Lessons Learnt from Flood Disasters

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 Editors
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Mission

The mission of the Institute for the Protection and the Security of the Citizen is to provide research-based, systems-oriented support to EU policies so as to protect the citizen. The main application areas are cyber-security and the fight against fraud; natural, technological and economic risks; humanitarian security, non-proliferation and nuclear safeguards. The Institute will continue to maintain and develop its expertise in information, communication, space and engineering technologies in support of its mission.

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ABSTRACT

The NEDIES project is being conducted at Ispra by the Institute for the Protection and Security of the Citizen (IPSC) of the EC Joint Research Centre (JRC). The objective of the project is to support the Commission Services of the European Communities, Member State Authorities and EU organisations in their efforts to prevent and prepare for natural disasters and accidents and to manage their consequences. The project also aims to protect the citizens via the dissemination of targeted information on risk perception and awareness.

A main NEDIES activity is to produce "lessons learnt" reports based on experience gained from past disasters. This report discusses lessons learnt from recent flood disasters. It is based on the contributions presented at a NEDIES meeting held at Ispra JRC on 27 and 28 September 2001.
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1 INTRODUCTION

NEDIES (Natural and Environmental Disaster Information Exchange System) is a project concerned with natural disasters and accidents, which occurred in EU Member Countries. It is carried out at the Institute for the Protection and Security of the Citizen (IPSC) of the EC Joint Research Centre (JRC).

This report is based on the contributions presented at a NEDIES expert meeting on lessons learnt from flood disasters held in Ispra, at the JRC, on 27 and 28 September 2001. With view to enlargement, this meeting was open to experts from Accession Countries. This is a novelty that will be pursued in upcoming NEDIES expert meetings.

Chapter 2 focuses on lessons learnt from various flood disasters experienced throughout Europe. There are six lessons learnt contributions from six EU Member Countries (Finland, France, Germany, Portugal, Sweden and UK) and four contributions from three Accession Countries (Czech Republic, Romania and Slovenia).

The first contribution is from Finland, which covers the 1984 Tornio River flood (Section 2.1). This is followed by a French contribution, which describes several disastrous floods between November 2000 and May 2001 (Section 2.2). The third event portrayed in this chapter occurred in May 1999, in Bavaria, Germany (Section 2.3) and is followed by the flooding that occurred in Ireland in November 2000 (Section 2.4). The next contribution is from Portugal, regarding a flood in January 2001 on the Mondego River (Section 2.5), followed by the flood that hit Arvika in the western county of Värmland in Sweden in November 2000 (Section 2.6). From the UK, there is a contribution regarding the autumn 2000 floods that devastated almost 700 locations in England and Wales (Section 2.7).

The lessons learnt that follow are shared by Accession Countries. The first of these contributions is from the Czech Republic, which describes a flooding event that hit the eastern part of the region of Bohemia in July 1997 (Section 2.8). Two flood disasters are portrayed by Romania: the first occurred in Spring 2000, which affected the western, central and south-western part of the country (Section 2.9), whilst the second took place in March 2001 and had an adverse effect on the north-western part of Romania (Section 2.10). Last but not least are the lessons learnt contribution from Slovenia, which covers the November 1998 floods that occurred all over the country (Section 2.11).

Chapter 3 portrays four contributions on other experiences in the field of flood management. The first contribution is from Austria, which describes general experience gained from floods that occurred in Salzburg (Section 3.1). The next contribution, from Greece, deals with flood management option and recommendations (Section 3.2). This is followed by another contribution from the UK, which offers disaster management experience gained from flooding events that occurred in that country over the last five years (Section 3.3). Finally, the second German contribution focuses on the role of the media during the July 1997 flooding of the Oder catchment (Section 3.4).

Chapter 4 summarises the various lessons learnt from the participating countries, and offers some conclusions arising both from the analysis of the lessons learnt contributions and the discussions made during the meeting.

This report mainly addresses the European Commission Services, Civil Protection Authorities of the EU Member Countries and people involved in the management of natural and environmental disasters. It is also available to any interested public. Although the report
is concerned with flood disasters, many of the lessons learnt presented can also be of help in
the prevention of, preparedness for and response to other types of disasters.
To assist the non-expert reader, an annex is provided, which contains selected flood terms
and definitions, along with a self-help checklist to prepare oneself for flooding events.
The report is included in the website (http://nedies.jrc.it) of the NEDIES project.

2 LESSONS LEARNT

2.1 Tornio River Flood in 1984 (Finland)

Jukka METSO (Ministry of the Interior, Rescue Service, Helsinki)

Tornio River is located in the northern part of Finland in the province of Lapland. It is a
boundary river between Finland and Sweden and it is one of the bigger rivers, where there
are no electric power stations.
Floods in Finland are usually annual spring floods caused by thawing snow and ice. During
the thawing period, heavy rains, as well as water content of the thawing snow, can increase
the scale of a flood. One of the most common reasons of flooding in Finland is ice dams that
build up either at the estuaries or at the rapids of rivers.
The most serious floods during the last few decades in Tornio River have taken place in
1984, 1985, 1986, 1990 and 1998. In 1984, the surface level of the water in the river was 6 m
over normal level and in 1986 it was over 8 m over the normal level.
The event described below is from floods that occurred in spring 1984.

2.1.1 Date of the disaster and location
7 May 1984, Lapland.

2.1.2 Short description of the event
The event started on 7 May when a person made an emergency call that one summer cottage
was threatened by flooding. The alarmed emergency and response centre immediately
informed the police of Tornio (Finland) and Haaparanta (Sweden) as well as the emergency
centre of province of Lapland regarding the situation. After the first warning, more warnings
followed. The authorities of Tornio gathered to consider what should be done if the situation
would begin to get worse. On the evening of the same day, local police informed that the
first dam of ice had formed in the upper stream.
In the morning of 8 May the situation rapidly got worse. A meeting at 10.00 o’clock was
held in the fire station of Tornio. Police, fire authorities and regional water and environment
authorities participated in the crisis meeting. They immediately decided to take the following
measures:

• To start immediate monitoring of surface level of water in three points of the river
  namely in two water pumping stations and in one customs station. Measuring
  frequency was every half an hour.
• To inform the police of Haaparanta (Sweden) of the current situation and of possible
  threats and emergencies.
• To contact the police of Pello on the Finnish side around 120 km north of Tornio in order to warn them and to ask them to provide information in case the situation in the upper stream would become critical.

• To contact coastguard station of the area and ask how thick the ice cover on the sea was in front of Tornio. They verified that the ice was very firm. In fact, the thickness of ice cover in the sea was 75 cm.

• To provide a helicopter for the frontier guards so as to monitor the whole situation. This way, he/she could give advice to the regional board of water and environment regarding a possibility of using the hovercraft of the regional board of road and hydraulic engineering to break the ice on the sea in the estuary of the Tornio river.

• To contact the rescue office of the provincial government office of Lapland.

• To carry out several monitoring journeys to get a better picture of situation.

Because the sea had a thick cover of ice, the local authorities (police, fire and water authorities) and experts assessed that if the ice makes a dam in the estuary area, the situation could become very difficult to manage for both Tornio and Haaparanta, which are situated at the river mouth.

The following day, the people responsible for running the hovercraft were contacted. It was learnt that in order to use the hovercraft, decisions from the province offices of both Lapland and Oulu were needed. The provinces consequently made the decisions needed. Furthermore, a team was set up in order to monitor continuously the flood situation towards the upper stream. Their task was to inform the others if something remarkable were to happen.

In the afternoon of the same day, the Swedish authorities, police and fire authorities, joined the meeting. They agreed with the Finnish authorities and experts that the most important measure in the operations was to guarantee free and open flow of the flood waters and ice though the mouth of the river into the open sea without giving the ice any possibility to build up an ice dam at the estuary. A joint decision was made between the Swedish authorities that the Finns that the ice at the mouth of the river should be broken using the hovercraft only if technically possible. The Swedes were in charge of exploding the pack ice and heaps of pack ice as well as ice dams in the river, using helicopters if needed.

The next step was to prepare to detonate any possible ice dams in the upper part of the stream. On 10 May the situation worsened rapidly. The surface level of the river started to increase and new ice dams started to form upstream. As planned, the hovercraft started its work on the evening of 10 May. A crisis management centre was established upstream to carefully follow and monitor the situation there. The border between Finland and Sweden was no obstacle for the detonation work. The leading centre of the whole operation was situated in Tornio, from where they contacted and informed Haaparanta of the current situation.

On 11 May, the hovercraft continued breaking ice and until noon the work was completed. The ice was broken in large area both in Finnish and Swedish side of the sea.

8.00 o’clock in the morning on 12 May, the police of Haaparanta informed Finnish authorities that the ice had started to move and flow rapidly downstream at Matkakoski approximately 100 km further up on the Finnish side of the river. There were still three big ice dams down the river one in Matkakoski, one in Karunki and the third one in Kukkolankoski. The inhabitants’ residential houses were warned of the expected situation.
A decision and announcement was made that the Swedish partners were to start to detonate the ice dams from helicopters. Firstly, they decided to detonate the dam in Kukkolankoski and then, if necessary, they would also destroy the upstream dams in Karunki and in Matkakoski. When the hovercraft succeeded in breaking the ice in the estuary, thus allowing the flow at the river mouth to carry on its natural path to the sea, the surface level of the water in the river stopped rising and the pioneers succeeded to detonate the critical points. The whole emergency was over late in the evening of 13 May and during the next few days the authorities and insurance companies assessed the damages and analysed the whole event.

2.1.3 Human consequences

There were neither fatalities nor injured people; however, some families remained homeless for a while.

These floods are annual and tend to occur in springtime. Unfortunately, there were years when the Tornio River claimed the lives of people.

2.1.4 Economics losses

Several hundred thousands to a few millions of Euro were lost due to damaged family houses and cottages (summer houses, leisure time house) and broken roads and smaller bridges. This also included costs of using hovercraft and helicopters, as well as costs for preparedness measures to cope with flooding in Tornio and Haaparanta.

In 1999, a committee report was produced, where the experts estimated how high costs of damages can be in the worst case. In that case, the flood should be a very serious one (probability of one in 250 years in the Tornio area). The total costs were estimated to be around 42 Million Euro.

2.1.5 Prevention measures and related lessons learnt

Every year, the authorities have examined and analysed how they have succeeded to respond to and prepare for these floods. After the 1984 flood, the Ministry of the Agriculture set up a committee, which made a report of the costs and how to reimburse the costs of the damages to local people and other parties.

In 1990 an even worse situation occurred and in 1990 towns of Tornio and Haaparanta were hit by the floods. On the basis of this emergency, fire authorities gave their recommendations on how the towns and individual households should prepare for these events.

In 1989, the *Smhi Hydrologi* and National Board of Water and Environment published a report proposing preventive measures to avoid damages and costs in the area of Tornio River.

In the case of floods and ice dams there are always engineers and technicians (pioneers) available, if needed, to detonate dams or ice during the flooding period.

A special ice sawing apparatus has been developed with which the ice can be sawed in smaller pieces to avoid the building up of ice dams. This method has been used very successfully during past years to prevent ice dams.

There are also plans:
to construct embankments in critical points of the river (Tornio and Haaparanta as well as some other villages along the river);

- to dredge a 6 km long, 5.5 m deep and 50 m wide channel in the sea just in front of the river mouth to facilitate the passage of water and ice to reach the open sea;

- to spread sand and ash on the ice so as to weaken it before the floods;

- to dredge also the river bed in critical points.

2.1.6 Preparedness measures and related lessons learnt

After 1984 flood, the following lessons learnt were highlighted:

- It is necessary to set up an executive team or committee, which should have meeting(s) and consider possible precautionary measures before the next spring floods;

- The executive team or committee should also discuss and agree on the roles and duties of local, regional and national authorities. This executive group should include both Finnish and Swedish authorities.

- The regional emergency plans in the case of floods should be updated every year and regularly checked.

- It is recommended not to build houses or cottages too near the river.

Nowadays, the co-operation between authorities have been strengthened and practiced. This concerns also the transboundary co-operation between Sweden and Finland.

2.1.7 Response actions and related lessons learnt

Look at the text in points 2.1.5 and 2.1.6.

2.1.8 Information supplied to the public and related lessons learnt

The public is always informed of and are used to flood situations. The public is also advised not to build any buildings (summer cottages or residential buildings) too near the river.

2.2 Six Months of Flooding in the Western Defence Area Between November 2000 and May 2001 (France)

Gerard COURTOIS (Ministry of the Interior, Directorate for Civil Defence and Safety, Western Defence Area, Rennes)

2.2.1 Date of the disaster and location


2.2.2 Short description of the event

Over a period lasting approximately six months, between 6 November 2000 and 10 May 2001, départements in the western defence area experienced severe flooding. The most severe occurred in December 2000 and January 2001. In both December and January, the average level of flooding reached was very high, and in some areas exceeded the levels of the one hundred-year flood of 1995.
Storms were the only reason for these recurring disasters. Not only did the year 2000 begin in the aftermath of the violent storms of 26 and 27 December 1999, rainfall in each of the months of the year was higher than the usual average. As the soil and water tables were already saturated, the rain that fell in September and October 2000 was discharged in its entirety into watercourses that were already overloaded. The hydrological season between October 2000 and March 2001 in the west of France was the wettest since measurements have been recorded by the French meteorological office (Météo France); in those six months, rainfall in the centre of Brittany exceeded the annual norm by 40%. As evapotranspiration is low at that time of the year, it may be concluded that every drop of rain had ended up in a river basin.

2.2.3 Human consequences

There were three people who died during this period and a total of approximately 750 people needed to be evacuated, with some more than once.

2.2.4 Economic losses

There were 1,500 homes flooded and severe damages were incurred. Furthermore, 400 traffic routes were cut off and a high speed train (TGV) derailed without damage. Also, 15,000 homes were deprived of electricity, 150 companies were affected to a lesser or greater extent with staff unable to work for technical reasons and 15,000 people were without drinking water for 15 days.

It should be noted that there is no information available on the overall economic consequences of the disaster.

2.2.5 Prevention measures and related lessons learnt

Usual measures

Leaving aside land improvement measures and works to dyke or channel water (dykes, rock facing, dams, etc.), the general principle governing flood prevention in France is based on the flood warning plan.

Every département in France has a flood warning service, which is generally part of the Provincial Directorate for Public Works (Direction Départementale de l'Équipement). Once informed by Météo France of the rainfall forecasts, the flood warning service assesses the likely levels, which will be reached for each watercourse in turn. In the western defence area, the rivers are to be found in a plain and thus, the water levels rise relatively slowly compared with those from mountain streams. Consequently, the forecasts are recalculated every twelve hours or even more frequently in exceptional circumstances.

It should be noted that the initial level of the water course considered, along with the nature of the soil and to what extent it is saturated with water, is taken into account in these calculations.

Whether large or small, rivers are grouped into basins and sub-basins. Graduated scales, whether manual or automatic, are located at visible points in each sub-basin making it possible to read the water levels reached and then determine, depending on previous situations and consequences, the pre-alert and alert thresholds.

As soon as the pre-alert threshold is reached for a basin, a sub-basin or a watercourse, the flood warning service informs the Prefect of the province. The Prefect then addresses a
message to the mayors of the municipalities concerned and, in certain cases, if provided for under the flood warning regulation, to companies or installations, which are vital for the government to continue operating. The mayor in each municipality is responsible for informing his population.

At the same time, various public services receive the pre-alert message (fire brigade and rescue service, police, gendarmerie, etc.), which is also addressed to the Inter-Regional Centre for the Operational Coordination of Civil Defence (Centre Interregional de Coordination Opérationnelle de la Sécurité Civile - CIRCOSC), which is the area Prefect's operational watch body.

Once the pre-alert message has been disseminated, an oral message is recorded on a telephone answering machine to enable the various authorities and services concerned to follow the development of the floodwaters. After each new forecast, the recorded message is updated.

When the alert threshold has been reached, the Prefect informs all the authorities and services concerned (written message and the answering machine of the flood warning service). When this happens, mayors must organise the evacuation of people in the predetermined areas defined in the flood plan drawn up by the Prefect of the province.

Following each flood, the data recorded serve as references:
- to determine which areas have to be evacuated in advance;
- to correct, where necessary, the pre-alert and alert thresholds;
- to regulate rising levels in watercourses and areas of water with dams or weirs by manoeuvring the latter.

Regional weather alert reports (known as BRAM) put out by the inter-regional weather centres (CMIR) which give warning of weather events likely to be hazardous or to create serious disturbances must be added to the flood warnings. These bulletins make it possible to inform the authorities and populations of approaching climatic hazards.

**Analysis of procedures**

The flood warning procedures cover almost the entire hydrographical network, omitting only small watercourses. Major floods in the past (1974, 1983, 1995) had already made possible notable improvements, both in the calculations for forecasts and in the information procedures, including that aimed at the general public with the help of the media. As a tried and tested mechanism it functioned well. The heights of the water forecast were generally 2 to 3 cm higher than the heights actually experienced. Finally, if the flood warning is reliable, it appears credible in the eyes of the population, which explains the number of preventive evacuations and the low rate of consequences for humans.

On the other hand, the meteorological warning system is undergoing new trials, not as a result of the abundant rainfall in the period concerned, but on account of the failure to analyse the regional weather alert reports and take them into account quickly enough in the operational process during the December 2000 storms. Following an experimental phase, which is in progress and due to end on 1 October, these weather alert reports will be replaced by a weather watch procedure.

Twice daily a map of France will determine the risk to which each province is likely to be exposed, the degree of severity being determined by a four-level chromatic scale.
Lessons learnt

- From experience it has been shown that there is a weakness in the process of alerting mayors. In fact, one peculiarity in France is the high number of French municipalities (over 36,000) with local communities ranging from 250 and 600 depending on the province. The small localities, which have approximately 200 inhabitants, are the most numerous and they generally do not have permanent administrative nor technical services. Thus, the transmission of the alert to the mayor or one of his deputies could be risky and could arrive too late.

- Currently there are different experimental systems in operation to disseminate alert information to mayors. In the Western Defence Zone, the provinces of Maine-et-Loire and Ille-et-Vilaine are pilot areas, where automated alert systems via telephone automated voice messaging have been set up. The system is designed to ring at regular intervals until the receiving end picks up the phone. Each successful call feeds back to the system as an acknowledgement of receipt, which allows the control of messages received a beforehand. Presently, modifications have been requested from constructors to reduce the time between two unsuccessful calls and to increase the reliability of the acknowledgement of receipt mechanism.

2.2.6 Preparedness measures and related lessons learnt

Preparation of rescue services

First the regional weather alert reports and then the flood warning messages in the so-called pre-alert phase permit the various services to be placed in a state of increased vigilance, and in particular:

- permit the permanent emergency services (police, fire brigade, gendarmerie, the emergency medical service (SAMU), to reinforce their teams on duty;

- permit other services (such as the municipal technical teams, departments of public works, the armed forces, etc.) and charity organisations to prepare to mobilise their staff.

From the pre-alert phase on, the flood warning service follows the situation as it evolves from data collected in the field and the Météo France forecasts, and reports to the Prefect who, being fully apprised of the situation, can thus issue instructions to the different services and complete the information for the mayors.

Populations are informed of the risks they are facing, especially those who are in the threatened areas, in order that they may prepare for their evacuation, if need be. For evacuated people who do not have temporary accommodation (with family members or friends, for instance), mayors have to anticipate provisional accommodation, record the numbers to be sheltered and the number of beds available in boarding schools, equip recreational facilities and provide food and drink.

