- the objectives, measures and priorities of the National Flood Risk Management Plan (FRMP) and the National River Basin Management Plan (NGP)
- Regional and spatial planning, building regulations, emergency management, nature conservation and other administrations and authorities as well as – where required –
- other users and those affected in the catchment.

Specialisation and time components of a River Basin and Risk Management Concept / GE-RM (schematic).



Coordinating the River Basin and Risk Management Concept (GE-RM) with the competent authorities, municipalities and stakeholders is compulsory.

The River Basin and Risk Management Concept comprises the following steps:

- *Preliminary study:* In the interest of efficient planning, existing data is reviewed and tasks for the subsequent revision are specified.
- *Inventory* taking supply missing data that as are necessary to determine deficits, objectives and measures.
- *Setting objectives:* Based on the inventory taking and cross-linking to the goals of river basin management as well as the objectives of flood risk management potential deficits can be identified. By this integrated approach guiding principles are defined serving as a common target state to be reached.
- Based on a consistent catalogue of measures, the *concept of measures* finally describes the intended measures in the planning area ranked by priority.

A GE-RM is created primarily for water bodies and catchment areas with a need for action regarding flood risk management and river basin management. Apart from the flood hazard, the ecological status, land use, zoning, third party rights etc. are considered. On the basis of studies and inventory taking, interdisciplinary objectives and measures are defined. These form the base data and starting point for subsequent general projects and detailed planning.

General projects

General projects build on the interdisciplinary guiding principles and the concept of measures defined in the frame of a GE-RM. They serve to determine and coordinate the concept of measures in more detail for a large part of a water body. Often, this is based on a comprehensible analysis of different options of measures. The result is the determination of the most efficient/suitable measure (or bundle of measures) for further detailed planning.

4.3 Planning at the local level

4.3.1 Hazard zone planning

Hazard zone plans are to be created in accordance with the provisions of the Forest Act and the Water Act. They include torrent catchments within the competence of the Austrian Service for Torrent and Avalanche Control (WLV) and especially Areas of Potential Significant Flood Risk within the responsibility of the Federal Water Engineering Administration (BWV). The declaration of Yellow and Red Hazard Zones is the significant part of the planning process. As the Service for Torrent and Avalanche Control and the Federal Water Engineering Administration (operating under the Forest Act and the Water Act, respectively) are the competent authority for catchments with different topographies and processes, their approaches are slightly different.

Within flood risk management, hazard zone plans fulfil important functions

- as basis for spatial planning and zoning
- to inform those affected
- to raise awareness and promote individual adaptation measures
- as basis for the planning and implementing structural and non-structural measures
- as basis for Flood Risk Management Plans, regional programs for water management and River Basin and Risk Management Concepts (GE-RM).

Example of a hazard zone plan.

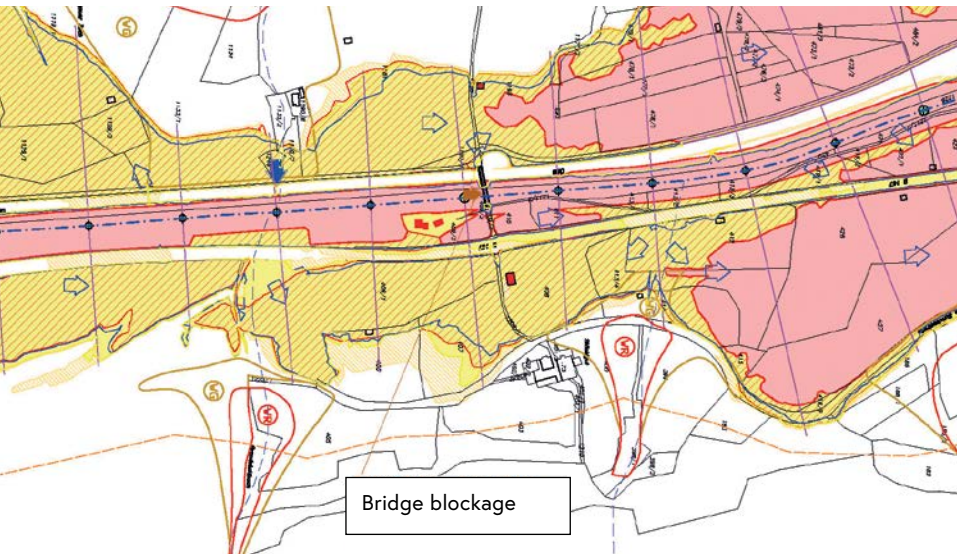
Hazard zones and areas with a specific function for water retention, conveyance routes and potential measures are marked red, yellow and blue in the hazard zone plan.

Red Hazard Zones are characterised as areas with high process intensity, therefore, risk for life has to be assumed. In *Yellow Hazard Zones*, significant damage to objects or infrastructure has to be expected. As total safety by means of flood protection is economically and feasibly not possible, zones with low hazard probability (*Residual Risk Areas*) are also marked. These areas are flooded if existing protection measures are overtopped or in case the measures fail (e.g. when a dyke breaks).

Flood risk management requires space. For this reason, areas which are needed for potential future measures and their maintenance are marked as *Blue Functional Areas*. Areas with flood retention potential and those required for flood conveyance are marked as shaded Red-yellow Functional Areas.

Hazard zone plans are to be considered in local spatial planning and in building regulations. In many federal provinces, building bans are defined in areas of high and moderate flood hazard, especially in Red Hazard Zones. Areas prone to a low probability of flooding are treated under the principles of risk prevention and risk reduction.

Hazard zone plans are available to all municipalities, provincial authorities and federal authorities. For citizens and the general public they are accessible in the municipal offices.



Hazard zones

- Cadaster
- Threatened objects
- HQ30 zone
- Red Hazard Zone
- Red-Yellow cross-hatch functional zone
- Yellow Hazard Zone
- Low-probability hazard (hazard area up to HQ300)
- "Residual Risk Area" (HQ300 behind protective structures)
- Alluvial deposits hazard
- Bed load jam hazard
- Debris jam hazard or dam-burst
- Red Hazard Zone WLV
- Yellow Hazard Zone WLV

4.3.2 Detail projects

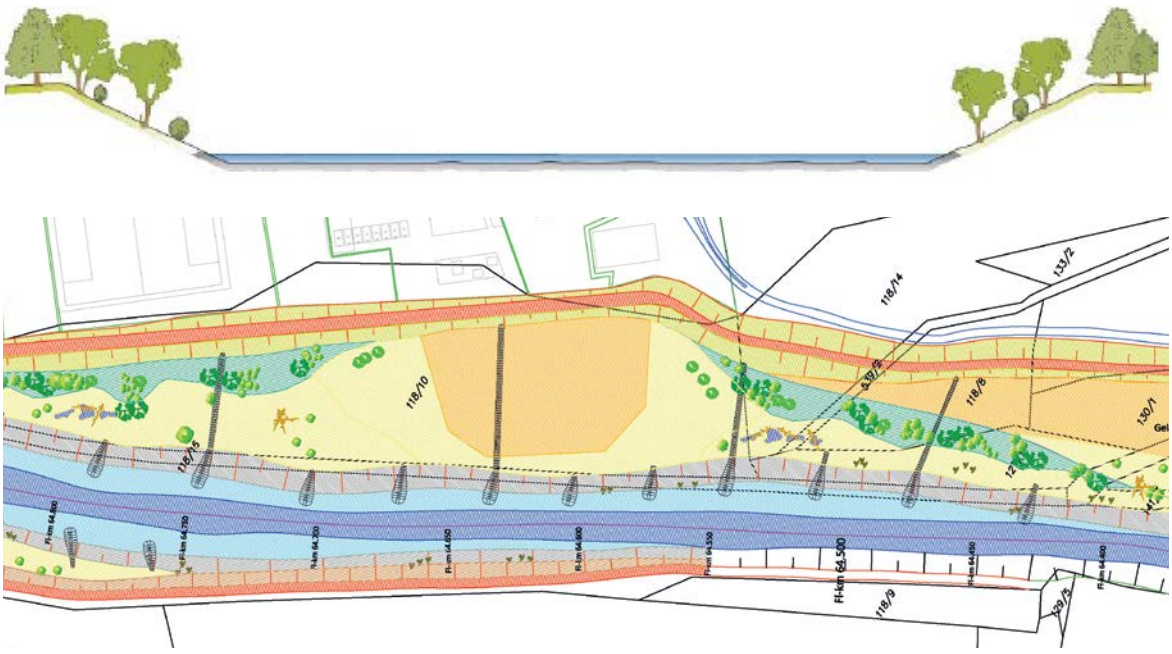
Detail projects are to calculate and prepare measures for their implementation. Moreover, they contain all information necessary for the approval processes (under the relevant laws for water, forest, conservation, railways, etc.).

If third party rights are potentially affected, especially those of local and downstream residents, it is of high priority to assess whether and to what degree these residents are affected by the project under discussion. Further, options to avoid or compensate potential adverse effects are defined.

4.3.3 Maintenance and repair plans for water bodies

Setting up maintenance and repair plans is obligatory in the frame of planning and implementing flood protection measures since 2016. They define the technical maintenance of the structures constructed and the ecological development of the water body's bed, banks and hinterland. The Plans need to be in line towards the desired ecological status according to the National River Basin Management Plan (NGP) and to consider the specifications and determinations made in water law for the water body section. This anticipatory approach is a new one as the future condition already forms an important part of the planning process of flood protection measures. The main reason for that is to minimise restoration efforts and to ensure the function of flood protection measures for the whole life cycle.

Example of a Detail project (bottom image). Desired state of the bank wood strip as defined in the maintenance plan (top image).

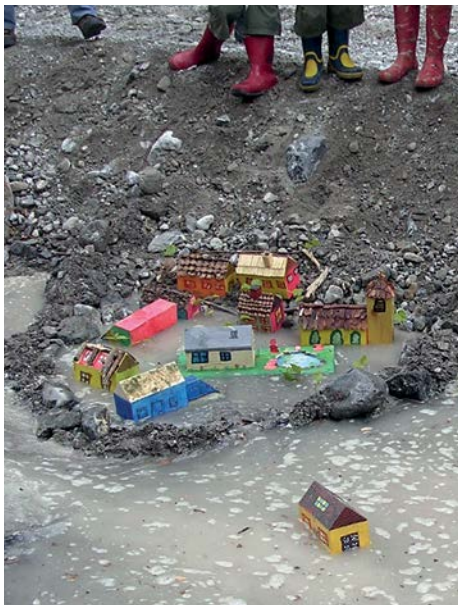


4.4 Risk communication and public participation

Awareness of individual responsibility is a fundamental aspect of integrated flood risk management. The risk awareness of the population is still low and the individual flood risk is often underestimated. Fundamentally, though, everybody is responsible for his or her own property.

To raise hazard and risk awareness and thus improve individual responsibility, efforts are being made to communicate flood risks to the population comprehensible through measures designed to raise awareness, such as emergency exercises, presentation and discussion of flood risk maps and hazard zone plans, exhibitions etc.

Reviews of hazard zone plans can be used to recruit local knowledge in dialogue with those affected, simultaneously creating risk awareness.



Left image:
Exhibition “45 Years after the 1965/66 Möll Flood in Großkirchheim” (Carinthia). Interest in the images and texts by contemporary witnesses was high.

Right image:
School project “Hazard Zone Plan for Kids.” A small experiment in the field makes the consequences of a flood visible.

5 Flood risk management beyond borders

The Danube – 2857 km long – and its tributaries drain from 19 countries. Seen from this angle, the river basin is the most "international" in the world. Austria bears a large international responsibility for the Danube.

Where flood risk management and water body maintenance concerns meet neighbouring countries, bilateral transboundary river commissions have been established which meet periodically to consult and exchange information with each other, as shown here at the Salzach.

5.1 International cooperation

The Water Framework Directive and the Floods Directive implementation are coordinated at the international river basin district level. Three international river basin districts are relevant for Austria. Around 96% of the federal territory drain into the Danube, around 3% into the Rhine and around 1% into the Elbe.