When the alert threshold has been reached, the crisis cells are set up and include:

- sector command posts in town halls when the municipality is severely affected;

- advance command post in the neighbourhoods concerned;

- operational defence centre in the prefecture;

- defence area operational centre if the situation is such that the CIRCOSC alone is not sufficient, such as if the floods affect several provinces within the same defence area;
• the Interministerial Crisis Management Operational Centre (*Centre Opérationnel de Gestion Interministérielle des Crises – COGIC*), within the Directorate for Civil Defence and Safety and which is part of the Ministry of the Interior, is informed. Depending on the seriousness of the situation, the COGIC may put national resources on pre-alert.

The flood warning plan and the flooding plan prepared by each *province* Prefect contains all the elements needed to manage a disaster.

In principle, these plans contain the following:
- a list of the authorities and services to be informed or mobilised;
- the designation of responsible authorities, particularly the designation of the rescue services director and the rescue operations commander;
- the areas to be evacuated according to the predictable heights of the water;
- the "automatic action" charts which each service possesses;
- communication procedures.

Other plans may be implemented simultaneously, such as:
- a shelter plan to accommodate evacuated populations;
- plan for organising rescue when there are many victims (red plan);
- setting up of emergency medical and psychological support teams.

**Lessons learnt**

⇒ In most provinces, the emergency plans regarding whatever kind of risk, are regularly tested by the responsible organisation, and are revised wholly or in part, if deemed necessary.

⇒ After these catastrophic inundation events, thoughts were triggered to harmonise province emergency plans regarding floods. It was ascertained that every warning service (within the same water course) tends to have a different perception of alarm, pre-alert and alert levels. Thus, this harmonisation is necessary so that the reaction of the rescue services and the population, at each of the above-mentioned levels, would be the same throughout all the provinces.

### 2.2.7 Response actions and related lessons learnt

**Reconnaissance**

Reconnaissance constitutes the first phase of operations. This activity is performed by the fire brigade, the *gendarmerie* or the police according to the area of competence, but not systematically. In the early hours of the crisis, reconnaissance is carried out following telephone calls from victims requesting assistance for the lifting of furniture and electrical equipment or who would like to have water pumped out even before it has been announced that the floodwaters are going down.

At the request of the rescue services director or the rescue operations commander, it is possible to carry out reconnaissance operations by helicopter to locate people who are in immediate danger. This happened on two occasions during the floods and three people were winced to safety by rescue helicopter on 6 January 2001 in the province of Morbihan.

A helicopter flying over also makes it possible to assess the scope of the disaster and to observe the damage caused to railways and other structures by landslides, which are frequent in such circumstances. Aerial reconnaissance is also used in the case of dykes and dams that are inaccessible via normal routes.
Safeguarding the population

The public services inform the population as soon as evacuation becomes unavoidable. Those who are unable to benefit from help from family or friends are generally sheltered for the two or three nights needed until the water goes down (rarely longer). Charity organisations such as the Red Cross, Civil Defence League (Croix Rouge, Associations Départementales de Protection Civile - ADPC), etc., take care of the disaster victims, including providing psychological support.

It should be noted that, as a preventive measure, it was necessary on several occasions to evacuate populations exposed to the risk of dams' bursting on account of the excess water level.

Protecting property

The protection of property of value (furniture, machine tools, computer equipment) is carried out in a spirit of cooperation by the disaster victims themselves, neighbours, employees, who are assisted by firemen, first aid helpers, even the military, whenever the emergency or the inability of the individuals concerned (such as the elderly or disabled) dictates.

Property protection includes protection against looting, which requires the forces of order to seal off the evacuated areas.

Finally, as soon as the waters start to go down, drying-out operations begin. Together with reconnaissance and rescue operations, this is the most burdensome task for the public services and associations (pumping, cleaning up, etc.). That is why reinforcement was sought from national resources, in particular that of the civil defence investigation and intervention units (100 men plus their equipment) for the benefit of the provinces of Finistère, Ille et Vilaine and Seine-Maritime. Civil defence logistic support establishments also provided heavy-duty pumping equipment.

Supporting economic activities

On some occasions, the help of the armed forces was sought in order to avoid economic activities coming to a halt. In the sector of Redon, for example, the use of 4 x 4 military lorries enabled the working population to get to work by crossing a section of road which was under 30 cm of water; another example is the supply of feed to a large pig farm that had been completely cut off by the rising water and which needed five tonnes of food a day. On that occasion, an Engineering Corps barge was used for transport.

Lessons learnt

- Civil and military services geared to cope with crisis situations or to assist in the process of returning to a normal situation, have not failed in their task. The population appreciated their endeavours.

- It is important to note that the army has gone through a process of reform that includes a suspension of the military service. This led to a significant decrease in military manpower. Thus, it generally takes longer to carry out cleaning operations after the floodwaters have retreated, to assist in providing resources for evacuation during high waters, or to feed livestock. However, the decrease in manpower did not affect the military civil security units, led by the Ministry of Interior, who are permanently involved in the reinforcement of the civil resources.
2.2.8 Information supplied to the public and related lessons learnt

Coordination of operations and government information

During these disastrous and episodic floods, spread over six consecutive months, area and national resources were called upon to complete the arrangements put in place in each province by the Prefects.

The structure of organisation may be described as follows:

Within the province

There are three levels of management to be considered:

• The municipality. Under the authority of the mayor, the rescue operations commander takes the measures, which are required, and asks the provincial authority to give him the resources needed to cope with the situation. The mayor may set up a crisis unit bringing together the heads of the various services and associations which assist in dealing with emergencies.

• The province. As soon as several municipalities are involved, the Prefect may take the lead in rescue operations. He then appoints a rescue operations commander for the province and activates his operational defence centre (centre opérationnel de défense - COD).

The COD brings together all the heads of department needed to manage the crisis. In the case of floods, the following are usually present, under the responsibility of the Prefect's head of office:

- the head of department of interministerial affairs regarding civil defence and protection;
- the departmental director of the fire and rescue services;
- the commander of the gendarmerie;
- the departmental director of public safety;
- the departmental director of public works;
- the departmental director of agriculture and forestry;
- the head of the emergency medical aid service;
- the departmental military delegate;
- other leaders or experts whose opinion might be sought.

This operational centre receives information and requests for resources from the field. It prepares a summary of such information, which will permit the Prefect to take the decisions required, to fix objectives and to communicate with the media. He allocates the resources requested when they are available within the province or asks the Prefect of the defence area if area or national reinforcements are required.

• The District. In some particularly difficult situations, an advance command post may be set up in one or more districts (conglomerate of several municipalities) under the leadership of a sub-Prefect.

At defence area level

The defence area is a particular administrative entity conceived to respect two essential objectives, namely coordination in a situation of serious crisis of any kind (disaster, serious civil disturbances, implementing cooperation between civilian and military forces) and
administrative and technical support from units under the responsibility of the national police force.

It is placed under the authority of the area Prefect, assisted by a deputy Prefect for safety and defence. Under the leadership of the latter, an area command centre prepares the coordination measures in the event of a serious crisis affecting several provinces and implements such measures. It also prepares a summary of the information forwarded by the province Prefects and destined for the government. On a daily basis, 24 hours around the clock, the CIRCOISC, an operational tool for the area command centre, receives information and requests for resources. It may deploy departmental public and private resources to benefit another province, set up local aid teams, employ civil defence helicopters and ask for national civil or military resources.

During these floods, the area command centre:

- mobilised, on behalf of the requesting provinces, teams of firemen from provinces in the area not affected or less affected by these floods;
- asked for the assistance of the armed forces whenever necessary;
- called on the civil defence investigation and intervention units;
- requisitioned civil defence helicopters.

During the most critical phases, two summaries a week were forwarded to the COGIC within the Directorate for Civil Defence and Safety, which is part of the Ministry of the Interior. The province Prefects of the area also received these summaries, thus enabling them to be kept informed of the general situation.

At State level

In a crisis situation, the Minister for the Interior is in charge of coordinating the various ministries concerned. To this end he has an operational centre for inter-ministerial crisis management, which is placed under the responsibility of the Director for Civil Defence and Safety. The COGIC allocates the resources requested by the CIRCOISC, distributing them among the different defence areas when several have to deal with the same kind of event. This was the case when the northern defence area had to combat the effects of flooding in the Somme bay area at the same time as the flooding which occurred in the western defence area.

Comments on coordination

During the weather crisis which lasted from 12 to 20 December 2001, at the request of the Prefect of Finistère, the Ministry for the Interior dispatched a civil defence support team (Mission d'Appui de la Sécurité Civile - MASC) to the area to assist the departmental operational centre, the staff of which was not sufficiently large enough, given the scope of the event.

A similar occurrence took place between 5 and 10 January 2001, but this time it was the turn of Rennes CIRCOISC to relieve the area command centre, which had been dealing with a number of crises for several months. Rennes CIRCOISC still had the task of coordinating the recovery of chemical products from the wrecked chemical tanker "Jevoli Sun", which had sunk off the coast of Cotentin on 31 October 2000, as well as the task of coordinating the storage of animal fodder.
Apart from a few requests addressed by some authorities directly to the office of the Ministry for the Interior, the command and coordination circuits functioned well.

**Lessons learnt**

It is the task of the prefect of the province to disseminate information to the public. However, a more general type of information can be disseminated by the prefect of the Defence Zone or by the Government. The press release or press conferences are geared to provide user-friendly information regarding meteorological forecasts, water level forecasts, state of road and rail networks, assessment of damages, and all other issues that can assist the population.

⇒ The difficulty lies in the fact that journalists prefer to search for information in the field, even if the crisis management generally occurs in operational centres within the prefecture.

⇒ Also, certain prefects do not hesitate to meet the press, “with their feet in the water” and surrounded by the disaster-stricken population. It is an interesting approach, but one must be careful and ensure that the speaker is able to master the situation, otherwise the situation can degenerate.

### 2.3 Flooding in Bavaria in May 1999 (Germany)

*Hans ELLMAYER* (Bavarian Ministry of the Interior, Munich)

#### 2.3.1 Date of the disaster and location

22 May - 1 June 1999, Upper Bavaria, Lower Bavaria, Upper Palatinate and Swabia.

#### 2.3.2 Short description of the event

This event was the largest flood disaster in Bavaria for decades on Whitsuntide of 1999 in the period between 22 May - 1 June 1999. The Whitsuntide flood was a direct consequence of the strong rainfalls in the Alps and the foothills of the Alps. The rainfalls and snow melting before Whitsuntide saturated the ground completely so that it was no longer possible for the water to seep through when it rained on 20 - 22 May 1999. Therefore, the precipitation had to drain almost completely. This concerned an area of approximately 12,000 hectares. 16 county administrative authorities declared a state of emergency because of the flood.

#### 2.3.3 Human consequences

Approximately 100,000 persons were affected by the flood and 5 persons died. Approximately 1,000 persons had to be evacuated, among them 205 patients from 2 hospitals including the intensive-care wards and the inmates of a prison.

#### 2.3.4 Economic losses

Approximately 16,300 houses were flooded and the overall damage caused was approximately 336 million Euro. Approximately 30,000 emergency units of the fire brigade, the Technical Relief Organisation, sanitation organisations, the police, the German army and the German border guard were enlisted to fight the flooding event.
2.3.5 Prevention measures and related lesson learnt

It became evident that the greater portion of the settlement areas affected by the flood were not overplanned by development plans, nor by legally binding land-use plans. Development plans define what can legally be built in a given area and to what extent, and they also contain detailed requirements for the building methods; in short: they define, how the buildings should be constructed. Land use plans, on the other hand, define the possible type of use for the local area of a community; in short: they define, where the buildings can be constructed. Large portions of the areas affected have already been developed for decades or are in the core areas of historical settlements. These areas generally have the right to build. Incidentally, there were also areas flooded that were previously considered flood-free.

Lessons learnt

⇒ The Bavarian Ministry of the Interior reacted to the Whitsuntide flood by appealing to the cities to revise their representations of the construction land areas in land development plans and to change them if necessary. The focus here was on checking the areas affected by flooding that are represented as construction areas in the land development plan, but that do not yet have the right to build based upon development plans or other charters.

2.3.6 Preparedness measures and related lesson learnt

In Bavaria, protection against disasters is a state function based upon the Bavarian Disaster Act dated July 24, 1996. The disaster protection authorities on the lower administrative level are the county administrative authorities and the governments on the middle level. The supreme disaster protection authority is the Bavarian Ministry of the Interior. The county administrative authorities, as the lower disaster protection authorities, are always responsible for dealing with disasters and the disaster protection planning this is based upon. All disaster protection authorities have a computer-assisted general form of disaster protection planning structured based upon the specifications of the Bavarian Ministry of the Interior with a uniform structure (with the computer system BASIS). The potential for service available to the disaster protection authorities both within their area of responsibility and throughout Bavaria is contained in this framework in the widest sense of the word with all of the information required for the prerequisites for service, availability and alarming. The service potential required for dealing with the effects of floods (the emergency forces, equipment and material such as sacks of sand, transportation capacities, oil defence equipment, emergency power units, pumps, etc.) could be quickly called up and used in this fashion. A portion of the disaster protection authorities already affected had special plans for disaster protection with specific local emergency measures for floods at the time of the flood. The Bavarian Ministry of the Interior had an agreement with the Munich Regional Centre Office of the German Weather Service for several years, according to which thunderstorm and strong rain warnings would be forwarded to them. Until recently, the Ministry of the Interior passed these warnings to the governments that would probably be affected as the disaster protection authorities on the middle level, as was the case with the Whitsuntide flood in 1999. These governments in turn informed the county administrative authorities as well as the lower disaster protection authorities responsible for dealing with the disaster locally.
Lessons learnt

⇒ It was essential that the already existing special plans for disaster protection with special actions against flood at the Whitsuntide flood in 1999 be revised based upon experience. Most of the disaster protection authorities involved, which did not have the corresponding plans by Whitsuntide 1999 because there were not any floods in the past, intended to create special plans for disaster protection for floods after the disaster.

⇒ Disaster protection authorities plan to add a new module of “special plans for disaster protection” to the BASIS computer system already mentioned above that would provide the disaster protection authorities all of the possibilities for preparing qualified special plans for disaster protection. In the meantime, this new module is about to be introduced.

⇒ It was necessary to improve the process of passing on thunderstorm and strong rain warnings to the disaster protection authorities and emergency organisations that could probably be affected. Since January of 2001 the Munich Regional Centre Office of the German Weather Service has been directing these warnings directly to all disaster protection authorities and emergency organisations probably affected. This made the warning procedure significantly easier and faster.

2.3.7 Response actions and related lessons learnt

The Ministry of the Interior received a strong rain and flood warning for Southern Bavaria on Thursday, May 20, 1999. Because of the explosive nature of this report, it was immediately passed onto the governments according to the procedure mentioned above and they passed it onto the county administrative authorities. This warning put the disaster protection authorities affected in a position to make the necessary preparations. The state of emergency was declared in 16 counties and cities in 4 administrative districts (Upper Bavaria, Lower Bavaria, Upper Palatinate and Swabia). Beyond this, several county administrative authorities were affected by the flood, although below the threshold of a disaster. Approximately 30,000 emergency personnel of the fire brigade, the Technical Relief Organisations, the voluntary relief organisations (Arbeiter-Samariter-Bund, the Bavarian Red Cross, Johanniter-Unfallhilfe, Malteser Hilfdienst, DeutscheLebensrettungsgesellschaft), the police, the German Army and German Border Guard helped fight against the flood. There were widely varying degrees of damage and the emergency situation differed significantly in the area of the county administrative authorities affected and the emergency measures to be arranged were correspondingly varied. The governments and the Bavarian Ministry of the Interior co-ordinated the regional balancing of task forces and the work of the German Army and German Border Guard.

Lessons learnt

Individual disaster protection authorities (DPA) have recognised and implemented detailed possibilities for improvement to a great extent.

⇒ The DPAs were able to procure and use the necessary scope of the emergency equipment required in due time. They also had the very large number of sacks of sand required with non-regional equalisation measures.

⇒ Calling a state of emergency at an early stage meant that the locally responsible disaster protection authority take over the centralised direction of emergency. It became evident that this was an important prerequisite for effective and cost-effective
emergency action. The decentralised management structure of disaster protection has proved its worth in Bavaria. This provides for the direction of emergency operations being with the locally responsible county administrative authority because only they can have the detailed knowledge of the local situation necessary for decisions on emergency operations. The leadership strategy has also proved its worth that was introduced in Bavaria in the middle 1993 and that was established with the amendment of the Bavarian Emergency Protection Law dated July 24, 1996. This states that the political and administrative direction in emergency operations is taken over by a small disaster protection leadership group in the county administrative authority chosen according to the situation while the operation tactics are managed locally by local leads of operations who are appointed ahead of time and appropriately trained.

⇒ The intensive efforts in the last few years for properly training the leadership personnel and helpers have shown their worth in dealing with the floods on Whitsuntide 1999. The personnel employed were well trained throughout and were appropriate to needs. Regardless of this, it is still necessary to selectively train leadership personnel to maintain the level of training.

2.3.8 Information supplied to the public and related lessons learnt

Prior to the event

As already stated, the disaster protection authorities were informed on the imminent strong rainfalls by the German Weather Service through the Bavarian Ministry of the Interior, and the governments informed the disaster protection authorities that were probably affected. The population in most of the areas affected was warned by radio warnings, newspapers, loudspeaker announcements, data sheets, signs and also personal information, for instance by telephone as early as several hours or even some days before the occurrence of the actual state of emergency. In most cases, the population was given specific instructions for behaviour along with the information or warning. They concerned, for example, boiling water, securing oil tanks, clearing out flats and information places to stay, removing vehicles from underground garages and other endangered areas, etc.

During the event

In almost all areas affected strongly, a citizen’s telephone was set up that gave callers the appropriate tips for action. The media announced the fact that citizen’s telephones had been set up along with the telephone numbers.

After the event

The Bavarian Ministry of the Interior continued with telephone calls to the citizens even after the disaster was over in certain areas. It proved to be worthwhile to have qualified personnel on the telephone because the questions asked then were completely different for instance especially questions of garbage disposal and financial assistance. However, in spite of these measures, people in some areas felt they received information and warnings too late or that they were insufficient. One of the most important problems with warning and informing people was the fact that it was difficult to reach the people affected if there was damage occurring in the night. Some possibilities were warning via loudspeaker announcements from police or fire brigade vehicles. However, with a larger area it is very difficult to ensure that everybody affected is actually reached with loudspeaker announcements.
Lessons learnt

Based upon this experience, some cities were and are considering to set up siren warning systems in the appropriate cases so as to first of all wake people up and then to direct their attention to radio announcements. The Whitsun tide flood 1999 showed the importance of flood predictions and flood warnings. Informing the person affected at an early stage and with meaningful information makes it possible in many cases to reduce a significant portion of damage. This is the reason why the Bavarian State Office for Water Management has worked out the programme of "Innovation in the Water Service". The use of the latest equipment and modern means of communication will provide faster predictions at a higher quality in the future. Significant portions of this programme are planned for implementation by 2003. This programme includes:

- building up an automated on-line precipitation measuring network with approximately 300 measuring stations together with the German Weather Service,
- streamlining the level network including equipping all flood level indicators with automatic data transmission, and
- developing models for flood predictions for all Rivers in Bavaria as they have already been successfully used, for instance at the Sylvenstein Water Reservoir.