Issues concerning these river basin districts are coordinated in the International Commissions for the Protection of the Danube River (ICPDR), of the Rhine (ICPR) and of the Elbe River (ICPER). Austria bears a special responsibility concerning the Danube. The International Commission for the Protection of the Danube River (ICPDR) has its seat in Vienna, and Austria took an important part in its founding in 1994.

5.2 Bilateral coordination

Water respects no borders. For this reason, flood risk management measures are always coordinated bilaterally with the affected neighbouring countries. Usually, this results in synergy and positive effects.

Decades ago Austria has established important platforms – the bilateral transboundary river commissions – for periodical information exchange and coordination in the form of treaties with the neighbouring countries Liechtenstein, Switzerland, Germany, Czech Republic, Slovakia, Hungary and Slovenia.

In trans-border river basins, water management issues – including flood risk management – are tackled jointly. Some examples to follow.

5.3 Good practice: Restoration of the Lower Salzach

A joint project of Bavaria and Austria.

Regulations and power stations at the Salzach in the border region between Salzburg, Upper Austria and Bavaria have led to massive river bed erosion of up to 6 m over the last 100 years. The consequences are alarming: Bridge foundations and flood dykes may destabilise, bordering riparian ecosystems and Natura 2000 areas are in danger of drying out. In the project "Restoring the Lower Salzach", Austria and Bavaria search for ways together how to counteract this development.

The creation of the bed ramp and "soft" banks were important first steps for the restoration of the Lower Salzach in the Freilassinger Becken.

There already is some initial success. With an uniquely dimensioned flat ramp upstream of Laufen, the river bed was raised by 2 metres. Additionally, "soft" banks were created by removing bank protections, allowing more self-dynamic horizontal erosion. As a result, gravel is continually fed into the river, which stabilises the bed. At the same time, structurally diverse, near-natural banks develop through natural redistribution processes.

A win-win situation for all.

5.4 Good practice: “Rhesi” – Rhine, recreation and safety

On the basis of a treaty from 1892, Austria and Switzerland have been working together successfully at the Alpine Rhine for more than 100 years.

In 2005, the two countries signed off a water body development concept for the river under the title “Future Alpine Rhine”. The flood protection project “Rhesi” is the first big stage in its implementation. The project aims to improve flood protection for over 300,000 people in the lower Alpine Rhine.

The project area stretches from the Ill junction to Lake Constance. Construction measures which fulfil the legal requirements of Austria and Switzerland are required to reach the specified objectives. The aspects of ensuring drinking water supplies, ecological requirements and economical use of resources as well as the dialogue with the population are central to planning.

This is because only a sustainable project which improves flood risk management in the next 50-100 years can be funded and implemented. Planning is ongoing.

See http://www.rhesi.org/ for current information.

“Rhesi” stands for “Rhein, Erholung und Sicherheit” (“Rhine, recreation and safety”) The general project for the largest “torrent” in Europe specifies widening the channel by one and a half (photo montage to the right). The implementation is planned for 2023-2043 – a project for generations.

5.5 Good practice: Border river Mur

Austrian-Slovenian cooperation at the Mur.

Already in 1956, the Republic of Austria and the Federal People's Republic of Yugoslavia signed a treaty on cooperation regarding the border stretch of the Mur between Spielfeld/Šentilj und Bad Radkersburg/Gornja Radgona. It comprised natural hazard protection, hydro-electric use, melioration, water supplies, pollution by waste water as well as the ferries and bridges.

Following the Republic of Slovenia declaring its independence in 1991, the bilateral cooperation at the border stretch of the Mur between Slovenia and Austria was organised in a new treaty. The tasks specified in the 1956 Mur treaty were taken over. The bilateral transboundary river commission is named "Ständige österreichisch-slowenische Kommission für die Mur" ("Permanent Austrian-Slovenian Commission for the Mur") since 1991.

The tradition-rich, decade-long cooperation by both countries has become an example for good practice in jointly managing a stretch of an international river.

Channel widenings at the border stretch of the Mur, such as the one at Bad Radkersburg shown here, are to create retention areas, prevent further bed deepening, protect ground water and improve the ecological status on Austrian and Slovenian territory.

5.6 Good practice: Maltsch

Two countries – joint flood risk management.

A joint project with neighbouring Czech municipality Dolní Dvořiště has been protecting the municipality of Leopoldschlag against a 100-year flood since 2014.

In the past, the settlement area of Leopoldschlag im Mühlviertel was repeatedly affected by floods, especially in 2002. A flood protection project was, therefore, of high priority. Since, however, the Maltsch is a bordering river together with the Czech Republic, cooperation with the neighbouring municipality of Dolní Dvořiště (German: Unterhaid) was aimed for. This became possible through a cross-border Interreg project.

Construction work started in January 2014 on Czech territory. Within only 5 months, the hinterland at the right bank was lowered over a length of 1 km and an average width of 35 metres. The 75,000 cubic metres of material excavated from the roughly 40,000 square metre large area were deposited on the Austrian side. The cross-border cooperation at the Maltsch has become a good practice project of the EU, which funded 75% of the total cost of 1.5 million Euro.

The cross-border implementation of the Maltsch flood protection project shows that it is possible to successfully tackle sustainable flood protection internationally.

6 Integrated flood risk management in practice

6.1 Good practice: Flood prediction in Austria

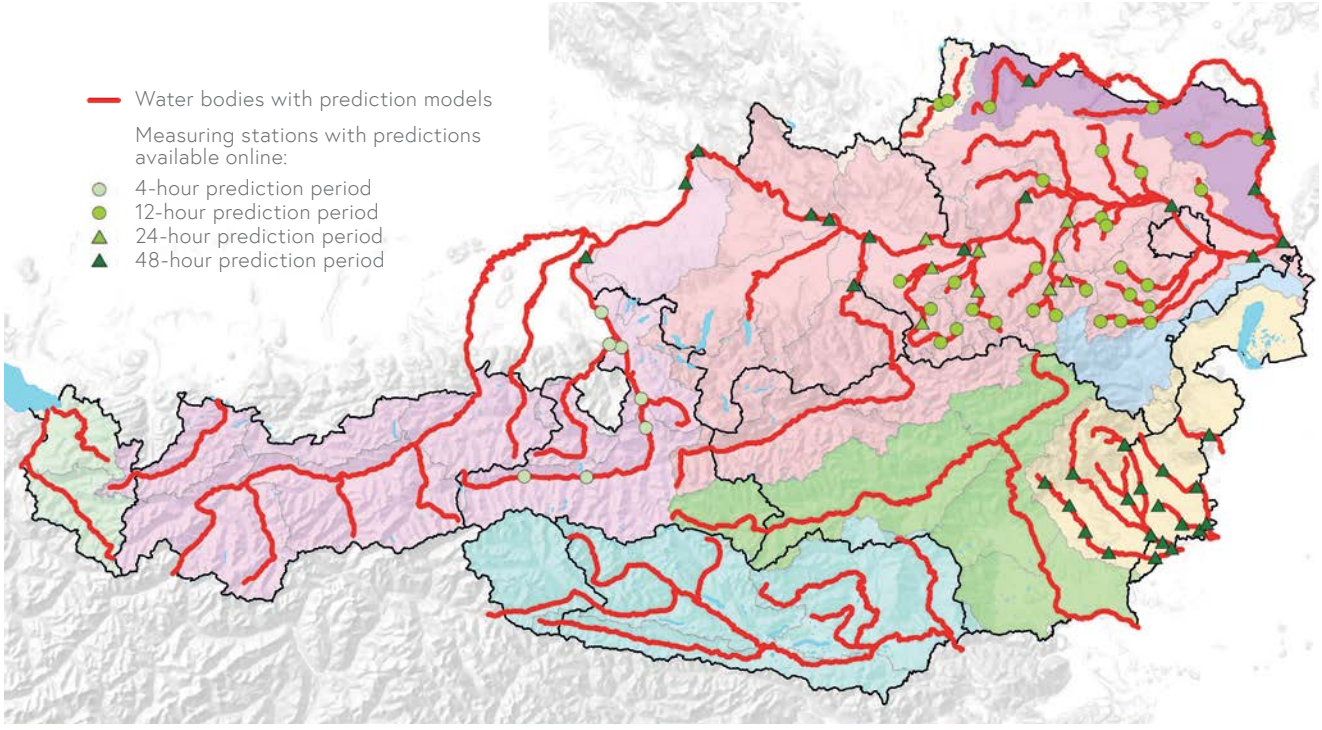
The use of forcasting systems highlights the relevance of integrated risk management.

The alerts issued well ahead of the flood events help to e.g. set up demountable barriers in time and to issue alarms to raise people's awareness. This is particularly important where mobile flood protection is the only option because of space limitations or the value of the landscape, for instance in the Wachau. Only with reliable forecasting and the cooperation of hydrographic and meteorological services together with the emergency management organisations these systems can be used to protect the population effectively.

Currently, forecasting models are in operation at almost every larger water body. The models constantly calculate the current discharge situation and predictions for up to two full days in advance. Further information can be found online with the hydrographic services of the respective federal province.

Information:

https://www.bmnt.gv.at/wasser/schutz_vor_naturgefahren/hochwasserprognose/hw_prognose_at.html



Flood prediction models support flood protection at many rivers in Austria.

6.2 Good practice: Mur Unternberg (Salzburg)

A good practice project for protection and recreation.

In the 1980s, the Mur was regulated in the Salzburg Lungau to improve agricultural production conditions. The river was left mostly devoid of structure. Additionally, the capacity of the regulation profile was exceeded during larger floods, which put the valley floor at risk of large-scale flooding. According to the 2008 hazard zone plan, 110 residential and industrial buildings were exposed to a 100-years flood.

The municipality, therefore, decided to create a flood protection project. It comprised linear protective structures as well as widening river stretches and was implemented in 2013-2017.

Today, the Mur is up to three times wider on a total length of 2.5 km. The population benefits from accessible local recreation areas around the river. The municipality's spatial development concept was also adapted to the hazard zone plan and the flood protection project in order to minimise the damage potential.

The Mur in the Salzburg Lungau had been straightened and regulated in the past. Despite this, settlements were prone to extreme flood events. Since 2013, river widening and protective structures provide safety. At the same time, the Mur has become more easily accessible for the population.

6.3 Good practice: City of Steyr (Upper Austria)

New ways of flood protection.

The historical town of Steyr associated to iron, located at the confluence of the Enns and the Steyr, has experienced floods since its founding. In 2002, the most recent of them flooded numerous houses. The damage amounted to over 40 million Euro.

A broad combination of measures implemented 2008-2011 promises relief. First, gravel deposits in the Enns were removed. To prevent these from accumulating in the future, the bed load is now deposited upstream of the town of Steyr in a new side arm designed to be near-natural. The side arm, optimised by a model experiment, is also used for local recreation. Downstream of the centre of the town, bed deepening, channel widening and the partial removal of an island have lowered future flood levels by a metre.

Additionally, a 48-hour flood forecasting model as well as alarm and emergency plans ensure efficient emergency management in case of flooding. The current hazard zone plan also forms the basis of spatial planning and building regulations. This approach aims for avoiding future increase of damage potential..

Flood protection can be this natural: The function of the new side arm in the Himmlitzer Au upstream of the town of Steyr is the removal of bed load, but it is also a popular local recreation area.