The city report plans regulate how information on floods is announced to the population. The water management offices have requested that all flood-prone cities revise these report plans for their effectiveness and completeness and they also offered their technical support here. The focus of this campaign was especially to check to what extent it is possible to give specific forecasts in case of a flood with reference to the flooding area and depth of the flood. A well-known aid is flood marking from known events at prominent places in the city.

2.4 November 2000 Floods (Ireland)

John Barry and Caroline Lyons (Department of Environment and Local Government, Fire Services and Emergency Planning, Dublin)

2.4.1 Date of the disaster and location

5 November 2000, South and East Ireland.

2.4.2 Short description of the event

Between Sunday, 5 November and Tuesday, 7 November 2000 significant rainfall resulted in flooding in many areas of Ireland. The most severe effects were felt in counties along the south and east coasts, and in Kildare, Kilkenny, and Tipperary. The worst affected urban areas were Arklow, Carlow, Clonmel, Dunboyne, Enniscorthy, Fermoy, Mallow, Tullow and Drumcondra (briefly).

Emergency services and transport and power utilities responded to the flooding. An outline of the response is given below.

2.4.3 Human consequences

There were two deaths reported and 436 people from approximately three hundred properties remained homeless during this flood event. Of those evacuated, forty-three people were
accommodated by local authorities, while the remainder found accommodation with friends and relatives.

2.4.4 Economic losses

Approximately 1,300 properties were flooded, including over 1,000 residential properties. The cost of insurance claims arising from the flooding has been estimated at 64 million Euro by the insurance industry.

Material losses summed up to approximately 50 million Euro.

Electricity supplies were affected both by high winds and flooding of substations in Enniscorthy and Dublin. Approximately five thousand customers were without supply at midday on Monday, 6 November.

Transport was also disrupted, with floods affecting road and rail infrastructure. National roads, such as the N1, N4 and M4, were blocked by floods, as well as numerous other regional roads. Bus services were disrupted or delayed where roads were closed or diversions in operation.

The Dublin Area Rapid Transit (DART) system was halted due to flooding and landslide in Blackrock. Mainline rail services were also halted by flooding at Hazelhatch, Co. Kildare, and on the Sligo and Rosslare routes, including Maynooth and Arklow suburban services.

No indication of response action costs is available.

2.4.5 Prevention measures and related lessons learnt

While flood events are natural phenomena, and will continue to occur, there is the possibility of taking measures in advance to reduce their occurrence or their effects on people, property, infrastructure, and essential services. This involves a number of organisations.

In Ireland, the Office of Public Works (OPW) has primary responsibility for devising and implementing flood relief measures. OPW currently spends approximately 12 million Euro annually on such works, and envisages a programme of flood relief works over the next number of years to the value of over 125 million Euro.

It is normal practice for planning authorities in Ireland to take measures to minimise the risk of flooding if a development is proposed in an area where they are aware that floods have occurred. For example, they can require that the finished floor levels of buildings in a development be above the storm water level, or ensure that the optimal storm water drainage layouts are put in place. Planning authorities would also liaise closely with the Office of Public Works in relation to the types of measures to be put in place.

As part of new legislation to strengthen the risk assessment and land use planning aspects, the Planning and Development Act, 2000 specifically empowers planning authorities to provide in their local development plans that development in areas at risk of flooding may be regulated, restricted or controlled. If development is proposed in a flood-risk area, the risk of flooding can be carefully evaluated and planning permission refused, if necessary.

An important element in mitigation of flooding is reliable identification of causes or sources of flooding. For example, some of the November 2000 floods resulted from accumulation of rainfall and runoff in low-lying areas or areas with poor or blocked drainage, while in other cases flooding resulted from overflow of rivers or streams carrying water from upstream rainfall.
In the case of the flood in early November, where local authorities, either in advance of flooding on a routine basis or at the onset of build-up of floods, had arranged to clear gullies and culverts, which helped to facilitate drainage of rainfall and minimise or prevent flooding. Work of this type has significant potential to avoid or minimise localised flooding by ensuring maximum capacity in drains and culverts.

**Lessons learnt**

- It is recommended that local authorities review the experience with the November 2000 floods, identify vulnerable areas and associated sources of flooding, and consider what procedures might be adopted to mitigate the effects of flooding.

- It is recommended that local authorities put in place arrangements for routine attention to drains, gullies, water cuts, and culverts, keeping them clear and facilitating removal of rainfall from roads and other public areas. Arrangements should also provide for clearance at the onset of severe rainfall, where necessary.

- Property owners should also be advised to arrange for routine clearance of drains from their property, to avoid or minimise unwanted build-up of water on their property, or flow of floodwaters to neighbouring properties. This advice could also be repeated when conditions giving rise to flooding are expected.

### 2.4.6 Preparedness measures and related lessons learnt

Prevention and mitigation measures rarely provide absolute protection against flooding, and it is necessary to make preparations for dealing with flooding where it arises. Preparation measures include examination of the history and experiences with flooding, with a view to identification of likely flood events, along with areas likely to be affected, and planning for response. Out of the planning process, information should emerge on the resources and arrangements necessary for the planned response. These will include personnel, equipment (sand, bags, pumps), training, arrangements for mobilising resources, arrangements for providing information to the public, arrangements for monitoring rivers and streams.

Emergency plans were in place in all areas affected by the November 2000 flooding. Some local authorities have put in place specific plans for flooding incidents. In other areas, emergency services relied on their Major Emergency Plans as the basis for their response to the flooding.

Overall, it appears from reports received that plans and arrangements provided effective bases for the response to the November 2000 flooding. In particular, the arrangements in plans for inter-organisational communication and liaison assisted with co-ordination of the response.

Plans and arrangements for response to flooding should be revisited from time to time, and changes made where necessary or where potential for improvement is seen. Experiences with flooding offer a valuable opportunity for constructive review, and should be followed by identification of lessons learned and by appropriate changes to plans and arrangements.

Some individual householders in areas with a history of flooding have prepared for floods by having sand and bags on hand or by installing proprietary systems at doorways to be deployed at the onset of flooding. Such measures can be valuable where floods do not reach a great depth or where floods do not persist for long periods.
Lesson learnt

➔ It is recommended that emergency services review their plans and arrangements for flooding events, to ensure that they are prepared to respond to flooding in an effective and efficient way. Reviews should include inter-organisational aspects of the response.

➔ Planning should include consideration of the possibility of persistence of flooding for significant periods. In the case of the November, 2000 flooding, waters receded within a few days; flooding that persists for longer periods may, however, lead to a greater and sustained demand on emergency services, including need for support and shelter for people displaced by floods.

➔ It is recommended that emergency services, voluntary organisations, and other organisations likely to be involved in response to flooding consider hazards to the safety and health of personnel that may arise in such response. Consideration should include arrangements for the safety of personnel working in or traversing floodwaters, including standing water and flowing water.

➔ In reviewing plans and arrangements, local authorities should look at arrangements for putting traffic diversions in place around flooded sections of roads. Where practicable, in respect of diversions from main routes, two diversion routes should be used to minimise difficulties with contra-flow traffic of large vehicles. Provision should be made for clear signage at all junctions on diversions.

➔ It is recommended that information be prepared and made available to the public, particularly in areas with a history of flooding, setting out advice on measures to reduce the effects of floods, action to be taken in the event of flooding, and recovery from a flooding event, including reoccupation of buildings, reinstatement or repairs.

➔ Businesses should be encouraged, as part of business continuity planning, to prepare for flood events, making arrangements for reduction of the effects of flooding, response to flooding, and recovery.

2.4.7 Response actions and related lessons learnt

Reports from local authorities indicate that Major Emergency Plans were activated in six cases. Three local authorities activated local emergency plans. The main emergency services, i.e. local authorities (including fire services), Garda Síochána (Police) and Health Boards, all played a role in responding to the situation with assistance and support from Defence Forces and Civil Defence, along with voluntary organisations, such as the Irish Red Cross and the Order of Malta. This section outlines the response to the flooding incidents, indicating the actions taken by the main public organisations involved.

Local Authorities

The resources deployed by the local authorities to manage the flooding situation differed between the local authorities involved but in general the same functions were carried out in the different municipalities. The general responses of the different local authorities are shown below.

Roads

• Traffic Control (including emergency signage and lighting)
• Flood alleviation measures
• Assessment of road/bridge/culvert damage and safety
• Clean up

**Water**
• Clearance of gullies
• Maintenance of essential services
• Repairs

**Fire Service**
• Evacuation
• Pumping
• Sandbagging

**Housing**
• Emergency remedial work
• In some instances the local authorities provided temporary accommodation.

**Garda Síochána (Police)**
The Garda Síochána mainly had a co-ordinating role and was involved in traffic management. Tow wagons were used to retrieve stranded vehicles in some locations. Garda Síochána members also assisted people whose households were cut off or threatened by flooding to move to nearby accommodation. In Dublin, the Garda Síochána assisted in patrolling streams and rivers, the assessment of defined risks and on-site incident management at flooded locations such as affected roads.

**Health Boards**
The response of Health Boards concerned included provision of emergency bedding, alternative accommodation, ambulance service and welfare facilities. Many non-urgent patient transfers had to be cancelled, due to difficulties gaining access for ambulances. Similar access difficulties arose in the case of some emergency ambulance calls; where necessary, other means of transporting patients were used (for example, in one case, a fire appliance was able to gain access where flood depth prevented ambulance access).

Emergency accommodation was provided for people displaced by floods, though many displaced people found accommodation independently, with friends or relatives. Community Welfare Officers made urgent needs payments to assist with immediate needs. In some cases, Health Boards made arrangements for meals to be provided at hotels for people affected by floods.

Health Boards received valuable assistance from voluntary organisations, such as the Irish Red Cross Society and the Order of Malta, who assisted with transport for people affected by flooding.

**Defence Forces**
Defence Forces responded in a number of areas to requests for assistance, mainly from local authorities. Assistance mainly comprised sandbagging and evacuation of people threatened
or cut off by flooding. Defence Forces also assisted with transport for patrols to monitor major rivers.

Civil Defence
Civil Defence assisted with evacuations, communications and sandbagging. They also managed evacuation centres and provided a welfare service. The Civil Defence response represented a significant contribution. This is noteworthy in view of the fact that Civil Defence members are mainly volunteers.

Infrastructure and services
The November 2000 floods affected services, in particular the transport sector. Railways were flooded in some areas, or affected by flood-related landslide. Iarnród Éireann (the State-owned railway company) responded by putting arrangements in place for transport by bus, where practicable. Similarly, flooding of roads disrupted or stopped traffic, including bus services.

Bus services were able to respond by diverting around floods, where possible, but still suffered from disruption of timetables. Responses also included contracting other bus operators to replace or supplement disrupted services.

The Electricity Supply Board responded to interruptions in supply caused by flooding and winds, working late into the Sunday night and early on the Monday (5 and 6 November).

Members of the public
Anecdotal information indicates that many individuals responded to problems caused by flooding. For example, farmers used tractors in numerous instances to retrieve stranded cars from floods; many householders assisted neighbours who were affected by flooding, providing food and assistance, for example, with evacuation.

Lesson learnt
⇒ The existence of emergency plans, which had been put to test in the past, was a critical success factor.
⇒ The knowledge, skill, dedication, experience and training of the personnel deployed were vital to the success of the operations.
⇒ The location of the Major Emergency Plan response group is vital to its effectiveness (i.e. with immediate access to secure communications, staff resources and back up, access to emergency plans, records, documents, etc.).
⇒ It is important to have arrangements for contact with and between organisations, particularly out-of-hours. The need to have emergency contact telephone numbers kept up to date and supplied to relevant organisations is essential.
⇒ In some areas, it was decided that resources would not be deployed until an assessment of risk had been carried out; this ensured that valuable resources were deployed only where necessary.
⇒ The value of disseminating up-to-date and accurate information on the flooding situation and the use of Internet web sites for this purpose was very high.
⇒ It was very important to have stocks of sand and bags available and accessible for prompt deployment. It was also suggested that larger size sandbags might be useful in the event of deeper floods or a need to put extensive barriers in place.
The response of the emergency services and organisations affected relied on significant extra effort on the part of staff and volunteers. Their commitment and professionalism in providing a sustained response to the flooding greatly enhanced the service to affected communities and the relief of hardship.

The lessons identified above have been brought to the attention to the emergency services for consideration in their review of plans and arrangements for response to flooding.

2.4.8 Information supply to the public and related lessons learnt

Provision of information to the public during the flooding was an important element of the response. In general, this involved providing information to television and radio stations and to the Automobile Association in respect of effects on roads and transport. One local authority used its Internet site to disseminate information to the emergency services, the general public and the national and local media and this was updated as necessary.

**Lesson learnt**

- It was suggested that the prompt and accurate dissemination of information prevented any undue concern or distress in communities. There was also some concern, however, that some of the information given to the public was misleading, and that more could have been done to ensure the accuracy of reports.

- It is recommended that organisations making information available to the public on conditions brought about in severe weather or other emergencies take reasonable measures to ensure the accuracy of reports.

2.5 Mondego River Floods in January 2001 (Portugal)

*Paulo PALRILHA (National Service for Civil Protection, Coimbra) and Raúl VIOLANTE (National Service for Civil Protection, Santarém)*

2.5.1 Date of the disaster and location

26 and 27 of January, at the central bed of the Mondego River.

2.5.2 Short description of the event

The adverse atmospheric situation coupled with the vulnerability caused by the flows of 6 December 2000 and 7 January 2001, resulted in the high water levels at the central bed of the Mondego River on the 26 and 27 of January. The flows were higher in magnitude at the Açude Ponte de Coimbra section, due to the congruence of two tributaries: the Agueira reservoir and the upper side of the Agueira dam (Alva and Ceira river). This led to the registration of the maximum discharge values greater than 1,900 m³/s on that section, at around 17.00 hours on 26 January.

The first dyke wall failure occurs at 13.15 hours on Saturday, 27 January, at the left side of the river, near the viaduct zone, after two hours of water passing over it. There were successive ruptures at the dyke walls on upper side, which provoked the inundation of the towns of Pereira, Santo Varão and Formosela on Saturday morning.

The breakdown of the dyke wall on the right side on the central bed of the Mondego river in the Santo Varão zone occurred between 4.00 a.m. and 5.00 a.m. on Sunday, provoking the
inundation of all the agriculture fields, thus affecting Montemor-o-Velho down field and also the Villages of Ereira, Valedos and Fojo for several days.

On Monday morning, Motorway 3 (IP3) is submerged and the water level rose to its peak, at the upper side of Fojo Elevation Station. At 16.30 hours a new rupture was produced from the inside to the outside of the river and water overtopped the dyke once again. Figures 2.5.2.a and 2.5.2.b show examples of the flooding caused by the Mondego River.

![Figure 2.5.2.a - Flooding on the Mondego River (Photo 1).](image1)

![Figure 2.5.2.b - Flooding on the Mondego River (Photo 2).](image2)

2.5.3 Human consequences
There were no human consequences during the flood event.
2.5.4 Economic losses

During the flood event about 500 persons were temporarily homeless and an amount of 775,000 Euro was spent for emergency help.

Many goods were destroyed, shops remained closed during several days and many losses were incurred due to damaged agricultural fields.

However, the main economical loss was the breakdown of the dyke on the left side of the river, which costs about 12.5 million Euro.

2.5.5 Prevention measures and related lessons learnt

Before the construction of the hydro-agriculture building of the “Baixo Mondego” and the system of Aguieira/Fronhas dams, the morphologic characteristics of the Modego basin, combined with the climatic conditions, which were of the Mediterranean /Atlantic type, caused tremendous water quantity variations in the original bed of the central basin. This resulted in a significant irregularity in its hydrological regime, varying from 1 to 300 m³/s at Easter. Since 1982, after the regulation of the above-mentioned buildings (80% of the total Mondego river basin upper Coimbra), the irregularity in the hydrological regime was almost eliminated. The village and its inhabitants felt protected by these infrastructures, thus they rapidly forgot the destruction and inundation they had suffered in the past years.

However, even with the entire new infrastructure, along with an emergency plan for flows, it was still impossible to stop the natural forces of the fluvial dynamics. The construction of the new structures changed the hydrological regime of the Mondego River and provoked new problems, such as those that were manifested by the 26/27 January flows of this year.

Due to the present difficulty in the existing implementation programs, the controlling systems of flows, water level forecasting systems and warning systems, which agents or organisation are responsible for, are not set up on a regular basis.

Lessons learnt

⇒ It seems that a fundamental part to planning at municipal level is to have a specific plan for specific flows (local flows).

⇒ The existing warning system proved to be inadequate in giving all the necessary information to the population. Even for the Civil Protection Authorities, it was hard to get real information that could be treated in real time. The existence of this system is really necessary, as was shown during the January 2001 floods.

⇒ It is important to set up a permanent system, which should have the control of the situation all year round. The people responsible for this permanent system should be in contact with other organisations, such as the Civil Protection (local and central services) and weather forecasting institutions on a daily basis.

⇒ Because of the flows sporadic character, it is essential to have periodic training at least once a year of all actors involved, in order to can be active within 24 hours during red alert situations.

2.5.6 Preparedness measures and related lessons learnt

In Portugal, the Civil Protection policy basically states on the one hand that all the citizens must assure their own protection and contribute towards community safety and protection, and on the other hand, that the Government, the Local Authority, Institutions and
Community Associations, must ensure that they take on their responsibility in contributing towards civil protection in times of crisis.

The objectives of the Civil Protection Authorities are:

- to forecast risks,
- to limiting the collateral effects of the risk forecasted,
- to assist and aid the populations in danger in case of accident, natural catastrophe or calamity.

Thus, it is essential to have a plan in order to carry out all the above-mentioned tasks. In Portugal, an Emergency District Plan (PDE) exists, which depends on the territorial extension. This plan caters for the following:

- technical co-ordination of the global structure of Civil Protection activities,
- building up better conditions for departmental and institutional exchange of information in emergency planning,
- improving the response capability to rescue the population during a crisis situation.

The law gives Governmental authorisation to the Civil Protection Emergency Operation Centre (Centro Distrital de Operações de Emergência de Protecção Civil - CDOEPC) to ensure the control of an emergency situation, by means of the District Emergency Plan, Municipal Emergency Plan and Special Plan. During a catastrophe or calamity, the Municipal Capacity Emergency District Planning Director (Civil Governor) must take the control of co-ordinating the operations, and if necessary, he/she must carry out exceptional emergency measures so as to minimise the risk of human lives.

**Lessons learnt**

- In order to shorten the response time to cater for human and material needs, it is necessary to have efficient planning at Municipal level articulated with the PDE.
- It is necessary that a Civil Protection Coordinator at municipal level gives support to the Mayor, assists him/her in making decisions and puts the PME into action during an emergency crisis.

**2.5.7 Response actions and related lessons learnt**

With the ongoing emergency situation, it was necessary to take some measures that minimised the effects, such as proceeding with the evacuation of the population at risk. Therefore, the joint co-operation between the Civil Protection Authorities and other organisations (Security forces, Firemen, Portuguese Red Cross (CVP), Regional Environment Services (DRAOT), Emergency National Services (INEM), Motorway Authority (BRISA), “Captain of the Figueira da Foz Port”, etc.) was important, so as to rapidly mobilise and reinforce all the necessary means and resources. This way, the population could be speedily warned, their safety ensured and damages to their belongings reduced.