6.4 Good practice: Lauslingbach (Styria)

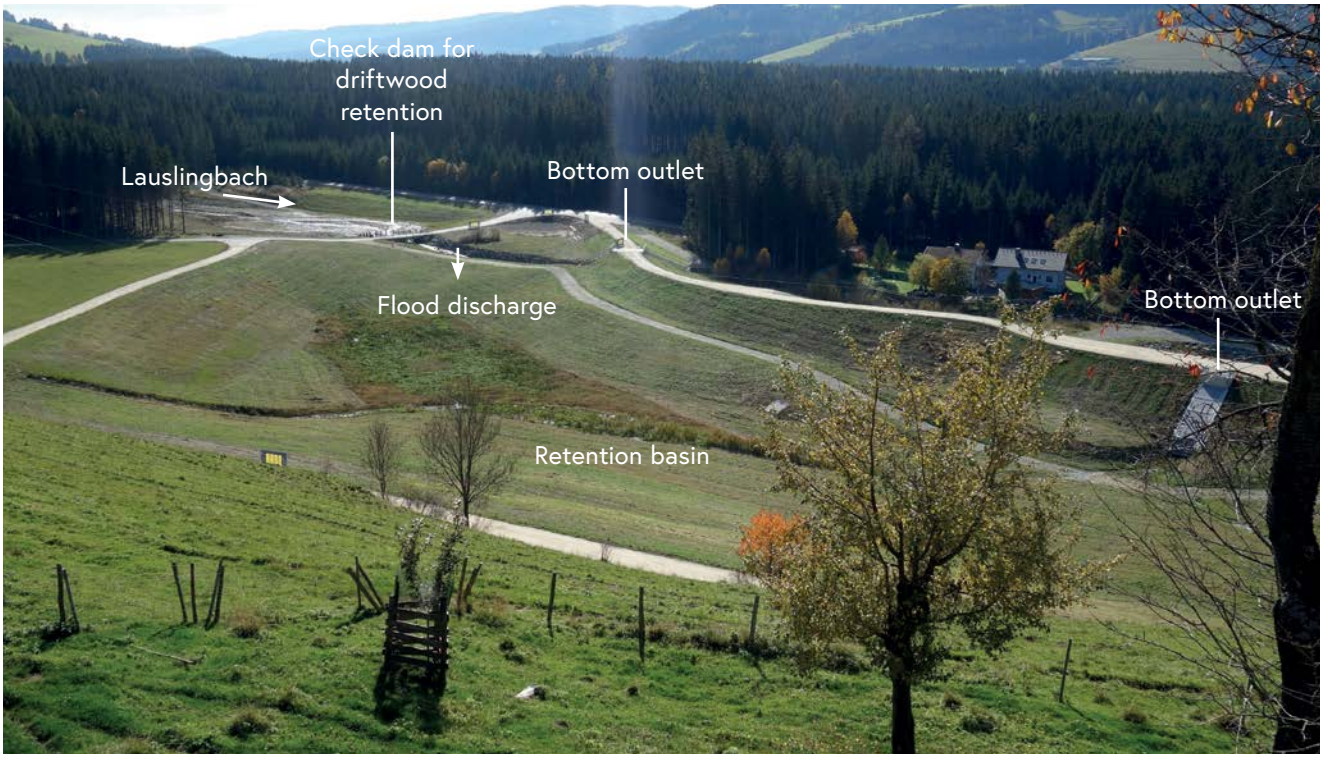
Combining longitudinal measures with flood retention.

In the past, the Lauslingbach repeatedly flooded the municipal area of Obdach. Aside from infrastructure, it also threatened 43 residential and office buildings as well as 10 businesses.

Planning needed to consider the lack of space in the village. A flood retention basin combined with longitudinal protective measures along the Lauslingbach proved the best solution for protecting against a 100-years flood. Parts of the linear structures were built along with the street bypass for Obdach. They prevented from significant damage during the flood event of 2012.

The flood retention basin, which was built as a bypass has a retention volume of 150,000 cubic metres. Its main element consists of an earth dam with a height of 13 m and a crest length of 300 m. A gravel trap and a driftwood rack precede the basin. The Lubibach, a tributary on the right side managed by the WLV, was also included and thus the associated flood risk reduced.

By now, the structure has been greened and is well-integrated into the landscape.



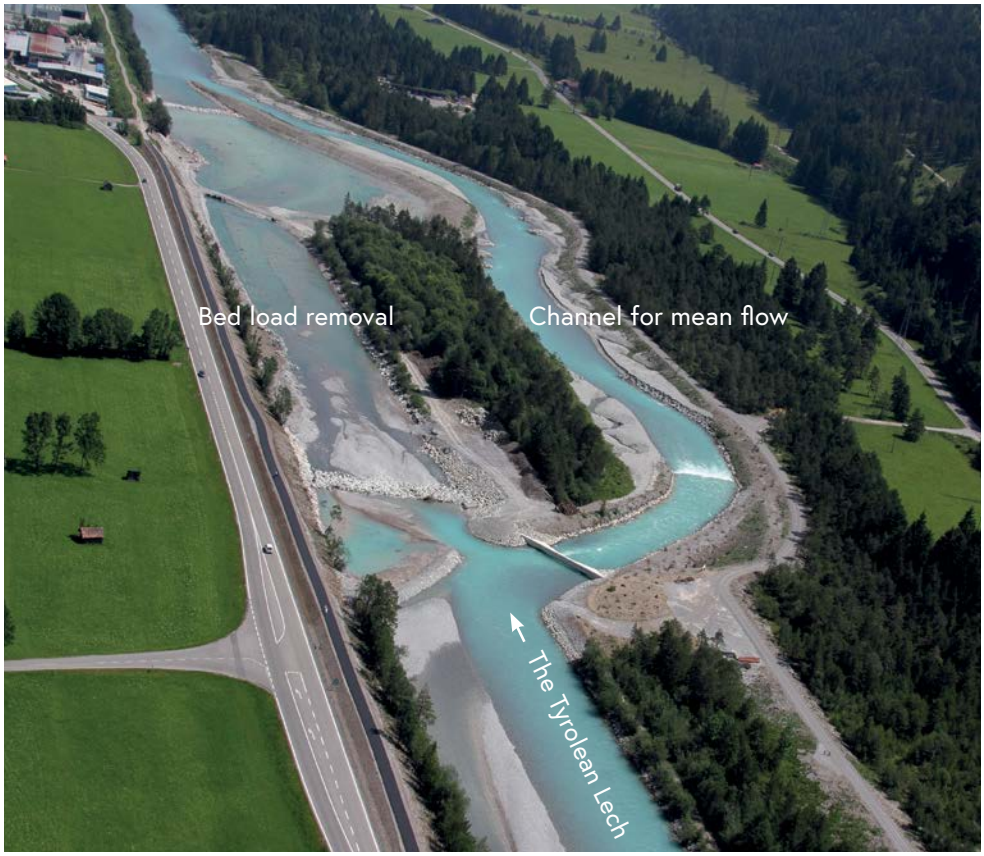
A newly constructed flood retention basin at the Lausingbach will protect Obdach from floods in the future. The bottom outlet regulates discharge during flood events and during normal water flow allows fish and water animals to migrate unimpeded.

6.5 Good practice: Lech (Tyrol)

Bed load management and flood protection in a Natura 2000 area.

The Tyrolean Lech is considered one of the last natural rivers in the Northern Alps. Despite regulation, its morphological dynamics and habitat diversity were conserved over long stretches. However, because the river was narrowed in places, because bed load was retained in the side valleys and because gravel was extracted from the Lech, the river bed deepened sharply in the middle Lech valley. In the settlement areas of Reutte, on the other hand, bed deposits grew quickly. They had to be removed repeatedly in order to ensure flood safety.

This problem was solved with the construction of a sediment trap. Excavation of bed load is now limited to a single spot which is not very sensitive ecologically and which allows sediment management. This promises to sustainably resolve the conflict between the dynamic river Lech and the justified need to protect the inhabitants of the Lech valley.



Bed load excavation facility Höfen-Hornberg:
A new channel for mean flow was constructed in parallel to the bed load trap. It serves to transport the necessary, although reduced, amount of bed load downstream.

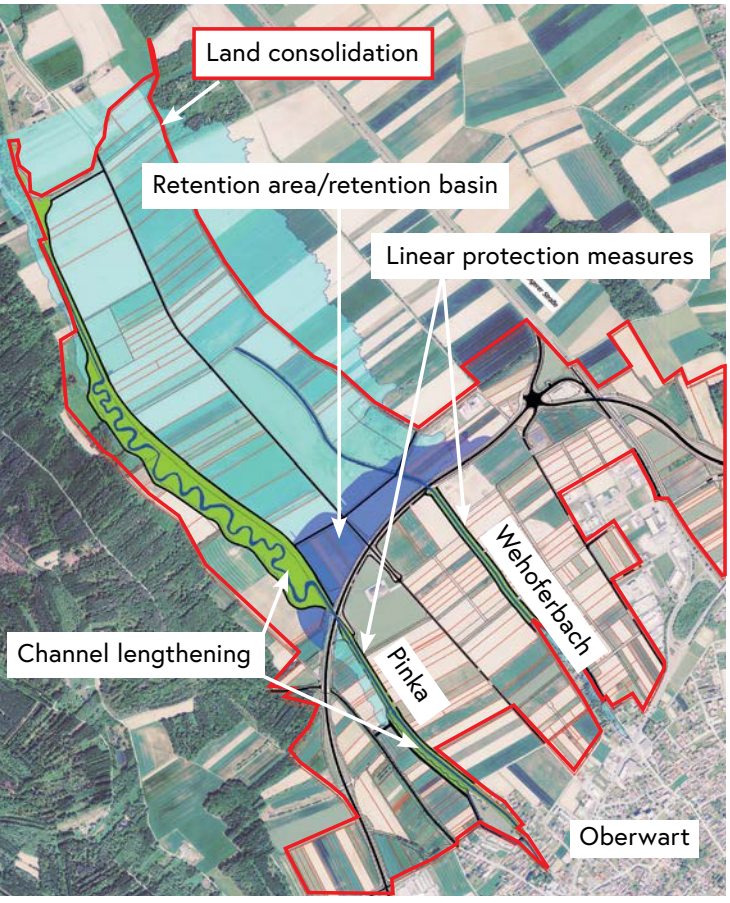
6.6 Good practice: Pinka (Burgenland)

Protective structures and revitalisation as the most effective solution.

During a number of flood events, especially in 2010, the Pinka and the Wehoferbach flooded large areas in the municipality of Oberwart. During the planning of improved flood protection, a combination of longitudinal protective structures and revitalisations was found to be the most effective solution in terms of flood risk and water management.

Those responsible thus decided to revitalise the water bodies, which were regulated at that point, by increasing channel length and side arms within a land consolidation procedure. At the same time, space was set aside for a retention basin along the federal road. It aims to slow flood discharge into the municipal area of Oberwart in the future. Additionally, several bed steps were made fish-passable again through the construction of fishways. As a side effect, a local recreation area for humans and recovery spaces for animals and plants were developed.

Integrated flood protection at the Pinka and the Wehoferbach: Following the joint implementation of river engineering and hydro-ecological measures, Oberwart is now protected against a 100-year flood. Simultaneously, the aims of the Water Framework Directive are fulfilled. 13 hectares of agricultural land were purchased in the process.



6.7 Good practice: Danube (Vienna)

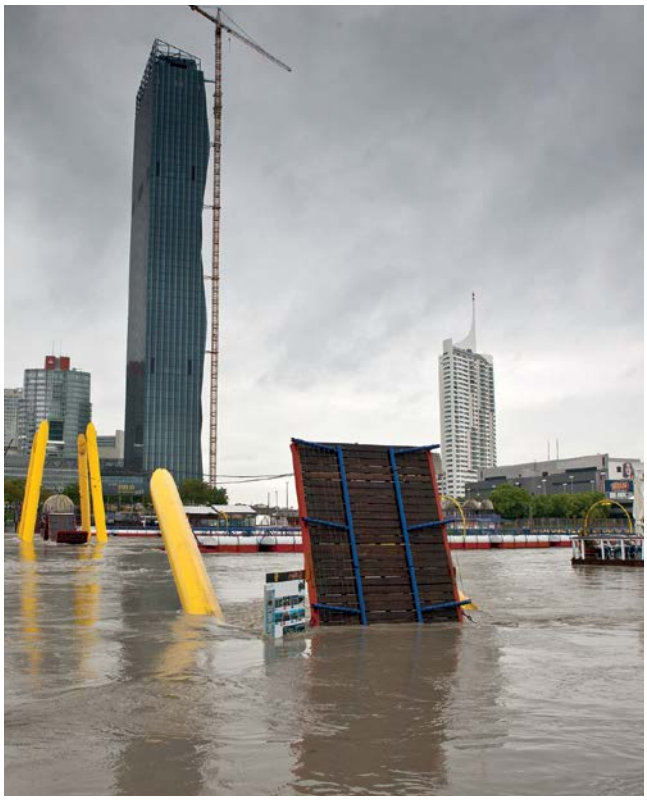
“Improved Danube Flood Protection” – proven for over 30 years.