During the flows it was fundamental to make quick and sound decisions regarding co-ordination and aid. Thus, the Municipio provided sufficient manpower and facilitated procedures in order to achieve this. The Operational Special Plan for Flows at the Coimbra District (PEOCDC), which was approved several months before the flood event facilitated the response procedures. The activation of PEOCDC was very important, as it permitted the district Authority (Civil Governor) to have total control of district operations, and also it
allowed obtaining external help from other Districts. This proved very crucial in the aftermath of the flood event. Army vehicles and Portuguese Marine boats were also solicited to help in the crisis.

**Lessons learnt**

- Planning is fundamental during a crisis situation, thus a Special Flood Emergency Plan at municipal level should co-ordinate an Operational Flood District Plan.
- Simulation exercises are requires in order to evaluate the efficiency of response systems.
- It is necessary to build scenarios to help prioritise interventions.
- A command system of real time water level forecasting must be installed, tested and maintained operational.
- Flood risks must be co-ordinated by the Municipal Director Plan.
- During the legislation of the warning and alert systems it is important that roles and responsibilities must designated, procedures must be established and equipment must be properly installed and maintained.
- The warning and alert made to the Civil Protection Authorities should be sent preferably by fax or communicated directly to the person in charge during a crisis situation.
- It is fundamental that Civil Protection Authorities disseminate information to increase public awareness and understanding regarding floods.
- An integrated Civil Protection policy should be cultivated and activated by the Civil Protection Authorities.
- There is a need for efficient communication and collaboration between all the services involved so as to have an efficient crisis management, and above all, to implement an efficient warning and alert system in the Civil Protection system, its actors and the public.
- It is important that a system of automatic data transmission be established to allow the monitoring of water levels in strategic reference points in the main hydrographic basins of the most important rivers such as the Tejo and Douro.

**Considerations on Legislation**

Inundations in Portugal led to the creation of a wide range of legislation to better improve the civil protection system:

These are the principal legal documents in Portugal regarding flows:

- *Protocolo de previsão e prevenção de cheias para a bacia do rio Tejo, de 15 de Março de 1984, dos Ministérios de Administração Interna, da Indústria e Energia e do Equipamento Social.*

- *Protocolo de previsão e prevenção de cheias para a bacia do rio Douro, de 20 de Maio de 1986, dos Ministérios de Defesa Nacional, Administração Interna, Plano e Administração do Território, Indústria, Comércio, Obras Publicas, Transportes e Comunicações.*
2.5.8 Information supplied to the public and related lessons learned

Since the water level of the River Mondego became higher, all the civil protection system stayed in alert. The Plan for flows at Coimbra District (Plano Especial de Operações para Cheias no Distrito de Coimbra – PEOCDC) was activated and all the civil protection agents were mobilised and all their means and resources were reinforced.

Lessons learnt

⇒ It is important to receive all the necessary information in real time, to be treated and supplied to the population.
⇒ It is fundamental to use more the local and regional radios to arrive faster to the public.
⇒ It is also important to introduce a system of official reports to the media and municipalities authorities with the necessary information and previsions to the next hours.

2.6 Arvika Floods in November 2000 (Sweden)
Håkan AXELSSON (Fire and Rescue Service, Arvika)

2.6.1 Date of the disaster and location
7 November 2000, Arvika.

2.6.2 Short description of the event
In late 2000 the municipality of Arvika in the western county of Värmland was hit by the most extensive flood that has ever occurred in one community of Sweden in modern times. The flood was caused by steady rain in combination with warm weather that led to an extreme amount of extra water in the regional lakes and rivers during October and November 2000.

The ground was already full with water after a very rainy summer and there was no buffer in the 4,000 km² source area of Lake Glafsfjordens, which is approximately 100 km². The
source of the By river, which is the river that replenishes Lake Glafsfjordens, is in Norway. The river then winds its way to Arvika, and then to Säffle, until it finally enters Lake Vänern. The By River has several narrow sections that facilitated the damming up in Arvika.

In the beginning of November, there were a few rescue operations in flooded buildings but as the water level in Lake Glafsfjordens increased and came closer to previously known peak levels, the problems increased rapidly. The flood threatened hundreds (approximately 350 to 500) of dwellings, offices, nursing homes, shops and buildings for industry. Also a lot of leisure houses around Lake Glafsfjordens were threatened.

At the end of November, the water level reached its peak at 3.14 m above normal level, which is the same as 48.36 m above sea level. Earlier known peak levels are 2.54 above normal level (1951) and 2.51 m above normal level (1904).

The rescue operations ended on the 7 January 2001. At that time the water level was less than 1.80 m above normal level.

2.6.3 Human consequences
There were no human consequences during this flood event.

2.6.4 Economic losses
The total cost of material losses summed up to approximately 13 to 20 million Euro, of which costs for insurance companies totalled 10 million Euro and costs for damage to infrastructure totalled approximately 3 to 10 million Euro.

Response action costs, on the other hand totalled to 2.5 million Euro. However, this value does not include the costs for the participation from authorities directly under the government, e.g. military forces, police etc.

2.6.5 Prevention measures and related lessons learnt
There is a lot of experience from earlier floods in the county of Värmland. Because of this, there was a common idea that there was no threat of flooding in Arvika. Therefore Arvika had no special rescue plan regarding high water level in Lake Glafsfjordens.

An inventory of risks was made in Arvika in 1991. Flooding was on the agenda but the general idea was that severe floods with higher water levels than in 1951 were not likely to happen. In 1998 there was a new inventory and assessment of risks in the municipality of Arvika. Due to lack of time, but also lack of knowledge, there were no further discussions about flooding at that time.

As a reflection, it ought to be mentioned that due to all technical installations such as electricity, water pipes and pipes for wastewater in the ground, the vulnerability of society has increased considerably. Waste water pipes made the situation worse in this event.

Lessons learnt

⇒ There is a need to analyse the whole area of Arvika for any problems that could be linked with high water levels.

⇒ There is a need for better planning of flows within the river-lake system.

⇒ There is a need to permanently protect buildings around Lake Glafsfjordens, especially the city of Arvika.
There is a need to install warning systems.

There is a need to make plans for rescue operations during floods.

2.6.6 Preparedness measures and related lessons learnt
Arvika has had a history of flood disasters, but not one of this size, thus it was not prepared to cope with the flood of November 2000.

Lessons learnt

According to the Fire and Rescue Service, a disaster of this severity should not have happened in Arvika. However, it is important that Arvika has a rescue plan for this type of disaster. It is also necessary to have a rescue plan dealing with floods for each community in Sweden with the help from the central authority and the meteorological and hydrological institutes.

2.6.7 Response measures and related lessons learnt
Arvika Fire and Rescue Service was in the process of forming a new staff organisation, together with its neighbouring services. Plans for a staff training event were made and a first meeting was set out on the 8th of November. That meeting had to be cancelled, as it was necessary to deal with a real severe event. A total of 500 firemen and officers, 200 employees from the municipality, 2,100 army soldiers, about 100 from governmental authorities and thousands of contractors and voluntary people took part in the rescue operation.

Arvika did not have a special plan to deal with floods so the chief officer who led the operation called for experts in different areas to provide him with knowledge and data to be able to make the right decisions. Among the experts were:

- Fire and rescue chiefs with experience from floods,
- Hydrologist and expert on dam safety from water power plants,
- Hydrologist and meteorologist from the Swedish Meteorological and Hydrological Institute,
- Swedish Maritime Administration (Responsible for the locks in the area).

In the beginning, there were difficulties in obtaining a proper estimation on peak water levels and peak time. The reason for this was that there was a lack of knowledge about Lake Glaesfjorden. The hydrologist from the biggest water power plant company came up with the information, which in hindsight turned out to be the required information. Also, there was a lot of contribution and collaboration from other experts active in flood disaster management.

The organisation of the rescue work proceeded as planned, although this flood event was much bigger than anything ever experienced before.

Lessons learnt

As the cooperation between the fire and rescue team and the army at such a large scale was a new experience, it took some time before optimal organisation was created on the scene.
2.6.8 Information supplied to the public

At the end of October several municipalities in the county of Värmland had problems with high water levels in lakes and rivers. All fire chiefs then asked the county administration to co-ordinate the flow of information with the aim to homogenise the information disseminated so as to prevent confusion and decrease uncertainty amongst the public due to possible contradictions. This was achieved because the county administration provided the media with information and the media then gave correct information to the public.

When it became obvious that the major problems were in and around Arvika, the staff of the rescue operations present there was made responsible for the dissemination of all the information about Lake Glafsfjorden. Other rescue services and the Swedish Rescue Services Agency, who are specialised in the field of information, helped in the dissemination of information activities.

The information office was responsible for information inside the rescue operation. E-mail and fax were used for this information flow.

Lessons learnt

➔ It is important that people suffering from floods get proper information, and if possible, get the information before they have asked for it.

➔ It is important to use as many channels as possible to disseminate information to the public, such as:
  - Media,
  - internet,
  - information offices,
  - home visits.

➔ Press conferences were useful in disseminating information, however, they must be well prepared beforehand via meetings between groups involved in the operations:
  - chief officer and rescue operation staff;
  - chief officer, politicians and police;
  - county administration and chief officers of the municipalities concerned;
  - chief officer and chief of information office.

➔ The press conferences that were held every day at 14.30 hours proved to be essential for everyone to get fresh information.

➔ The media proved to be the most important disseminator of information, but also the internet was useful. The Fire and rescue Service website, which was continuously upgraded had about 4,000 visitors every day during the event. (Usually there are 4,000 visitors a year).

➔ It was observed that people, who had problems or needed help or just wanted to talk, were told to call the information office. The goal was to give good relevant information and to avoid queuing. There should always be somebody to answer the phone. Although initially, this led to too many people working at the information office. At the end, it was a successful operation as people gained confidence in society and the rescue service because they always got a quick answer.
2.7 Autumn 2000 Floods (United Kingdom)  
Andrew FRASER (Environment Agency, Cumbria) and Martin WHITING  
(National Flood Warning Centre, Surrey)

2.7.1 Date of the disaster and location  
9 October 2000, throughout England and Wales.

2.7.2 Short description of the event  
The Environment Agency is a Non Departmental Government Body for England and Wales. The Agency uses weather forecast data to forecast flooding and to issue warnings to the professional partners and the general public. The Agency maintains and operates some flood defence structures and liaises with the emergency services and local government to provide support to affected communities.

In autumn 2000 England and Wales experienced a succession of weather systems bringing prolonged rainfall to many areas. The UK Meteorological Office has stated that with 503 mm of rain, it was the wettest September - November period since records began in 1766 (see Figures 2.7.2.a and 2.7.2.b).

The value is 196% of the 1961 - 1990 averages. The rain occurred as a series of storms. River catchments became saturated and river levels responded rapidly to very modest rainfall. Many of the storms were severe as isolated events however the cumulative effect led to repeated flooding in many places and to prolonged flooding in others.

![England & Wales Precipitation Daily Totals September 2000](image)

*Figure 2.7.2.a - Wettest September since 1981 (record starts in 1766)*
The Agency's preliminary assessment of flood locations suggests that approximately 28% of flooding problems were due to overtopping, outflanking or failure of flood defences, 40% were due to no flood defences and 32% were from small streams and inadequate local surface water drainage.

2.7.3 Human consequences
There were no deaths registered during the autumn 2000 floods. However, over 5,000 people remained homeless, 11,000 people were requested to evacuate their homes and a number of people unaccounted for were also injured.

2.7.4 Economic losses
The raised river levels caused flooding at almost 700 locations across England and Wales. In the order of 10,000 residential properties were flooded, a further 37,000 narrowly avoided flooding and some 280,000 homes were protected by flood defences. The single largest area of flooding was at Lewes in East Sussex where 800 properties were affected (See Figures 2.7.4.a and 2.7.4.b).

2.7.5 Prevention measures and related lessons learnt
In England and Wales, the Agency has calculated that some 1.8 million properties are at risk from flooding from a fluvial event with a 1% probability of occurring each year and from a tidal event with a 0.5 % probability of occurring each year. The Agency provides a flood forecasting and warning service where it is technically and economically feasible to do so. Currently a flood warning service is provided to some 840,000 properties.
The Agency has published flood risk maps to identify the location of flood risk. The maps are available on the Internet and are supplied to the planners and to the emergency services on CD-ROM.

Land Use Planning and the consent of new construction are the responsibility of local government. The Agency is a statutory consultee in all planning matters within the flood plain, however local government may decide that the Agency’s comments are less significant than other factors and hence disregard them. The Agency policy is to object to inappropriate development on the flood plain. The Agency reports to central government each year on the number of cases where any objections have been overruled.

![Figure 2.7.4.a – Flooding in Lewes (Photo 1)](image1) ![Figure 3.7.4.b – Flooding in Lewes (Photo 2)](image2)

Central government has introduced new legislation relating to land use planning and the Agency has ensured that the need to avoid increasing the number of properties within the flood plain is recognised.

The range of properties flooded during autumn 2000 included those over 100 years old to those constructed within the past five years. Many of the newer properties had been given planning approval against the advice of the Agency. The Agency has become more specific about agreeing to or objecting to planning applications to remove the possibility of any misunderstanding of the advice provided.

**Lessons learnt**

- There has been considerable public interest in the flood risk maps on the internet. Fears that the publishing of this information could lead to criticism of the Authorities have proved largely unfounded and the free access has been welcomed.

- Following the floods, it has been agreed that the Agency will develop Catchment Flood Management Plans (CFMP’s) for all rivers. Studies will be undertaken to understand the processes of flooding in river catchments, in order to develop integrated plans for the management of the risks associated with high flows to people and the developed and natural environment in a sustainable manner. This large scale planning framework will provide a more proactive management regime of flood risk for the future across England and Wales.
2.7.6 Preparedness measures and related lessons learnt

Emergency planning to deal with the consequences of flooding is the role of local government. Many areas of local government rely on generic emergency contingency plans in order to manage floods. The Agency is encouraging local government, and other essential services, to produce specific flood response plans. There are no statutory requirements on local government to produce emergency contingency plans. Where specific flood response plans existed, and where they had been exercised in advance, they worked well.

The Agency takes part in the exercise programme of the emergency services to test the contingency plans. The Agency also produces a programme of exercises to test the specific flood response plans and to train staff.

The Agency produces Local Flood Warning Plans that list the detail for each community of the extent of the flood risk area and the way in which the flood warning service operates. The plans are available for public inspection and copies are held by all operational organisations that have a flood response role. The Plans are produced by a local planning group that includes representatives of the operational organisations. A simple leaflet (Local Flood Warning Directory) that provides a summary of the detail in the Plan is produced for the general public.

To help the general public make an effective response to flood warnings a national public awareness campaign has been carried out in September 1999 and September 2000. As well as providing general information to the public, the campaign delivers a targeted message to those properties in an area where a flood warning service is provided (circa 840,000 properties). 70% of the properties flooded during autumn 2000 had previously received written information from the Agency. The national public awareness campaign costs some 3.2 million Euro per annum.

The Agency issued 190 Severe Flood Warnings during the period. The Agency issues warnings in two categories: Direct Warnings and Indirect Warnings. The principle direct method is an Automatic Voice Messaging system that delivers voice, fax and pager messages over the telephone system. The system delivered messages to 85,715 recipients with a success rate of 75% to 85%. The principle indirect method is local media (radio and TV). In addition to the news items, at least 3,000 radio and TV interviews were given by Agency staff. Information about flooding is provided by the Agency's "Floodline" telephone service. Using "Floodline" callers can listen to recorded messages about the local flood warning conditions, report flooding to the Agency, order information material about flooding and how to prepare for it and speak to an operator at the call centre (08:00 hrs to 23:00 hrs). Overall 781,000 calls were received in the period from 1 October 2000 to 31 December 2000, compared with 100,000 calls in the period September 1999 to August 2000.

Lessons learnt

➢ The Agency has identified that there is an urgent need to put flood emergency planning on a firm statutory and financial basis.

➢ The Agency has recommended that all operational organisations that have a flood response role should carry out flood risk assessments and prepare contingency plans for their assets in flood risk areas.

➢ The Agency introduced a new flood warning system in September 2000 comprising a new four stage message system: Flood watch, Flood Warning, Severe Flood Warning
and All clear (see Figure 2.7.6.a). The system was generally well received and considered to be a success.

2.7.7 Response actions and related lessons learnt

In general there was an effective and efficient response to the flooding. The response included local government, emergency services, the Agency and in some locations utility companies, the Army and voluntary organisations.

One major difficulty was that relating to the provision of temporary flood prevention (i.e. sandbags). Members of the public were sometimes confused as to where they could obtain sandbags as the policy varied between local government organisations.

The management of major incidents is led by the Police, following central government guidance. Three levels of Special Operations Rooms are established: Operational, at the site of the incident; Tactical, at a point remote from the site and possibly supporting more than one Operational room; Strategic, possibly at a regional office, again supporting more than one Tactical room.

![Flood Warning Codes](image)

**Flood Watch**
Flooding is possible. Be aware! Be prepared! Watch out!

**Flood Warning**
Flooding of homes, businesses and main roads are expected. Act now!

**Severe Flood Warning**
Severe flooding is expected. Imminent danger to life and Property. Act now!

**All Clear**
All Clear is issued when flood watches or warnings are no longer in force. Flood water levels receding. Check all is safe to return. Seek advice.

*Figure 2.7.6.a – Flood Warning Codes*

It is expected that in addition to the response by the professional organisations members of the general public will also respond in order to reduce the risk to their life and property. The response is measured by public opinion surveys (see Table 2.7.7.a), conducted independently after the flooding. Post-event surveys are set up and carried out on an ad hoc basis as and when a flood event occurs. The objective of these surveys is to provide an assessment of the efficiency of the flood warnings service among
people who are actually flooded. A survey was conducted among a sample of 1,497 residents. Of these, 1,395 lived in twelve areas, which experienced a flooding event during autumn 2000. Respondents were asked if their property had flooded at all, including the building, any gardens, drive, outbuildings and car parks. 44% of respondents were flooded during the autumn of 2000 and the majority of them (60%) were only flooded once. If a respondent was flooded on more than one occasion, they were asked to think about the most recent flooding event only. Of those who were flooded, 13% experienced flooding above the floor level of their property. The flooding was most extensive in Woodford Green and Malton where 95% and 90% of respondents said they were flooded respectively. Of the respondents in Malton, half (50%) were flooded above the floor level of their property. Although only 5% of respondents in Woodford Green were flooded above floor level, almost half (46%) were flooded below floor level and 94% said they experienced flooding in their garden. 32% of respondents (in Maidstone experienced property flooding above floor level).

The Environment Agency aims to warn all addresses in the target dissemination areas. 63% of respondents who were flooded received a prior warning. In Gloucester and Woodford Green, 77% and 76% respectively of respondents had a prior warning about the flooding. However, only 26% of respondents received a prior warning in Newark and only 31% of respondents did in Worcester. 32% of the respondents who experienced flooding did not get a warning or any information at all.

Of those respondents who received a prior warning, 80% received at least three hours notice of possible flooding. Only 5% of respondents received a warning less than half an hour before the flood. 76% of respondents thought they were given enough notice to act effectively, whilst 21% thought that they should have been given more notice. 66% who experienced a property flood received a prior warning, whilst 26% did not receive any information.