The decision for the regulation of the Danube was made in 1868. The same machines used during the construction of the Suez Canal dug a new, 280 m wide bed for the Danube in Vienna. However, it quickly became apparent, it was too small, and improved flood protection was needed.

The City of Vienna decided to design an overflow channel – the “New Danube”. The excavated material was used to create an island between it and the existing river bed – the “Danube island”.

Only during flood events significant amounts of water flow through the “New Danube”. An intake structure regulates inflow volume. Two additional weirs maintain lake-like conditions during mean flow – that is for most of the year. In combination with the Danube island as a flood protection measure, an attractive recreation area was developed which has become Vienna’s largest “leisure time oasis” and gained worldwide recognition as a good practice project for integrated flood protection.

The project was officially concluded on 29 July 2016 after 46 years of construction.



In 2013, Viennese flood protection was severely tested (left image). Thanks to flood protection that has been continually improved over decades, serious damage was prevented. Outside flood periods, the Donauinsel is the favourite local recreation area of the Viennese (right image).

6.8 Good practice: Ill (Vorarlberg)

Technology in the service of flood protection and ecology.

During long-lasting rainfalls, the Ill in Vorarlberg can reach dangerous levels, as the floods of 1999 and 2005 have shown. After founding a cross-municipality water management board, much effort has been put both into the coordinated extension of flood protection and the ecological melioration of the Ill over the past 15 years.

The retention basin at Bludesch/Gais is the core element of this effort. During floods, the structure diverts some of the Ill's water into a bordering riparian area 38 hectares large. In four basins, up to 600,000 cubic metres can be stored temporarily, and can be released back into the Ill through the Dabaladabach after the flood peak has passed. The system is controlled remotely via a discharge level measuring station downstream.

At the same time, a bed step impassable to fish was modified into a step-pool ramp using the crossbar-pool system. The total construction costs, including land acquisitions and the bed ramp, were approximately 10.8 million Euro.

Retention basin Bludesch/Gais (left image): During floods, water is removed from the Ill through three segmented gates 17 m long and stored temporarily. Thus, protection has been improved for the adjacent settlement area and the downstream channel. At the same time, a bed drop was made fish-passable (right image).

6.9 Good practice: Suchabach (Carinthia)

Flood protection pays off.

The village of Gösselsdorf was at significant flood risk by the Suchabach. Almost 200 buildings would have been affected by a flood. The damage resulting from a 30-year flood was estimated to be 3.1 million Euro.

The municipality and the hydro-engineering department of the Province of Carinthia searched and found a solution in terms of construction and funding, which was able to be implemented at a total cost of around 3.7 million Euro. A retention basin, which can reduce the flood peak, combined with widening the stream profile within the village, which allows the flood water to run off without causing adverse effects, were implemented. As the retention basin is filled only rarely, it can function as a local recreation area and a wetland habitat in times without flood discharge. Additionally, the WLV constructed barriers in order to retain parts of the bed load in the upper catchment.

During a local heavy rain event (HQ60) in August 2016 the system proved its effectiveness for the first time: There was no damage in Gösselsdorf – the protection measures prevented around 3.4 million Euros worth of damage!

Put to the test: The retention basin at Gösselsdorf in the municipality of Eberndorf can hold back up to 180,000 cubic metres of water. During the event on 15 August 2016 it damped the flood wave – thus, the lower course had no problem dealing with it and damage was prevented in Gösselsdorf.

6.10 Good practice: Laa an der Thaya (Lower Austria)

Innovative flood protection at Sieglißgraben.

During the construction of the new southern road bypass for Laa an der Thaya, the natural depression south of the road was adapted as a retention area for the Sieglißgraben.

The road embankment simultaneously functions as a flood dam. Instead of a bridge over the Siegließgraben, a discharge regulation structure was integrated into the dam, which reduces the volume of water flowing into the town area during floods. This combination of flood dam and road construction has a retention capacity of up to 120,000 cubic metres of water – this is 40 times the amount of water contained in a sport swimming pool.

The town of Laa an der Thaya at the same time is protected against a 100-years flood from the Siegließgraben.

Interdisciplinary thinking results in multipurpose solutions, such as here at the Sieglißgraben near Laa an der Thaya. The discharge regulation structure in the road embankment of the new bypass creates a flood retention area for the protection of the nearby town.

6.11 Good practice: “Flussdialog” (“River Dialogue”)

Talking to each other: successful implementations.