### Table 2.7.7.a - Location of Interviews

<table>
<thead>
<tr>
<th>Flood area</th>
<th>County</th>
<th>Agency Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malton</td>
<td>North Yorkshire</td>
<td>North East</td>
</tr>
<tr>
<td>Arundel</td>
<td>West Sussex</td>
<td>Southern</td>
</tr>
<tr>
<td>Maidstone</td>
<td>Kent</td>
<td>Southern</td>
</tr>
<tr>
<td>Gloucester</td>
<td>Gloucestershire</td>
<td>Midlands</td>
</tr>
<tr>
<td>Tewkesbury</td>
<td>Gloucestershire</td>
<td>Midlands</td>
</tr>
<tr>
<td>Bridgenorth</td>
<td>Shropshire</td>
<td>Midlands</td>
</tr>
<tr>
<td>Newark</td>
<td>Nottinghamshire</td>
<td>Midlands</td>
</tr>
<tr>
<td>Nottingham</td>
<td>Nottinghamshire</td>
<td>Midlands</td>
</tr>
<tr>
<td>Shrewsbury</td>
<td>Shropshire</td>
<td>Midlands</td>
</tr>
<tr>
<td>Tenbury Wells</td>
<td>Worcestershire</td>
<td>Midlands</td>
</tr>
<tr>
<td>Worcester</td>
<td>Worcestershire</td>
<td>Midlands</td>
</tr>
<tr>
<td>Woodford Green</td>
<td>Essex</td>
<td>Thames</td>
</tr>
</tbody>
</table>

Respondents who had received a flood warning were asked if they had been given any advice on what to do to prepare for the flood. 53% of respondents said they had been given some advice. These respondents were asked what advice they had been given. 32% mentioned spontaneously that they were advised to take belongings upstairs. Flood
packs and leaflets from the council were mentioned by 16% and 14% of respondents respectively and 13% mentioned information they got from the Environment Agency.

The advice that was given, which was acted on by more than three-quarters of respondents was to listen out for warnings (91% did this), warn your neighbours (83%), be prepared for a loss of power (81%) and to listen to a local radio station for further information (77%). It should be noted that these are the most passive pieces of advice and perhaps are the easiest for people to do. The advice, which was given but not acted on by the most respondents, was to put flood boards or gates in place and to boil tap water until declared safe (63% of respondents did not do each of these things). The main reason for not doing these things was that respondents felt it was “not necessary”.

**Lessons learnt**

⇒ Where flood response plans existed, these were followed and worked well. Where there were no plans there was a greater need to plan in "real time" and coordination was more difficult in some locations.

⇒ The Agency recommends that together with local government they should jointly develop a policy for the provision of sandbags, that they should investigate joint "call off" contracts for the supply and distribution of filled sandbags and that they should assess the capacity to supply large numbers of sandbags in an emergency.

⇒ The Agency is also investigating alternative solutions to the use of sandbags. The management structure worked well but has a large human resource requirement, particularly for incidents over a prolonged time period running 24 hours per day.

⇒ Surveys have revealed that there is likely to be a need for regular public awareness campaigns if effective public response and limitation of flood damage is to be achieved. Survey results indicate that there is value in providing information to the public to enable them to take action for themselves. The national public awareness campaign will continue to increase the understanding that action must follow the warning messages. A risk of complacency amongst those not recently affected by flooding has been identified.

**2.7.8 Information supplied to the public and related lessons learnt**

**Prior to the event**

As stated previously, information before an event is distributed to operational organisations via the Local Flood Warning Plans. Information to the general public is distributed during the annual public awareness campaign. Campaign material can be requested throughout the year via a dedicated telephone service and via the Internet. Both the telephone and Internet services are "branded" with the Agency's Floodline corporate identity.

**During the event**

During the event flood warning messages were disseminated, principally via the Automated Voice Messaging System, to operational organisations and to the general public. The Agency target is for 80% of properties flooded to have received a flood warning at least two hours in advance. This performance is measured by post event public opinion surveys. The results of the survey are not yet available. The warnings are issued by telephone message, by fax and by pager text. In some locations sirens are used and in others vehicle mounted loud hailers. Local community volunteers also cascade the warning message to their neighbours.
Once a flood warning is issued, further information can be obtained from the local radio, from the text message service on TV and from the Agency’s telephone service (Floodline). The telephone service provides, via individual message boxes, information about particular river catchments. The information is recorded in “real time” by Agency staff.

**Lessons learnt**

- The Agency has permissive powers to act on certain, but not all, rivers and streams. Those that are not within the role of the Agency are within the role of local government. There was evidence that the public did not understand this difference and wanted a “one stop shop” for any flood enquiry. It is proposed that the service should be expanded to provide a single point of contact for all flooding enquiries.

**Following the event**

Local government provides post event support to the community. The Agency has attended many public meetings to explain how and why the flooding occurred. The flood victims may be divided into two main groups, those with insurance and those without. For those with insurance their physical losses have been replaced, although in some cases it takes a period of months for the flooded property to dry out. For those without insurance, there is a much greater need for support from the social service departments of local government.

The Agency used all available information to catalogue the flooding that took place, the local causes of this flooding and how solutions or responsibility for action can be successfully attributed (see Table 2.7.8.a).

**Table 2.7.8.a - Summary of principal locations where more than 20 properties were flooded**

<table>
<thead>
<tr>
<th>Cause of flooding</th>
<th>River</th>
<th>Location</th>
<th>Agency Region</th>
<th>No. of properties affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overtopping of Agency defences</td>
<td>Main River</td>
<td>Stockbridge</td>
<td>NE</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Barby</td>
<td>NE</td>
<td>152</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ponteland</td>
<td>NE</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Waltham Abbey</td>
<td>T</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wanstead</td>
<td>T</td>
<td>230</td>
</tr>
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<td>Outflanking of Agency defence</td>
<td>Main River</td>
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<td></td>
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<td>Main River</td>
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<td>Gowdall</td>
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<td>Failure of third party defence</td>
<td>Main River</td>
<td>Skipton</td>
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<td>27</td>
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<td>Non Main River</td>
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2.8 Floods in July 1997 (Czech Republic)
Eva SOVJAKOVA (Ministry of Environment, Prague)

2.8.1 Date of the disaster and location
6 - 21 July 1997, Morava and Odra catchments and East Bohemia region.

2.8.2 Short description of the event
Two initial meteorological events in July 1997 (4 – 8 July and 17 – 21 July) led to the historically exceptional duration of extensive precipitation on the Czech territory, resulting in the flood disaster in the Morava and Odra River basin and in the East Bohemia region. The runoff response to the strong precipitation was extreme inundation of watercourses in mountainous and also in lower elevation areas. There were 538 cities and municipalities affected in 34 districts. The area of 1,248 km² was flooded.

In time of flood disaster the rescuing and safety operation measures required:

- 16,967 professional and voluntary firemen from 1,544 units,
- 3,500 of personnel daily from 125 army units and 19 civil protection units (the most of 7,400 personnel during the culmination of the flood),
- 31 aircraft and helicopters undertaking 2,501 flights; the most flights of a total of 650 were made on 9 July 1997.
- 819 land carries were at disposal.
- The civil protection units transported 150 tons of material and humanitarian aid, and made 157 demolition tasks of destroyed buildings.

Generally flood conditions that occur in the Czech Republic can be grouped into 4 main types as follows:

- **Winter floods** caused by ice phenomena, which can occur also during the periods when the flows are relatively low. These floods occur in river reaches exposed to ice jam formation.

- **Winter and spring floods** caused by snow melting that can be combined with rain. This type of flood is most frequent in under-mountain areas but these floods can also affect lower reaches of the rivers. The last flood event of this type occurred in March 2000, total damage was 90 million Euro.

- **Summer floods caused by long-lasting regional precipitation.** These floods usually occur on all watercourses in the area exposed to the precipitation with highest impacts along middle or large-size rivers. The flood disaster in July 1997 was a typical one.

- **Summer floods caused by short high-intensity storms** (frequently over 100 mm during several hours) affecting relatively small areas. These floods can occur anywhere on small rivers with catastrophic consequences mainly in those basins that are highly declined and fan-shaped. The last event occurred in July 1998, total damage was 54 million Euro.

From the long-term evaluation, mean annual flood damage in the Czech Republic is at a level of about 30 million Euro. About 40 to 50% is damage of agricultural production, 15 to 20% is damage to watercourses and associated structures, and the remainder is other damage in the flood plain areas. The flood disaster in July 1997 was extraordinary one. Since 1997
Czech Republic has been affected with flood event with occurrence over 50 year or 100 year in various regions each year.

2.8.3 Human consequences
During the extraordinary flood situation there were 50 fatalities, however an additional 10 people died as a direct consequence to the floods. Furthermore, approximately 700,000 people were injured and more than 80,000 were evacuated.

2.8.4 Economic losses
More than 1,621 houses were totally destroyed, 4,000 houses were damaged seriously, and 25,000 houses were damaged in a medium scale or slightly. Of the transport infrastructure, 51 roads, 15 railroad bridges and 1,217 km of roads and railroads were damaged or destroyed. Water supply was completely interrupted in 52 municipalities; the flood polluted 3,500 wells. 40 municipal wastewater treatment plants had to stop or limit their operation.

The total damage was estimated at 1.9 billion Euro of which 1.2 billion Euro on properties. By the ownership classification, 22% of the total property damage was caused on the state property, 10% on the municipal property, 13% on the property of citizens, and 55% on the property of the business subjects. By the type of property, of the total amount of damage, 14% was caused on buildings and flats, 42% on factories including equipment and supplies, 18% on transport infrastructure, 11% on water management facilities and structures, 8% in environment, 3% in agriculture and 4% to other properties.

2.8.5 Prevention measures and related lessons learnt
The purpose of prevention measures is to control evolution of floods and their impacts, with the aim to eliminate losses of lives and maximally reduce flood damage. Before the flood disaster in July 1997, the flood protection measures were taken but the prevention system was not sufficiently tested in practice. The forecast of extreme meteorological conditions was issued in time, the first warning about heavy rainfall was available two days before the disaster. Unfortunately, the local authorities and inhabitants were not aware of the flood danger and thus they did not take sufficiently into account the warning forecast.

Lessons learnt
⇒ It is obvious that the natural disaster of such extent as an event in July 1997 verified not only qualities and adequacy of legislation, functionality of the state administration and local authorities, the integrated emergency system in its entirely and its elements individually, but also preparedness of enterprises, citizens and insurance companies. Regarding the flood disaster, the role of the state is more oriented towards prevention, incorporating in part, for example, natural retention of water in landscape, financial participation in technical measures, prevention of risks, public education, information on endangered areas, operation of flood forecasting service, organisational and technical support for rescue operations, preparation of financing mechanism for support of affected individuals and for elimination of damage incurred on the municipal and state properties and support of individual insurance schemes.
2.8.6 Preparedness measures and related lessons learnt

Generally, the flood protection measures in the Czech Republic can be divided into: preparatory measures, measures to be taken before floods, operating measures to be taken during floods and those implemented after a flood. The preparatory measures include flood protection plans, flood protection inspections, organizational and technical preparation of the flood protection measures, creation of flood reserve stock, clearing of flood plain areas, development of an information system and training of persons participating in the flood protection activities.

Flood protection commissions

Activities associated with protection against floods are governed by flood protection authorities, which are bodies of the State administration fully responsible in pertinent areas for organisation of the flood protection services. The flood protection authorities govern, coordinate and control the activities of other participants involved in the flood protection.

During floods, the flood protection authorities are formed by flood protection commissions of municipalities, districts and basins, while during periods between floods, relevant responsibilities are undertaken by municipal authorities, district authorities and by Ministry of Environment and by Central Flood Protection Commission of the Czech Republic.

The flood protection commissions are established by bodies of the State administration as their executive components ensuring special activities during individual flood events. Municipal flood protection commissions are being established for those municipalities, which are exposed to flood danger. During periods between floods, the flood protection authorities at lower level are subordinated to the authority at a higher level in all matters concerning the activities of the State administration in the flood protection. During a flood whose areal extent exceeds the territory under responsibility of the authority at lower level or if potentials of this authority are insufficient for implementation of necessary measures, the responsibility for governing the flood protection activities is fully undertaken by the authority at higher level.

Flood protection plans

The flood protection plans contain available data and information for flood protection of a structure, municipality, watercourse, river basin or other territorial unit. Individual bodies or organisations prepare the flood protection plans in the extent and structure relevant to their needs or in accordance with requirements specified by a flood protection authority. Basic hierarchic structure of the flood protection plans is formed by municipal flood protection plans (of municipalities whose territories are exposed to flood danger), district flood protection plans, river basin flood protection plans, and Flood Protection Plan of the Czech Republic, which is prepared by Ministry of Environment. If required by a flood protection authority or needed, the flood protection plans can also be prepared for individual properties that are exposed to flood danger.

The plans contain factual and graphical part, which includes relatively unchangeable information on sources of the flood danger, flood plain areas and flood protection measures. Operational part of the flood protection plans includes mainly information on the contacts to individuals and bodies of the flood protection service.

The flood protection plans are annually examined and if needed also amended. The factual parts of the flood protection plans are submitted for approval to pertinent flood protection authority or the authority at higher level. The operational parts are continuously updated and
forwarded to flood protection authorities and other participants of the flood protection system.

**Degrees of flood protection activities**

The degrees of the flood protection activities are usually related to certain stages, which should be derived by using an objective method. The stages for declaring the degrees of the flood protection activities are specified in the flood protection plans and approved together with the plans by the flood protection authorities. The flood danger is specified by 3 degrees of the flood protection activities as follows:

- **Degree one (state of alert)** - at water management structures, this degree begins when limit values of observed variables or safety parameters of the structure are reached or when unusual facts which could lead to danger of a flood which could be caused by man-induced factors are detected. This degree requires that increased attention is paid to the watercourse or some other source of the flood danger and the activities of the flood watching and reporting services are usually commenced. The state of alert is also a situation to be reported by the Flood Forecasting Service of the Czech Hydrometeorological Institute (CHMI).

- **Degree two (state of emergency)** shall be declared when the limit values of the observed variables or safety parameters of a water management structure are being exceeded. The flood protection authorities and other participants involved in the flood protection are being activated as well as relevant technical means, and measures for flood mitigation as specified in the flood protection plans are being implemented.

- **Degree three (state of danger)** shall be declared, simultaneously with initiation of emergency measures, when critical values of the observed variables or safety parameters of a water management structure are being reached. The time when the danger is reported normally coincides with the moment when water overflows riverbanks or when safety of a water management structure is endangered. Flood protection and, if required, rescue activities and evacuation is organised.

**Lessons learnt**

- On the basis of assessments of 1997 flood disaster and its consequences, it was decided to launch activities aimed at preparing relevant legislation concerning flood protection, and, under relevant ministries, to start special programs aimed at flooded area definition, control of emergency situations, restoration of areas after floods and realisation of flood protection structures.

- In 1999 the Government decided and issued the Czech Government Decree No 100/1999 Collection on protection against floods. In 2000 it was approved by Resolution of the Czech Government No. 382 of 19 April 2000 the document Strategy for Protection Against Floods in the Czech Republic. Finally, in June 2001, the Government adopted new Water Law 254/2001 Collection. This Law deals also with protection against the flood and specifies flood protection measures. It describes the above-stated system in more detail, especially in relation of obligations and responsibility of involved bodies.

**2.8.7 Response actions and related lessons learnt**

The operating measures that are taken during floods include: flood forecasting service, reporting and warning system, regulation of flow regime, flood protection activities, rescue
activities (evacuation), transportation, and other activities. The measures to be taken after floods include renewal of functions spoiled with the flood in the affected territory, determination and evaluation of the flood damage, elimination of the flood, and flood documentation and assessment.

a) Flood forecasting system

The flood forecasting and warning service in the Czech Republic has been entrusted by law to the CHMI in co-operation with the River Authorities. The CHMI established the Central Forecasting Office in Prague and six Regional Forecasting Offices in its subsidiaries. The main function of the meteorological service of the CHMI in the flood forecasting is monitoring of the weather situation, forecasting of the weather and warnings of dangerous weather events, in particular of heavy precipitation, storms, hail etc.

b) Reporting and warning system

The hydrological service of the CHMI monitors the actual situation on the rivers in the country by its some 150 gauging stations which are providing regular information together with the data from the Water Management Centres of the River Authorities on the flow regulation in reservoirs, and the data from their own gauging stations networks. River Authorities play an important role in flood forecasting and early warning systems and flood protection measures in the relevant basins in co-operation with CHMI. Reporting and warning systems are essential so as to provide information to the Ministry of Environment of the Czech Republic.

c) Regulation of flow regime

The other activities of River Authorities are focused on operation and maintenance of watercourses including the regulation water flow regime. During the flood disaster in July 1997 the control of the runoff regime was ensured by the operational water management control units of the River Authorities on a high level. However the July 1997 flood was extraordinary to such as degree that the landscape retention capability could not eliminate it.

d) Rescue and emergency system

Activities of individual participants of the flood protection system, which includes state rescue and emergency system, depend on type of the flood and local conditions. The representatives of the local rescue and emergency system are usually members of flood protection commissions. The importance of the rescue and emergency system in July 1997 is described in the leading paragraph 2.8.2. The central control of this system is vital as it feeds valuable information to the Ministry of Interior of the Czech Republic.

e) Restoration processes

With respect to high level of damage associated with the 1997 flood, the Czech Government decided that it was necessary to ensure central co-ordination in providing material and financial assistance to the affected areas and appointed the Minister of Environment as a representative for specification, co-ordination and implementation of a Programme for restoration of areas affected by the catastrophic flood. The decision-making concerning restoration of the areas affected by the floods was concentrated on creation of necessary financial reserves, specification of priorities in allocating financial means, and questions associated with the State participation in compensating the flood damage.
Lessons learnt

Regarding paragraphs a) to d), the mentioned systems were upgraded both by financial budget and by approved Governmental Decree and Law.

Regarding paragraph e), the State financial contribution reached almost 48% of originally estimated level of the total damage associated with the floods event in 1997. High portion of the State financial assistance in compensating the flood damage triggered discussion about participation of the State in relation to compensations to be paid by the insurance companies. In resolving this problem, systems adopted in other European countries were taken into account and it was decided the new Law on restoration of areas after natural disasters is prepared. The Law should resolve also questions such as insurance of property of the State and municipalities and problems associated with concluding insurance agreements in risk areas. Data provided by the Czech Association of Insurance Companies show that compensations paid from insurance after the 1997 flood reached 320 million Euro, which represented about 15% of the total damage. Of this, 210 million Euro (66%) was paid to business companies and only 34% to individual persons. It will be necessary in future to encourage interest of the population in concluding insurance agreements involving risks stemming from natural disasters.

2.8.8 Information supplied to the public and related lessons learnt

Prior to the event

Quantitative Precipitation Forecast is one of the most important activities of the Czech Central Forecasting Office and is provided by use of numerical modeling of the weather (The DWD, ALADIN or LAM Model) with use of reports of several European Meteorological Services (France, Germany, UK). This information is supplemented by data from the meteorological satellites and maps of rain intensities provided by meteorological radar. Nowadays the information is available on the web pages of CHMI (see: www.chmi.cz).

During the event

The flood forecasting and early warning system is running during the event. The hydrological service of the CHMI monitors the actual situation on the rivers in the country by its some 150 gauging stations which are providing regular information together with the data from the Water Management Centers of the River Authorities on the flow regulation in reservoirs, and the data from their own gauging stations networks. The information is also on the web pages of CHMI. The regulations of cooperation with public media were approved during flood disaster.

Following the event

After the 1997 flood, the Czech Government established a project whose aim was to provide complete documentation, which would describe and assess meteorological causing factors of the flood, extremity of the causing precipitation, flood hydrographs, extremity of peak flows and flow flow volumes, hydraulic conditions of outflows and overflows, effect of reservoirs and other water management structures, and impact of the flood on quality of surface water and groundwater and their circulation. The output from the project included also an assessment of the conditions and use of land on flood evolution and geographical
information documenting evolution and consequences of the flood disaster. Video and film
documents, which were produced, are aimed at supporting public awareness of flood danger
and protection against floods. The geographical documentation of the flood evolution is used
in a number of international projects, such as that on hydrological modelling of flood
hydrographs carried out under the sponsorship of the Government of Denmark.

**Lessons learnt**

- Population needs to get sufficient information. It is important to employ all of the
  available information systems, including Internet.
- It must be permanently checked up that all participants of both the flood forecasting
  system and the reporting and warning system are connected to the information
  network.
- It is recommend to organise discussions with population about all planned measures
  for effective protection against floods and to support the awareness of the flood
danger.

**2.8.9 International dimension of the disaster**

The Government of the Czech Republic highly appreciated international financial, material
and expert assistance after the 1997 flood. Level of financially quantifiable assistance
reached 3.7 million Euro, which was used for providing direct economic assistance to
affected households, purchasing masonry dryers or ensuring accommodation for low socio-
economic groups of the population. It was important that the assistance included also vaccine
supply for vaccination for protection against jaundice. Thanks to this assistance, no epidemic
of this disease was registered during and after the flood.

The output from an integrated assessment of mainly the 1997 flood includes knowledge
which should be used for an improvement of the flood protection on the territory of the
Czech Republic and neighbour countries. The July 1997 floods mainly in the Odra
River basin initiated the establishment of wide co-operation between the Czech
Republic, the Federal Republic of Germany, Poland and European Union in the domains
of flood forecasting and control, restoration of flooded areas and also preventive
measures. The activities at international level include also INTERREG projects and the
activities of the International Commission for the Odra River Protection or International
Commission for the Elbe River Protection.

**2.9 Flooding in Western, Central and Southwestern Romania during
2000 (Romania)**

*Septimius MARA* (Ministry of Waters and Environmental Protection, Bucharest)

**2.9.1 Date of the disaster and location**

In 2000, Western, Central and Southwestern Romania.

**2.9.2 Short description of the event**

The beginning of the year 2000 was characterised by heavy snows in January and February,
which affected mostly the counties from the west and south-west of the country, where the
thickness of the snow layer recorded 211 cm in the Caras Severin county (Semenic
mountain), 170 cm in Alba county (Apuseni mountain) and Cluj county (Vladeasa
mountain), 128 cm in Maramures county and up to 80 cm in Arad and Bihor counties, caused 5 fatalities and blocked the national, counties and local roads, interrupted the power, water supply and telephone connections, and isolated a few villages.

In the first half of March, the central and western area of the country was crossed by an atmospheric system characterised by relatively higher temperatures and heavy rains, which fell down over the snow layer in the mountain area. The total rainfall during the period between 9 and 12 March, which recorded 220.5 l/m² in the Alba county, triggered high floods in the Crisuri, Somes, Mures, Timis, Iza, Viseu and Olt hydrographical basins.

The high floods produced during this period affected 8 counties (as shown in Figure 2.9.2.a): Alba, Arad, Bihor, Bistrita-Nasaud, Brasov, Cluj, Hunedoara, Mures, caused 2 fatalities and damaged 1,618 houses of the population, 22 socio-economical objectives, 108 km of roads and 10,300 hectares of agricultural land.

![Figure 2.9.2.a - Map of the counties affected by the floods during 2000](image)

During the period between 5 and 10 April 2000, the rainfall measured was frequently above 50 l/m² in 24 hours. This phenomenon, combined with the rapid melting of a snow layer of up to 150 cm, along with warmer temperatures, produced high intensity floods on many rivers in the western and central parts of the country. Also, historical discharges were produced on the rivers Timis, Crisul Alb, Barzava, Poganis, which exceeded the studied flow control design of the flood defence dikes.

As a result of the spillover and breaches of the dikes from the rivers Timis, Caras, Poganis, Crisul Alb, Mures, Niraj, Lut, Crasna, coupled with the runoff from slopes and overflow of some water courses uncontrolled by hydrotechnical works, 10 counties were affected: Alba, Arad, Bistrita-Nasaud, Caras-Severin, Hunedoara, Maramures, Mures, Salaj, Satu-Mare, Timis.
Local floods were also produced in the rest of the year 2000 caused by short duration and high intensity rainfall associated with hail, which generated surface water flow from the slopes. In most cases, the slopes were either deforested or without developments of the torrents. This affected 6 counties (Bacau, Botosani, Giurgiu, Neamt, Olt, Vaslui).

2.9.3 Human consequences

During this period, 12 people died, 250 people were injured and 2,000 people were evacuated.

2.9.4 Economic losses

5,646 houses were damaged and 352,607 hectares of agricultural land were devastated, along with 247 social-economical infrastructure. Furthermore 1381.5 km roads were disrupted.

Material losses during this event totalled 114 million Euro.

Response cost totalled 250 million Euro, however this sum also includes response costs during 1999.

2.9.5 Prevention measures and related lessons learnt

Following the flood event, the major prevention actions taken were the following:

- The Central Commission for Defence Against Floods, Dangerous Hydrometeorological Phenomena and Accidents at the Hydrotechnical Works (Comisia Centrala pentru Apararea Impotriva Inundatiilor, Fenomenelor Meteorologice Periculoase si Accidentelor la Constructiile Hidrotehnice - CCAI), elaborated and approved the following:
  - County Plans for defence against the floods, dangerous hydrometeorological phenomena and accidents at the hydrotechnical works,
  - Basin Plans for defence against floods for the period 2000-2003, which include maps of the frequently flooded areas, where it is prohibited to construct buildings.
  - General Urban Plans (Plamuri de Urbanism General - PUG-uri), which provide the land use planning and building codes for the whole territory of each locality, including also the frequently flooded areas where it is not permitted to build buildings. These plans are usually managed by every mayor.

- At the level of the municipalities, towns and villages, plans for defence against floods and ice for the period 2000-2003 were partially elaborated by a commission for defence against the disasters.

- The owners of the dams, have elaborated warning-alert plans for the downstream localities and infrastructure.

- Through the Investment Program of the Ministry of Waters and Environmental Protection, impounding, regularisation, consolidation and bank protection of the water courses banks and reservoirs for high flood dumping were executed, from the funds allocated from the State budget and from external credits (from the European Investment Bank).
• The project of a Law regarding the “Plan of the national territory development” was elaborated. The Fifth section, which deals with “risk zones”, includes the presentation of the zones prone to floods, landslides and earthquakes.

• The owners of the hydrotechnical works completed the deposition of materials for flood defence. It is necessary to allocate the funds from the local budgets for the construction and completion of this kind of deposits at the level of the localities.

• The Technical Permanent Secretariat of **CCAI - Secretariatul Tehnic Permanent al Comisiei Centrale pentru Apararea Impotriva Inundatiilor, Fenomenelor Meteorologice Periculoase si Accidentelor la Constructiile Hidrotehnice**, organised annually verification of the technical and functional situation of the major hydrotechnical works with purpose for defence against the floods, also the situation of the deposits of the materials and means for operative intervention, the decisional-informational flux, the repairing and the rebuilding the hydrotechnical works, the organisation conditions of the commission for defence against the disasters, establishing the necessary measures, with terms and responsibilities.

• A Framework Guideline for organisation and function of the county commissions for defence against the disasters was elaborated by the Permanently Technical Secretariat of the Governmental Commission for Defence Against the Floods.

**Lessons learnt**

⇒ During 2000, among the floods produced by overflowing of the water courses, a major cause of flooding was caused by the frequent high intensity precipitation that fell on restricted areas, which triggered violent floods from the slopes.

⇒ The flash floods effects were worsened by some sewage networks subdimensioned from the localities, the lack of maintenance and undeveloped unclogging works, and also by technical mistakes of design and execution of these.

⇒ Furthermore, difficult situations were encountered when the bridges and foot bridges were subdimensioned regarding the flow, built without design projects and without water management permits. In other areas, even the bridges and the footbridges that were correctly designed, were overwhelmed by the increased flows.

**2.9.6 Preparedness measures and related lessons learnt**

Measures taken during the preparedness phase are described here below.

• National Institute of Meteorology and Hydrology elaborated warnings and prognosis regarding floods and dangerous meteorological phenomena, which were sent to the Water Directorates. These, at their turn, warned the affiliated counties commissions for defence against the disasters which, at their turn, through the informing-alarming posts warned the local commissions for defence against the disasters.

• The county commissions for defence against the disasters initiated the “flood alarm situation” and ensured that permanent shifts were established at the commissions and local commandments of defence and at the dispatching centres of the water management units. It must be specified that according to the “Scheme of defence against the floods, dangerous meteorological phenomena and accidents at the hydrotechnical constructions” (approved through the Governmental Decision no. 638/1999), defence schemes should be establishes and followed at flood-prone facilities, irregardless of the status of the owner. These schemes (as shown in Figure
2.9.8.a) are locally directly subordinated to the communal, town and municipal commissions for defence against the disasters, lead by the majors. Also, in order to assure the transmission of the information, prognosis and warnings from the meteorological and hydrological units to the counties and local commissions for defence against the disasters, through the operative Plans of defence were established means of telecommunications to be used, at which are assured a permanent activity.

**Figure 2.9.8.a - Scheme of the informational-decisional flux for defence against floods at the national level**

- Local commissions and schemes for defence against the disasters initiated the operative actions in conformity with the provisions of the Plans for defence against the floods, dangerous meteorological phenomena and accidents at the hydrotechnical works for the period of time 2000-2003, elaborated by the county commissions for defence against the disasters and by the hydrographical basins branches of the “Romanian Waters” National Company.
- In order to prevent the production of some damages, along with the verification of all works designated for settling ponds, all the owners of the mining tailing dams from the possibly affected area were warned.
- The reservoirs managed by the “Romanian Waters” National Company and SC Hidroelectrica functioned in conformity with the exploitation rule at high waters, making a preliminary discharge of the reservoir lakes, in order to retain the forecasted high waters.

**Lessons learnt**

⇒ An important task represents the updating of the “Instructions of drawing out the warning-alarm Plans” with the clear specification of the decision factors regarding the measures of warning-alarming and evacuation in different exploitation situations of the dams.

⇒ The dam owners were required to finish the installation of warning equipment for their dams near the localities that could potentially be affected downstream.
2.9.7  Response actions and related lessons learnt

The counties and local commissions for defence against the disasters took action according to the provisions of the Plans for flood defence, as it follows:

- Measures were taken for raising the dikes at the points where a risk for spillover (on the rivers Crisul Alb, Timis, Niraj, Lut, Crasna) existed and also for stopping the infiltration and springs from the dikes, slope erosions and closing the breaches;

- For the evacuation of the internal waters, the drainage pumping stations functioned at their entire capacity and was created a breach in the dike of the Crisul Alb river and another breach in the track of the railway Arad-Oradea;

- Actions were undertaken for the evacuation of the population from the affected localities and supply with water, food, medicine and aids. In the operative defence actions, units of the “Romanian Waters” National Company, National Society of Land Improvement, Ministry of National Defence, Ministry of Interior, Civil Protection counties inspecting posts were involved;

- Actions for the reconstruction and assurance of the water and power supply of the affected localities were intensified;

- Supplementary means of telecommunication from the police, civil protection and army were used;

- Roads and bridges for re-establishing the circulation to the isolated localities were temporarily reconstructed.

The Technical Permanently Secretariat of the CCAI surveyed the evolution of the meteorological and hydrological phenomena, verified the prognosis and warnings transmission, made reports for the Governmental Commission for Defence against the disasters and mass media. It verified the dikes affected by the high waters in the field and assessed the necessary funds for their rehabilitation.

Lessons learnt

- In some cases, major deficits were encountered in the existing defence structures as they were regulated especially for: fuel, intervention with equipment, warning sirens, lightning devices, radio-communication equipment, power groups, submersible pumps, protection equipment, motor boats, landrovers.

- In order to face the floods, supplementary funds (e.g. for radio-communication equipment procurement, installation of the supplementary telephonic posts, expenses for defence actions and protection of resources - according to the "Frame Normative stock of flood and ice protection equipment for operative defence activity", approved through the Governmental Decision no. 638/1999), must be stipulated in the budget of the county councils and other economical agents, which own the flood defence works or have legal obligation of coordination and intervention in case of floods.

2.9.8  Information supplied to the public and related lessons learnt

The decisional and informational flux, which includes the following systems: hydrometeorological, water management, land improvement, counties and local disaster defence (as shown in Figure 2.9.8.a), functioned properly, corresponding with the actual technical facilities.
The major malfunctions that occurred are the following:

- The presence in some hydrographical basins (for example the hydrographical basin Crasna) of faulty radios that temporarily worked at the frequency of 32 MHz, and whose spare parts for repair could not be easily procured;
- Incomplete supply with radiotelephones or mobile telephones of the personnel involved in the operative actions;
- The permanence not assured at some rural halls (during the free days);
- The lack of some performing radar, which can supply complete information regarding the dangerous meteorological phenomena over the Romanian territory;
- Inadequate prioritised assurance of the communication on the basis of the special indicatives, in conformity with legal provisions;
- The informative and synthesis reports transmitted by the local commissions for defence against the disasters did not arrive in time at the Flood Defence Centres due to the lack of a good collaboration between the water management systems and the informing-alarming posts near the Inspecting Posts of the Civil Protection Counties in some areas. Thus, the dangerous meteorological phenomena resulted in accidents at the hydrotechnical works of the Permanent Technical Secretariats of the County Commissions for Defence Against the Disasters;
- The request of the Technical Permanently Secretariat of the Governmental Commission for defence against the disasters for different types of damages reporting, caused by floods and dangerous meteorological phenomena, which differ from the regulated ones.

**Lessons learnt**

⇒ An intensified activity for public education, information dissemination and preparedness schemes to face a crisis situation is necessary.

⇒ The public have to be informed by the water-management authorities and by the public administration authorities that the high floods are components of the hydrologic regime of the water courses, and knowing this fact the public will became aware that in the areas with flood risk is prohibited to build.

⇒ An important involvement has to be shown by Mass media, which must help for the correct spreading of the information and to educate the population.

**2.9.9 General lessons learnt**

The major causes of the damages produced by floods, were mainly the following:

⇒ The heavy precipitation cumulated with the rapid melting of the thick layer of the snow, which produced discharges exceeding probabilities ranging between 0.5-10%, higher than the designed discharge repetition probability of the dikes, and burst of some dikes by rupture or spillover.

⇒ Undeveloped flood control works on some water courses, which require desilting, deforestation and obstacle removal.

⇒ Inadequate maintenance of the dikes as a result of the insufficient personal in charge and the funds allocated for this activity.
The transport capacity of the bridges or footbridges exceeded because of the underestimated design and also because of the clogging of the flowing section with woods, debris, waste deposited in the riverbed area or removed from the slopes.

Inadequate maintenance or lack of the drainage and discharging trenches of the rainwater in most rural areas.

The building of the houses and domestic facilities in the flood plain area of the water courses without a water management permit.

The lack, at the level of the local commission for defence against the disasters, of the teams and also the materials and means for operative intervention.

The ignorance of the local public administration for their tasks in the case of this type of disasters, which led to an inadequate function of the informational and the warning-alarming system of the population.

2.9.10 International dimension of the disaster

As a result of the floods from the spring of 2000, for the rebuild of the infrastructure works severely affected, the European Investment Bank (EIB), has approved a Framework Loan of up to 250 million Euro, from which 90 million Euro was for the rebuilding of the hydrotechnical works damaged by the high floods, in the same affected area of the country, during the period 1999 - 2000.

The Romanian Government gave humanitarian aid to the affected population from the following counties: Arad, Bihor, Caras-Severin, Hunedoara, Mures and Timis, which consisted of food, clothes, shoes worth 52,500 Euro (through Governmental Decision no. 254/13 April 2000).

The insurance companies, NGOs and different local organisations had a week involvement in the activities for preventing and reducing the effects produced by the floods in the high risk areas from Romania. The insurance companies are unwilling to insure the goods from the properties located in the flooded prone areas, the only financial resource for minimising the damages caused by the floods being represented by the funds allocated from the State budget and external credits.

2.10 Flooding in Northwestern Romania in March 2001 (Romania)

Septimiu MARA (Ministry of Waters and Environmental Protection, Bucharest)

2.10.1 Date of the disaster and location


2.10.2 Short description of the event

The heavy rain that fell during 3 - 6 March 2001, in the north-west of the country, which recorded 218.5 l/m² at Cavnic, 135.8 l/m² at Firiza, and 112.0 l/m² at Mara, combined with the quick melting of the remaining snow layer and the ice blockage, caused the increasing of the flows and levels on the rivers west and north of the country. The discharge of Tisa River rose from 60 m³/s to 3,560 m³/s (historical discharge) and Viseu River from 20 m³/s up to 1,500 m³/s.
As a result of the meteorological phenomena during the period 3 - 6 March 2001, 11 counties (as shown in Figure 2.10.2.a), (Alba, Bihor, Bistrita–Nasaud, Botosani, Cluj, Harghita, Hunedoara, Maramures, Satu Mare, Salaj, Suceava) were affected by floods.

2.10.3 Human consequences
There were no deaths during the March 2001 inundations. However, 170 people were injured and 1,500 people remained homeless. Furthermore, 3,723 persons were evacuated.

![Map of the counties affected by the floods during 3-6 March 2001](image)

2.10.4 Economic losses
The total amount of material losses was 26 million Euro, whilst the response action costs summed up to 19 million Euro. The damages during the event affected:

- 219 localities,
- 2170 houses,
- 57.8 km dikes,
- 46 social-economical units,
- 637 bridges and footbridges,
- 306.4 km national, counties and communal roads,
- 506.7 km forestry roads,
- 6 km electric distribution lines,
- 4.4 km railway network,
- 11 km water supply networks,
- 195 hydraulic structures for flood defence,
• 9906 ha agriculture land,
• water intake of Sighetul Marmatiei city (the municipal town of Maramures county).

In particular, the Romanian Government allocated 7.4 million Euro, through the Ministry of Waters and Environmental Protection, to eliminate the flood effects by repairing the damages produced at the dams and other flood control works (such as: river bank protections and consolidations, impounding and stream bed regularisation), including the completion of the stock materials for defence against the floods.

For the affected infrastructure works (such as: a municipal water intake and a water supply pumping station, roads, streets, bridges and footbridges), which required urgent reparations, the Romanian Government allocated 11.2 million Euro through the Ministry of Public Works, Transports and Housing.

2.10.5 Prevention measures and related lessons learnt

The Ministry of Waters and Environmental Protection, based on the Framework Scheme of hydrographical basin development, elaborated the national strategy for defence against the floods, which was integrated into the national strategy for defence against disasters, and includes the following measures:

• To organise, at the local level, the physical and juridical persons, who are beneficiary of some flood control works. It has to be specified that the physical and juridical persons who own or use lands or other facilities in areas, which can be affected by the destructive effects of the waters or by the accidents at the hydrotechnical works, have the obligation to participate at the defence actions and to assure the maintenance and the safety exploitation of the existing defence works;
• To reorganise the national and local system of collection and distribution of the humanitarian aids, including the NGOs association, especially for the affected homeless persons;
• To set up some NGOs with social activity objective, regarding the education of the population from the areas with the flood risk;
• To observe the way in which the allocated funds from the State budget are used for the investment and maintenance works at the hydrotechnical structures with purpose for flood control, for torrent control or other works, which contribute at the minimisation of the flood risk and damages;
• To ensure the necessary funds for the investment works or other projects in the areas affected by floods;
• To stipulate impounding bank protections and consolidation, along with the installation of high flood alarm equipment for defence against floods:
  - against floods,
  - of unprotected infrastructure as a function of their importance,
  - of unprotected infrastructure located in undeveloped lands;
• To draw up external funding to improve the management of areas with flood risk and the activity of defence against floods;
• To use incentives for the investors, physical and juridical persons that construct works, which have also the purpose for diminishing the flood danger or reducing the discharge of high water waves;
• To speed up the installing of warning equipment at important dams and at downstream localities, which can be potentially affected in case of dam accidents or rupture;

• To continue river beds maintenance (desilting, vegetation removal, flow capacity recovering of the bridges, etc.).