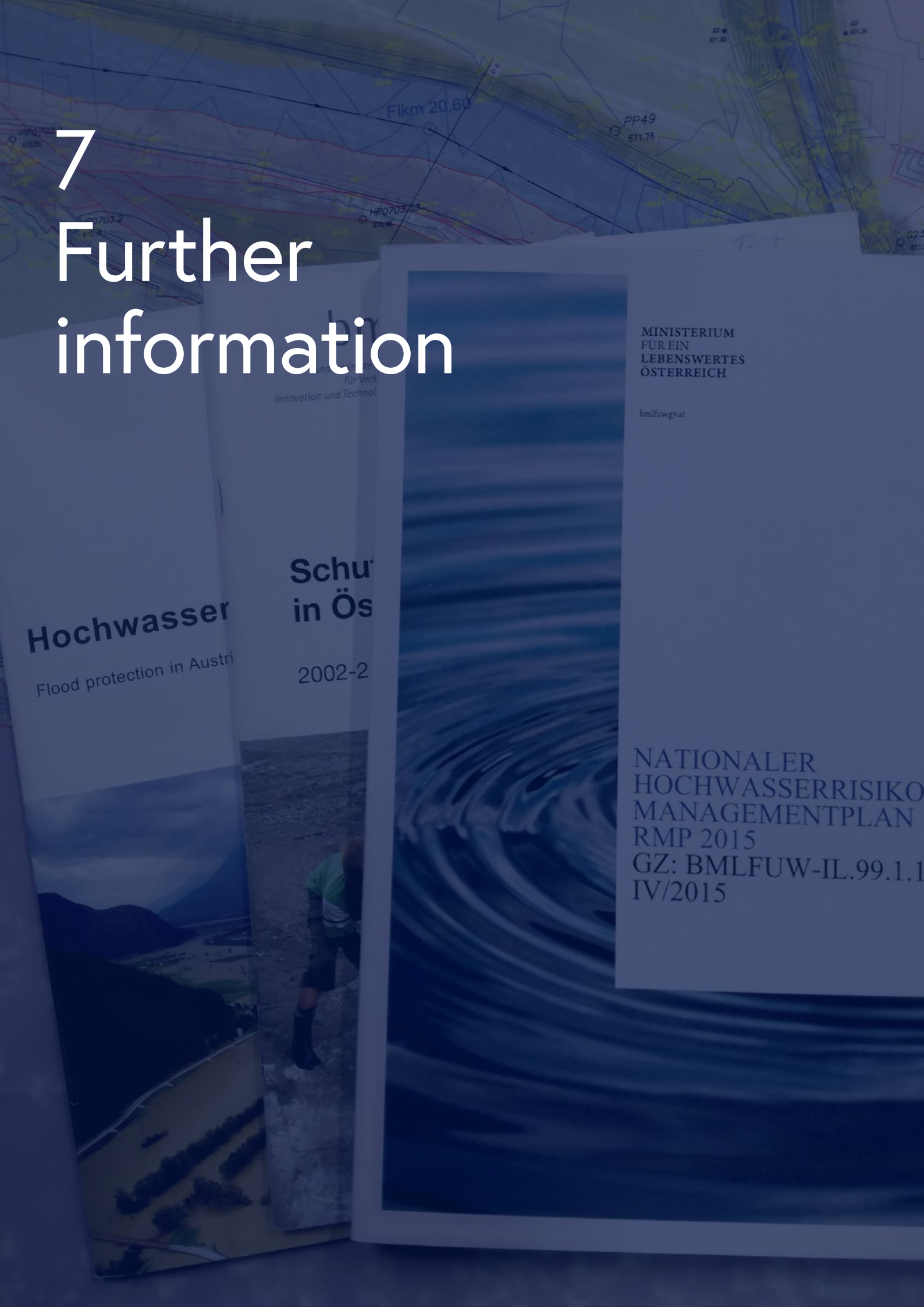
Only those who talk to each other can successfully implement projects. The “Flussdialog” is committed to this principle. It has sought to involve the inhabitants of the regions in the planning process for the Water Framework Directive and the Floods Directive implementation since 2008. At “Flussdialog” events, those responsible at the province or federal level discuss tasks, challenges and chances with stakeholders and the interested public which concern “their” river. In this way, they raise awareness and promote understanding for hydro-engineering measures and flood risk management measures.

All participants are able to provide input actively. Specific topics are discussed in a practical way, laypersons can discover connections, and issues of affected residents gain visibility. They are heard at the province and federal level and taken into consideration for future measures.

Regarding acceptance of the “Flussdialog”, the numbers are impressive. From 2008-2012, around 240,000 households and over 2,200 regional stakeholders in ten river areas were invited to participate in the discussion. Over 11,000 people joined and participated in online surveys. Just short of 1,500 visited the regional “Flussdialog” events.

Since 2008, the Federal Ministry for Sustainability and Tourism, in cooperation with the four Provinces of Upper Austria, Carinthia, Styria and Salzburg, has organised 13 “Flussdialog” (“River Dialogue”) events in ten river basins. Interest and participation were high.

7 Further information



7.1 Contacts and Competent Authorities

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Provincial Government of Salzburg
Department 7 - Water
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www.salzburg.gv.at

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www.wasserwirtschaft.steiermark.at

Office of the State Government of Upper Austria
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www.land-oberoesterreich.gv.at

Tyrolean Regional Government
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www.vorarlberg.at

Provincial Government of Vienna
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www.gewaesser.wien.at

Forest Engineering Service for Torrent and Avalanche Control

Federal Ministry for Sustainability and Tourism

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7.2 Publications

www.bmnt.gv.at/publikationen

Leben mit Naturgefahren, 2010. Guide for personal precautions against floods, mudslides, avalanches, rockfall and landslides.

Schutz vor Naturgefahren in Österreich, 2012. Natural hazard events and protection measures in Austria since 2002.

1. Nationaler Hochwasserrisikomanagementplan RMP, 2015. Report, annex. www.bmnt.gv.at/wasser/wisa/fachinformation/hochwasserrisiko/hochwasserrisikoplan/managementplan.html

2. Nationaler Gewässerbewirtschaftungsplan, 2015. Report, tables, maps. www.bmnt.gv.at/wasser/wisa/fachinformation/ngp/ngp-2015.html

1. RMP /2. NGP, 2015. Two-sided brochure on public participation.

Technische Richtlinien für die Bundeswasserbauverwaltung (RIWA-T), Version 2016.

7.3 Links

www.bmnt.gv.at/wasser
Homepage of the Federal Ministry for Sustainability and Tourism with extensive current information on water management.

www.bmnt.gv.at/wasser/wisa
Austrian water information system, with background documents, specialised databases and opportunities for participation.

www.hora.gv.at/
Digital map showing possible flood hazard, allowing a first estimation, if the own property is potentially at risk.

www.naturgefahren.at
Detailed maps on natural hazards, event history, measures, projects and cooperative efforts, services and much more.

www.wasseraktiv.at
Essential information on the EU Water Framework Directive and Floods Directive.

www.generationblue.at
Austria's largest youth platform on the topic of water, with many campaigns and attractive materials for young people and teaching.

www.neptun-wasserpreis.at
The Austrian Wasserpreis Neptun is awarded every two years and makes it possible for both specialists and the wider public to win great prizes for innovative ideas.

ec.europa.eu/environment/water/index_en.htm
Water platform of the European Commission with information on international water management.

water.europa.eu
Water Information System for Europe (WISE) with comprehensive reports, data, publications and further information.

www.icpdr.org
Information on the international catchment area and protection of the Danube.