In the Crisuri hydrographical basin, a warning system is in the process of being set up that consists of a meteorological radar (Doppler type) and an automatic system of data log and transmission, which is financed by PHARE. Another PHARE project that has also been approved is situated in the hydrographic basin of Somes-Tisa, which consists of a Doppler meteorological radar, an automatic system of data processing and a GIS, which includes hydraulic and hydrological models, for management and promptness of the decision to be taken in exceptional situation.

In order to optimise the informational system of the “Romanian Waters” National Company, the extension of the radio territorial network is taken into account, where the data traffic are unlimited, under low cost conditions.

The General Urban Plans of (PUG-uri), which are managed by every mayor, provide the land use planning and building codes for the whole territory of each locality, including also the frequently flooded areas where building is not permitted.

Lessons learnt
In order to properly prevent floods, the activity of the defence against them has to be carried out through combined actions, consisting of structural measures and non-structural measures as follows:

⇒ Structural measures should be represented by the development of the hydrotechnical works with defence purposes such us: storage lakes, impounding, improvements, bank protections;

⇒ Non-structural measures should regard the legislative and functional framework, the forecast, warning and alarming systems and the Plans for defence, which stipulate the measures for prevention, intervention and minimisation of flood effects.

2.10.6 Preparedness measures and related lessons learnt
On 27 February 2001, the Central Commission for Defence Against the Floods, Dangerous Hydrometeorological Phenomena and Accidents at the Hydrotechnical Works (CCAI) sent the hydrometeorological forecast elaborated by the National Institute of Meteorology and Hydrology to the following organisations:

• General Secretariat of the Government,

• Permanent Technical Secretariat of the Governmental Commission for Defence Against the Disasters,

• Ministry of Public Administration,

• All prefectures.

CCAI requested the emergency convocation of the county commissions for defence against the disasters, in order to establish the defence and intervention operative measures, which are needed to be in accordance with the provision of the county Plans for defence against floods, dangerous hydrometeorological phenomena and accidents at the hydrotechnical works.
The county commissions for defence against disasters initiated the “defence situation” and ensured the permanence at the local defence commission and commandments and at the dispatching units of the water management systems. It must be specified that according to the “Regulation of defence against the floods, dangerous meteorological phenomena and accidents at the hydrotechnical constructions” (approved through the Governmental Decision no. 638/1999), defence commandments are organised at facilities, which can be affected by floods, independently by the status of the owner. These commandments (as shown in Figure 2.10.8.a) are locally directly subordinated to the town and municipal commissions for defence against the disasters, lead by the majors. Also, in order to assure the transmission of the information, prognosis and warnings from the meteorological and hydrological units to the counties and local commissions for defence against the disasters, through the operative Plans of defence are established means of telecommunications, which will be used, at which will be assured a permanent activity.

All the owners of the mining tailing dams from the Tisa hydrographical basin were warned, in order to prevent damages and to verify that all works regarding settling ponds are respected according to the provisions of the exploitation guidelines during the winter.

In order to forecast the high floods in the upstream part of the catchment area of reservoirs, the volume of water stocked into the snow layer is taken into account and is converted into a preliminary discharge.

**Lessons learnt**

⇒ The repeated and intense high-floods constitute one of the hydrological phenomena, characteristic for the rivers from Romania. As a result, the floods represent a permanently presence on the Romanian territory. The frequency of these phenomena, reported to a period of 100 years is approximately 50%.

⇒ The most important feature of the evolution of these phenomena is that in the last decade, between 1992 and 2001, almost in every year, were recorded significant high floods which led to human loses and important material damages, especially in the centre, western and northern part of the territory.

**2.10.7 Response actions and related lessons learnt**

Local commissions for defence against the disasters, together with the Civil Protection units, took action on the rivers Dorna, Moldova and Bistrita for relieving the zones affected by ice jams. Dynamites were used for the ice jams on the rivers Dorna and Moldova, in the localities Carlibaba, Poiana Stampei and Breaza, from Suceava County.

The local commission for defence against the disasters, together with units of the Ministry of Interior and Ministry of National Defence, have assured the evacuation of the population, animals and belongings from the following localities: Remeti, Salva, Cosbuc, Telciu si Romuli (Maramures and Bistrita-Nasaud counties).

For the evacuated population, accommodation was improvised and medicines, medical assistance, food and mineral water were assured. Targeted assistance was given to the isolated villages. The Romanian Government provided humanitarian aid for the evacuated people, which totalled 402,000 Euro.
The territorial units under the authority of the Ministry of Public Works, Transports and Housing, took actions with specific devices to clear away the roads and railways from the counties of Bistrita-Nasaud and Maramures (National road 18 at Baia Sprie locality and railway Salva-Viseu). The medical-sanitary staff of the Public Health Directorates, along with the contribution of the family doctors and the representatives of the Red Cross, made an inventory of the houses with flooded water wells and distributed disinfectants. Measures were taken for warning the population regarding the potable water consumption just after a preliminary boiling. Recommendations were made regarding the restricted use of the water in the affected areas and the water supply of the municipal town Sighetul Marmatiei was secured with cisterns, with the aid of the army and fire fighters.

A permanent epidemiological and epizootic surveillance was carried out to protect the population and animals against diseases in the affected localities. Fire fighter units pumped the water from the basement of houses and flooded water wells.

The decision was taken to mobilise specialised construction units to undertake hydrotechnical works and to participate in the operative actions of the local commissions in the affected areas.

The water reservoirs from the administration of the “Romanian Waters” National Company functioned in conformity with the exploitation guidelines regarding high floods (Stramtori-Firiza reservoir from the Firiza River, Calinesti reservoir from Tur River, Holod polder from the Holod River). The specialists from the territorial units of the “Romanian Waters” National Company, together with forces of the Ministry of National Defence, Ministry of the Interior and Civil Protection, took the following actions:

- to close the breaches of the dikes from the Tisa River in the municipal town of Sighetu Marmatiei and the Iza rivers at the Valea Cufundoasa and Oncesti-Nanesti villages,
- to protect the defence dikes at the locality of Dej from the Somes River and at the locality of Gherta Mare from Tur river.

**Lessons learnt**

⇒ The most part of the affected areas benefit only from embanking works, without storage works with a mitigation role against flooding.

⇒ It is important the continuation and completion of the protection works started and the promotion of new works with a mitigation role according to the provisions of the frame schemes.

**2.10.8 Information supplied to the public and related lessons learnt**

The Counties Commissions for Defence Against the disasters urgently gathered in order to establish the intervention measures and the maintenance of the informational flows with the local commissions, including the co-ordination in the field and nomination the specialists for inventory and evaluation of the produced damages.

The dispatching centres of the Water Management Systems maintained the informational flow, warned through the informing-warning Posts, the local commissions regarding the high waves propagation (an example of the information flux in case of floods, at a level of a county is shown in Figure 2.10.8.a).

Taking into consideration the rapid evolution of the high flood on the water course Salauta in Bistrita-Nasaud county, a team of the Water Management System Bistrita effectively warned
the population of the villages Romuli, Telciu, Cosbuc and Salva, equipped with a land rover and siren.

It has to be specified that each County Commission for defence against the disasters surveyed the evolution of the dangerous meteorological and hydrological phenomena recorded on the hydrographic basin rivers from their own county. On the basis of the prognosis and warnings sent by the “National Institute of Meteorology and Hydrology” and by the water management units of the “Romanian Waters” National Company, each County Commission participated at the warnings of the local commissions of defence against the disasters. In this spirit the entire local commissions and commandments for defence located downstream of ice jams were warned by telephone. Furthermore, it was recommended to make channel works, with manual, mechanical or explosive means, depending on the local conditions and the degree of endowment. On the river sectors affected by the ice jams, the order to use explosives was established and calculations for the discharge and forecast of the ice movement were made, in order to avoid the superposing of the ice formations on the rivers.

The initiation of the evacuation of the localities that were in danger of flooding was made in accordance with the Defence Plans against floods, dangerous meteorological phenomena and accidents at hydrotechnical constructions.

In the same period of time, Ukraine and Hungary were also affected by the same flood event in the Tisa hydrographic basin. The connection between the Romanian and the Ukrainian part, regarding the exchange of meteorological and hydrological data, functioned satisfactory. Also the forecasts and hydrological warnings were transmitted to the Nyíregyháza Water Direction from Republic of Hungary.

**Lessons learnt**

- It is essential to draw up practical guides for the use of majors at countryside regarding the measures, which have to be taken in flooding situations.
- More active utilisation of the mass media in operative and monitoring actions is needed.
- The involvement of the local broadcasting is required, especially in the crisis period, in order to introduce the advertising announcements for warning and alarming the villages endangered by the floods risk, during their current program.
- Increased frequency of the appeals for collecting humanitarian aid are necessary for the people from the affected areas by floods.

### 2.10.9 International dimension of the disaster

Because of the large volume and rapidity of the flow on the Hungarian territory, as a result of the propagation of the high floods produced on 04 March 2001 in Hungary, catastrophic effects were recorded in the upper part of the Tisa River catchment. In this respect, on 12 March 2001, Hungary requested support from Romania, through the Governmental responsible in the Romanian-Hungarian Hydrotechnical Joint Commission, to reduce the catastrophic effects of the propagation of the high flood produced on Tur River, which had caused the destruction of the protection dyke from the area of Sónkád village and flooded a large area in Hungary.
Due to the increased water levels and discharges of the Tur River due to the increased water levels and discharges of the Tur river, the Ministry of Waters and Environmental Protection, through the responsible of the Romanian Government in the Romanian-Hungarian Hydrotechnical Joint Commission decided immediately to reduce the discharge from Calinesti-Oas reservoir, in order to limit the effects of the floods on the Hungarian territory.

The above mentioned decision taken by the Romanian Part in order to minimise the effects of the flooding on the Hungarian territory was in accordance with the “Regulation regarding the defence against the floods” of the joint Romanian-Hungarian Hydrotechnical Commission, which specify that at the request of one of the Parts and in the limit of the existing possibilities, the other Part will take action in order to minimise the danger of the floods on the neighbouring territory.

2.11 November 1998 Floods (Slovenia)
Izok PREZELJ (Faculty of Social Sciences, Ljubljana)

2.11.1 Date of the disaster and location
4-6 November 1998, all of Slovenia.

2.11.2 Short description of the event
According to the data of the Hydrologic prognostic service at Hydro-meteorological Institute of Republic of Slovenia (HMZ)¹ and the Notification Centre of Republic of Slovenia

¹ The Hydro-meteorological Institute of Republic of Slovenia, with the Law on changes and complements of the law on organisation and working area of ministries (Zakon o spremembah in dopolnitvah zakona o organizaciji in delovnem področju ministerstev, Ur.I.RS 30/2001, 27. 4. 2001), ceased to exist. Its activity is
(CORS) for the year 1998, the rivers, streams and the sea have exceeded the banks and the shore 88 times, but bigger floods took place on:

- 14 and 15 May (Dravinja, Paka, midstream Sava, Ljubljanica, Savinja and Voglajna rivers),
- 5 September and 12-14 September (Kolpa, Krka, Dravinja, Ljubljanica and Sotla rivers),
- 5-10 October and 18-21 October (Soca, Idrijca, Sava, Krka, Iska, Savinja, Dravinja, Loznica, Drava, Kamniska Bistrica, Ljubljanica, Kolpa),
- 4-6 November (Vipava, Idrijca, Kolpa, Ljubljanica, Borovniscica, Kamniska Bistrica, Poljanska in Selska Sora, Sora, Savinja, Dreta, Bokska, Paka, Voglajna, Hudinja, Dravinja, Mislinja, Sava, and Gradascica).

This gradual and continual wetting of the ground kept groundwater levels high. This build up contributed to development of the worst catastrophe since the flooding in 1990 in terms of inflicted damage, and since the flooding in 1992 in terms of frequency. In fact, the November events could be denoted, together with the earthquake in April of the same year, as the worst natural disaster in Slovenia in 1998. This study will focus only on the November flooding, taking into account some effects of the previous flooding in this year.

On 3 November, a high tide from the sea caused flooding in the coastal town of Koper. The situation deteriorated next day. Strong precipitation began on the 3 November in Western and Central Slovenia and then spread to other parts of the country, causing flooding of many rivers, streams and torrents. Western Slovenian hills and mountains were exposed to the amounts from 200 to more than 300 l/m², Central Slovenia to more than 100 l/m² and even Prekmurje in the Eastern Slovenia to around 70 l/m². The rivers and torrents in Western and Central Slovenia started to flood first (waters springing in Julijske Alpe, Tmivski Gozd and Nanos) and then many others in the Eastern and Southern part of the country (Vipava, Idrijca, Kolpa, Ljubljanica, Borovniscica, Kamniska Bistrica, Poljanska in Selska Sora, Sora, Savinja, Dreta, Bokska, Paka, Voglajna, Hudinja, Dravinja, Mislinja, Sava, and Gradascica). In some areas started even snowing on 5 November in the morning. All waters started to decrease gradually on 6 November.

According to calculations for the region, 703 landslides were triggered, 16 houses severely damaged and around 35 bridges demolished or severely damaged. 81 traffic routes were interrupted and the main traffic lines between the capital Ljubljana and Celje (between Central and Central-Eastern Slovenia) were interrupted.

2.11.3 Human consequences

There were two deaths during this event. The figures for the number of injured people and the number of homeless are not known. In Celje, an older resident did not survive a stroke while rescuing his belongings and a man in Velenje fell into the nearby stream and drowned.

2.11.4 Economic losses

The damage caused by the consecutive floods, which was calculated by the National commission on damage assessment in 1998 (September, October and November floods), amounted to 145 million Euro. Today carried out by the Agency of Republic of Slovenia for environment. In this study of crisis management of floods in 1998, the old name will be used.
2.11.5 Prevention measures and related lessons learnt

The precipitation and floods in November 1998 were predicted. The Hydro-meteorological Institute of the Republic of Slovenia sent several warnings every day to the Notification Centre of the Republic of Slovenia. Most of the warnings received by Administration of the Republic of Slovenia for Civil Protection and Disaster Relief from Hydro-meteorological Institute of the Republic of Slovenia were forwarded down to all 13 regional defence agencies. On Wednesday morning (4 November), the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief sent to all regional defence agencies a special letter of warning against flooding of rivers, streams and sea, including landslides, and advisory measures to the regional defence agencies (Uprave za obrambo), local defence offices (IZpostave za obrambo) and municipalities. The mayors of municipalities were advised to monitor the situation and ensure the appropriate readiness of municipal staffs of civil protection and other forces for protection, rescuing and assistance in disasters, including timely informing of the endangered population. They were also reminded to inform in oral or written manner their regional notification centres. The regional defence agencies were ordered to assure preparedness of experts on Wednesday and Thursday, and offer support to regional notification centres. Probably the key lesson from the notification phase is that timely prediction of strong precipitation and flooding could not compensate the missed opportunities and failures in the preventive phase.

Lessons learnt

⇒ Consecutive flooding and strong precipitation increase the probability of another flooding.
⇒ Very high flooding is to be expected at the confluences of the flooding rivers.
⇒ Flooding causes also parallel problems in form of landslides, oil and fuel sinking, interruption of telephone, electrical, gas, water, road, etc. links.
⇒ Unfinished or unprotected sewage systems can act as tube for spreading the flood to the areas where flooding has been previously unknown.
⇒ The failures and missed opportunities in preventive phase, insufficient allocation of financial resources for the water management and inadequate interventions into environment (e.g. building settlements and roads in flood risky areas) have increased the probability of floods and contributed to even higher consequences of the November floods in Slovenia. The professional opinion of water resource experts and urban planners should be regarded more by the municipal authorities and water resource management should receive more financial resources.
⇒ Realistic and accurate threat assessments are the basis for further planning and actions. It is however not always easy to assess the flood risk areas due to the torrential character of most water flows in Slovenia.

2.11.6 Preparedness measures and related lessons learnt

Here below are the lessons learnt during the preparedness phase.

Lessons learnt

⇒ Severity of any forthcoming flood highly depends on the mitigation measures carried out as a consequence of a previous flood. In case mitigation measures (structural or non-structural) are inadequately applied or not applied to infrastructure, the damage
caused by the next flood would be higher and even a small increase of water would create a flood. An indicator of inadequate and incomprehensive mitigation measures is to be found in repeating the same sort of damage on the same objects.

- Consecutive floods in a limited time frame also prevent the responsible institutions to carry out mitigation measures.
- Slovenia needs to adopt a Law on waters in order to comprehensively arrange all the problems associated with water.

2.11.7 Response actions and related lessons learnt

Only at the second day of disaster, on the 5 November, the key national decision-making bodies convened. At 19.30, the extraordinary session of the National civil protection staff was convened. The staff commended the activation and operation of civil protection and disaster relief units as timely, organised and effective. The staff adopted several key decisions, such as (Zapisnik izredne seje staba CZ, 5.11.1998):

- Strengthen the night shift at the Notification Centre of the Republic of Slovenia on 5 and 6 November,
- Assure the night shift at the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief on 5 and 6 November,
- Ordered the Chief health inspector at the Ministry for Health to determine necessary measures for stabilising any epidemiological situation that may arise and to restore the normal operating of hospitals in Celje, along with the task of informing the population on obligatory boiling water before use,
- Decided to notify the Chief inspector for protection of environment on the problem of oil sinking in the flooded areas,
- Approved the use of armed forces according to needs and conditions in affected areas,
- Decided on aerial photographing of affected areas under lead of Administration of the Republic of Slovenia for Civil Protection and Disaster Relief in cooperation with 15 Air-force brigade,
- Decided to notify the regional civil protection staff on the increased possibility of triggering the landslides in next couple days,
- Authorised the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief to require the financial resources from government for interventions,
- Decided to notify, through Notification Centre of Republic of Slovenia, all ministries and regional civil protection staffs to finish with basic measures before 9 November, when the meteorological situation would deteriorate again.

The Chief of General staff of Slovenian armed forces (SAF) issued an order on readiness of all military units for protection and rescue tasks in floods on the territory of Slovenia. The order was sent to commanders of all three operational zones. It was explicitly stressed in the second point of this order that he would issue a special order for activation of units and commands for protection and rescue activities.

The Ministry of Health (Chief health inspector) issued a public release on chances of polluted water in Slovenia. The residents were advised to boil water some 20 minutes or buy
water in bottles. The release was sent to the media and Notification Centre of Republic of Slovenia, which forwarded it to all regional notification centres.\(^2\)

The Slovenian government discussed the disaster in three November sessions (on 5 November, 12 November and 19 November 1998). The stress was on the damage assessment (activities of the National commission and municipal commissions for damage assessment) and preparation of interventionist law on ensuring the resources for restoration of the consequences from September, October and November floods.

The Parliament of Republic of Slovenia adopted the Interventionist law on ensuring the resources for restoration of the consequences from floods at its 29\(^\text{th}\) extraordinary session (25 November - 12 December 1998).

President of Republic of Slovenia, together with Commander of civil protection units of Slovenia and Director of Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, visited the flooded areas in West Stajerska on 6, President of Parliament on 7 and Prime minister on 8 November.

In the most affected region of West Stajerska, the civil protection staffs were timely activated in all 23 municipalities. The Regional Notification Centre (RECO). Celje inducted a strengthened permanent shift and readiness at home after receiving the notification from the Notification Centre of the Republic of Slovenia on 4 November on danger of floods. It regularly informed Notification Centre of the Republic of Slovenia on the events in the region. The Notification Centre of Republic of Slovenia activated 175-times the executors of protection and rescue activities in 36 hours of crisis and sent 266 times information to media on levels of water, affected communications, protection and rescue activities etc. Interesting is that the regional civil protection staff was activated but did not meet in a session.

The key protective and rescue units in the region and its local communities were the Water resource management companies and firemen units. The former started with extraordinary monitoring and intervention measures (e.g. strengthening and increasing the height of dykes, etc.), immediately after reports on the possibility of flooding. Firemen associations and units in most municipalities were fully activated. Their activities could be grouped into three key areas:

- Rescuing, transportation and supplying the affected people,
- Pumping the water,
- Pumping of sank oil derivatives.

Almost all of the rescue and protection activities in West Stajerska were carried out with municipal, inter-municipal or regional resources. The municipalities are obliged, according to the principle of gradual use of forces and means, to use up their own forces and means first, before requesting outside intervention. Only in case of their insufficiency, the help from other municipalities or state may be requested (see Zakon o varstvu pred naravnimi in drugimi nesrecami, 1994: art. 14). The help from other municipalities was requested only in exceptional cases where the local forces lacked equipment or forces (horizontal inter-municipal cooperation). Only two municipalities (Lasko and Celje) requested help from the state and the Slovenian armed forces.

One of the negative experiences from floods in 1990 and 1998 was that many toxic substances were stored in the flood-threatened and flood-exposed areas. Many examples of

\(^2\) This warning was withdrawn on 9 November by the same Ministry.
spilled fuel oil were reported. In many cases, the flooding water pierced into buildings, causing outruns of fuel oil and overturning of containers with used oil, etc. Also an overturned cistern with fuel oil near Lasko caused some pollution. Only in the region of West-Stajerska, 18 interventions in such cases were reported. The question is, how many small spills did the residents not notify.

**Lessons learnt**

- Inter-ministerial exchange of information on the volume of flooding rivers was perceived as too slow from the perspective of some local crisis managers in the most affected region of West Stajerska. The data of Hydrologic Prognostic Service on the level of water reaches the regional level in approximately one hour, which is obviously too late to execute the preventive measures on the local levels. For example, the flooding wave travels from Nazarje to Celje about three hours, of which one hour on average would be already lost for transmission of information from measurement post from the region to the Notification centre in the region. Also information on Teletext page number 147 by Hydro-meteorological Institute of Republic of Slovenia on the levels of rivers was delayed for about one hour. This problem becomes very evident in case of rivers of torrential nature. For this reason, the Regional Notification Centre relied also on more timely information from local "observers" (e.g. one member of its staff lived in Mozirje and informed them on the level of Savinja) and NIVO Celje (company tasked also with river monitoring). Many residents were also informing the Regional Notification Centre on the level of waters, which in some cases also called people from the field for information on the levels and floods.

- Understaffed and technically inadequately equipped institutions could not perform excellently in time of increased labour pressure in crisis.

- The rescue and protection services that become victims in the crisis could not perform as supposed by the protection and rescue plans. These were the cases of the flooded cellar of regional notification centre in West Stajerska, main hospital Celje, Radio Celje and many firemen associations.

- The need for participation of armed forces in protection and rescue activities is relative and dependent from the needs of municipal authorities. In the most affected region, only two municipalities out of 23 expressed a need for participation of armed forces.

- Limited (human and technical) resources of protection and rescue institutions force them to prioritise their activities. This prioritisation, directing rescue efforts first to the public institutions and then to the individual buildings, were perceived in some cases as the ineffectiveness of the protection and rescue system by the people who had to wait too long for help.

- Threat assessments should be continually updated, especially indicators of water levels.

**2.11.8 Information supplied to the public and related lessons learnt**

Prior to the November 1998 floods, the media focused on the mitigation of the consequences from previous floods. The analysed documentation shows that the public was regularly and timely informed during the November floods on a local, regional and national level. The Administration of the Republic of Slovenia for Civil Protection and Disaster Relief was in the time of crisis issuing Daily informative bulletin and Regional notification centre from Celje issued the Regional informative bulletin on 7 November.
After November floods, the Slovenian media were transmitting information predominantly focused on the damage assessment and reimbursement. The level of critical media attitude towards the floods and crisis managers rose significantly in the months after disaster.

**Lessons learnt**

- The media, as transmitters of information to public, could be also vulnerable to the effects of floods. In such case, the notification centres must redirect their public messages to other relevant media, covering approximately the same area.
- Understaffed and technically inadequately equipped notification centre could not inform the public in an appropriate way.

3 OTHER EXPERIENCE IN FLOOD MANAGEMENT

3.1 Experience Gained from Floods in Salzburg (Austria)

*Hans WIESENEGGER (Regional Government of Salzburg, Hydrographical Service)*

3.1.1 Types of floods in Austria

Austria as well as the Province of Salzburg situated in a transition zone between Atlantic climate (in the west), Mediterranean climate (south) and Pannonian continental climate (east) is covered to a high percentage by mountains (Alps) and therefore susceptible to extreme weather situations as floods.

These floods, as a result of various combinations of meteorological and hydrological processes, often appear in typical patterns (Bloeschl, 1997; Kresser 1965):

- Winter and spring floods caused by snow melt combined with concurrent rainfall;
- Summer floods caused by short, very intensive rainfall, especially affecting small catchment areas (flash floods);
- Summer floods caused by long regional rainfall;
- Summer floods caused by special meteorological situations.

3.1.2 Flood protection (legal and technical aspects)

In Austria two governmental institutions are responsible for the development of strategies and projects dealing with floodwater protection.

- **Federal Institute of Torrent and Avalanche Control**
  They have a defined area of interest (Forestry law) and projects based on so called red or yellow danger zones caused by floods of a return period of 150 years which also includes debris flow.

- **Federal Water Administration Authority**
  With projects to follow clearly defined legal aspects such as values of a very high interest to the community in regard to life, culture or economy should be protected against any possible flood, settlements (cities, villages) and important traffic structures as well as economical infra-structure should be protected against flood with a return period of 100 years (HQ100). For special reasons the protection of single houses or single factories etc. can be reduced to a return period of 30 years (HQ30).
Other not so important infrastructure should be protected against HQ30 floods. Agricultural land or Areas used for forestry purposes should not be specially protected. These strategies and projects include natural means, structural means as well as non-structural means, as specified below.

- **Natural means** such as: holding back water (retention) in wet meadows, pastures or other unsealed surfaces before it runs off to creeks, infiltration of water from sealed surfaces to the groundwater system, use of farming methods considering the influence of different crops on surface water runoff, revitalisation of river systems.

- **Structural means** such as:
  - *linear methods*: protection of villages and people by using different technical methods e.g. dykes and dams, mobile walls;
  - *two dimensional methods*: retention basins and dams, special solutions for single buildings (waterproof reinforced concrete cellars etc.).

Linear and two dimensional methods are can also be used in combination.

- **Non structural means** such as: land use plans and their control by local governments, protection of flood prone areas, flood warning and forecasting systems, risk education of inhabitants, different procedures of prevention to decrease flood consequences.

### 3.1.3 Flood warning and forecasting

According to a federal law (*Hydrographiegesetz*, 1979) the Governor of each Province (Land) of Austria is responsible for the preparation and distribution of flood warning information, which is prepared and distributed by the Hydrographical Service, based on a network of approximately 200 online stations (water level, discharge, precipitation, air temperature).

Each of the 9 Provinces of Austria has its own Hydrographical Service using different methods to provide information about floods. Styria, the Tyrol and Vorarlberg operate a mere “warning system” with online information about water levels, precipitation and air temperature. Upper Austria, Lower Austria -, which also provides information for Vienna, Burgenland, Salzburg and Carinthia provide flood forecasting information based on different models.

### 3.1.4 Floodwater warning systems

Well-operated floodwater warning systems are more than the sum of their single components [ROHRER, 1999] and normally there are quite a few people involved to make it successful. Therefore a strict organisation and clear definition of duties are essential and need to be worked out in time. Co-operation of the involved people should be practised in trial situations.

Floodwater warning systems ideally consist of the following components:

- **Precipitation forecasts**

  Specific meteorological situations, which create floods in large river basins, can be analysed and identified by meteorologists using computer models up to 72 hours ahead. Precipitation data for the next 24 hours or more derived from these forecasting models are a great help in oncoming floodwater situations as well as during the flood itself. The larger the scale of the rainfall area is, the better it can be forecasted whereas weather radar data can be used to predict local rainfall up to a few hours, nevertheless
good teamwork between meteorologists and hydrologists is necessary in order to produce accurate floodwater forecasts.

- **Monitoring network**
  Every forecasting method needs on-line information of different meteorological and hydrological parameters. Representative data from spatially well distributed gauges should be transmitted in short regular intervals to a central data bank in order to operate forecasting models under supervision of the responsible hydrologists.
  Different methods of data transmission (radio equipment, telephone, glass fibre cables etc.) are in use. Regular testing and checking of the whole signal path in non-flood periods is essential.

- **Floodwater forecasts**
  The mountainous area of Austria is the reason for relatively short concentration times on small and medium sized rivers and often leaves only a few hours for operational runoff forecasts as well as preparations on the arriving flood. Forecasts for periods longer than 3 to 6 hours can only be achieved by using precipitation forecasts but certainly human experience is needed for appropriate results.

- **Communication system**
  In crisis situations like floods communication systems tend to collapse due to overload or technical faults caused by the floods. Reliable connections between responsible authorities and operational hydrological services should therefore be developed in time and also be frequently tested.

- **Headquarters**
  Headquarters are necessary to co-ordinate activities during flood periods, provide flood forecasts as well as flood reports and need to be well equipped with communication systems.

- **Alarm plans**
  Endangered people need to be warned or evacuated in time, organisations (army, fire brigade, red cross etc.) dealing with flood situations have to be informed in time. Nevertheless operation rules for power stations and reservoirs have to be put into action in time. All the necessary phone numbers, check lists and other important information compiled in alarm plans and should be updated frequently.

- **Reports and Information**
  Flood water reports (with a general description of the floodwater situation at present, a precise short time forecast (quantitative information) and a long-time forecast (tendencies, qualitative information) play an important role on the information line during floodwater situations. Therefore they need to be clearly structured and easily readable without a chance of misinterpretation by local authorities and involved organisations as well as endangered people and media (IKSR - Internationale Kommission zum Schutz des Rheins or ICPR - International Commission for the Protection of the Rhine, 1997).
  There should be a clear strategy in the contents of reports and newer information should not contradict old reports.
3.1.5 Floodwater forecasting systems

Floodwater forecasting systems are not able to prevent big floods but they can certainly offer in-time-warnings to minimise the loss of human lives as well as decrease the amount financial losses and other negative impacts of floods.

Forecasting discharge in real time is a difficult task and in order to meet the requirements of an operational forecasting service in a very accurate way, river basin models like HYFORS (Hydrological forecasting system) were developed [Gutknecht 1994].

The accuracy of flood forecasts often depends on the hydrological knowledge about the regarded catchment, on the experience of the responsible local hydrologists as well as on the availability of data and information from field stations.

3.1.6 Development of HYDRIS (Hydrological information system for floodwater forecasting in Salzburg)

HYDRIS, based on HYFORS and developed at the Institute of Hydraulics, Technical University Vienna, in co-operation with the Hydrographical Service of Salzburg, is described by Bachhiesl (1997) and by Kirchlechner & Wiesenegger (1998). It was put into operation as a consequence of the experience gained from floods on river Salzach in 1991.

Hydrological changes in almost every sub catchment, caused by regulations of rivers, urbanisation, hydro-electric power stations, change in land use etc. made parts of the acquired hydrological experience inadequate and floodwater forecasts, based on this experience, could therefore not be used any more.

In HYDRIS complex hydrological processes in a river basin were modelled by dividing it into smaller sub catchment areas, depending on the hydrological structure of the region as well as on the type of tributaries.

Different floodwater situations (snowmelt, torrent rainfalls, regional rainfall etc.) as well as possible influence of human activities (e.g. reservoir management, effect of power stations) had to be analysed and model parameters were optimised based on extensive analysis and real-time simulations of observed flood events.

Continuous updating procedures, which take account of the errors between computed and measured data at each time step of the forecast had to be developed and on line estimation by a dynamic Bayesian estimation algorithm [Schnatter, 1988] using the actually observed discharge data was used as an approach for accurate solutions of the problem that the simulated Hydrograph often differs from the measured Hydrograph up to the time of the forecast.

Figure 3.1.6.a shows several model components of HYDRIS such as:

- **runoff model** describing the modification of the floodwave between two neighbouring gauges
- **rainfall – runoff model** combination of discharge based on rainfall in the sub-catchment and runoff
- **superposition model** at the confluence of larger streams
- **model representing human activities** (power stations)

which were combined to describe discharge at any gauging station in the catchment.

Figure 3.1.6.b shows the structure of data flow in HYDRIS.
Three partners, Tauernkraft (now Austrian Hydro Power), SAFE and the regional government of Salzburg, with different tasks, use the same system in order to forecast floods as well as to manage floodwater situations in hydroelectric power stations along river Salzach.

A sufficient spatially distributed network of precipitation stations, gauges along the main river and its tributaries as well as data about air temperature, wind-speed and air humidity is necessary and shown in Figure 3.1.6.c.
Information of the area-height relation in the sub-catchments is also useful in order to operate a snow model showing the influence of snowmelt on floodwater.

Figure 3.1.6.c - Monitoring network of a complex river basin model (HYDRIS)

3.1.7 References


### 3.2 Flood Events and Management Options in Metropolitan Athens (Greece)

**Christos A. KARAVITIS (Water Resources Planning and Management, Athens)**

#### 3.2.1 Introduction

The greater Athens metropolitan area comprises mainly the peninsula of Attica, which is situated approximately at the center of Greece. The metropolitan region has an area of 426.8 km², from which 296.4 km² (69.5%) are covered by buildings, streets, etc. The average precipitation is 392.5 mm/yr. (National Observatory, 1999). The Athenian agglomeration and its current structural characteristics is a succinct case of rapid urban and industrial growth, in a region with limited natural resources, without systematic planning and management. The current population of the metropolitan Athens area is 3,096,775 or 30.19% of the whole country (1991 census, National Statistical Service of Greece). In addition to the absence of city planning, environmental problems are compounding their impacts to the area. Water, air (smog) and land pollution have transformed and deteriorated the Attica plain. Given, then, climatic vagaries, absence of urban planning, an expanding population, and heavy industrial concentration, the Athenian region has surpassed the carrying capacity of the system (natural, urban and demographic). Hence, the Athens metropolitan area has a very limited resilience to natural hazards.

The Attica sector is the only water sector in Greece where urban water supply exceeds by far any other uses. In describing the water resources of Greece, the key element seems to be the uneven distribution, both in time and space, of precipitation, activities and population. Western Greece is by far richer in water creating watercrescent from the north to the south than the eastern part of the country, where the majority of population is concentrated. Some additional constraints may be imposed by the continuing increase of water demand as well as by environmental considerations. The Athens metropolitan area is the main user of water in the sector. The responsibility for the water supply and the wastewater of the Athens region belongs to the Company of Water Supply and Wastewater of the Capital (CWWC). According to the existing legislation CWWC is solely responsible for water supply and wastewater works to perform studies, construction, maintenance, repair, operation, financing, revenue, etc. However, for flood protection and pollution control works, the Ministry of Environment, City Planning and Public Works
(MEPPW) has the responsibility of studies and construction, whereas CWWC executes the remaining functions. The Ministry of Economics supervises the budget of CWWC.

The stormwater system of the Athenian region is inadequate to perform a good standard of services. The reasons for such a mediocre performance may be summarized as follows (Karavitis C.A., 1999):

- The natural collectors (rivers, torrents, etc.) have not been regulated sufficiently enough to handle effectively floods with a return period approximately greater than 10 years. In addition, the runoff concentration time and the runoff have significantly changed due to poor city planning and urban development (paved roads, parking, deforestation, etc.).
- Many of the natural collectors have been covered due to urban development.
- The existing (1997) stormwater system services only about 40% of the current needs, with a length of about 3,000 km (120 km natural collection).
- The lowland coastal areas have almost lost access to their natural outlet (the sea) due to development (sea side highways, filling up of the coast and reclaiming the land, etc.), without consideration for stormwater drainage.
- The cost of a storm water system construction may run high since urban development has already taken place.

The torrential floods of 1993 and 1994, and of 1996 and 1997, have demonstrated clearly the above argumentation.

Accordingly, flood contingency plans were not considered of announced. In this regard, it may be safe to predict that if another flood is set over metropolitan Athens, crisis management efforts will be again applied. In addition, the recent droughts in Attica have started to change the perspective. To the public water shortage and on the same time torrential flooding consisted a typical oxymoron. However, the situation in Greater Athens is showing the lack of understanding the need for holistic water resources management strategies under adverse conditions, facing physical, economical, political and social impediments. The absence of serious planning, the haphazard city development and the inefficient water infrastructure will always present problems unless they are confronted with long-range time horizon commitments of an effective water resources planning and management scheme.

3.2.2 The flood context

The recent floods in Athens, although the corresponding precipitation events were of medium intensity, produced severe damages showing at the same time that the flood protection in the Athenian plain is very limited. The reasons for such problems may be primarily attributed to the following elements:

- The natural collectors (drainage ditches, torrents, streams etc) are insufficient to convey the increased runoff volumes due to the extensive urbanization and in many times the decrease of their natural properties (dimensions, slope, etc). Existing urban development policies are also concentrating on covering the natural collectors, in contrast to the established practices of protecting and preserving the natural water courses, as poles of special ecosystems and recreational activities according to environmental sustainability principles.
• The stormwater system was constructed incrementally in different time periods, thus without the necessary strategic view and the resulting integration of its components. The primary system does not practically exist, with the main ephemeral streams (Illyssos and Kefisos) to serve as the primary collectors. The tertiary system does not exist and the majority of the streets and roads are flooding almost in every rainfall event. It is pointed out, that the older downtown districts having a common wastewater and stormwater system from the 19th century are experiencing far lesser flood problems.

• The haphazard and dense urban development has increased the runoff concentration time, leading also to higher peaks and volumes for rainfall events of the same return period (before and after the urban development). In addition to that, the city expansion in the surrounding foothills without coherent and integrated planning efforts has minimized the flood management of the suburban watercourses.

• The design criteria of the flood control works are antiquated and oversimplified (rational method, Grandoffi etc). Risk assessments are not present, as well as economic analyses for a more precise computation of the anticipated risk.

• The maintenance and operation efforts and practices are lagging, since CWWC practically seems not to be able to perform such duties, as the various Athenian metropolis municipalities cannot also perform the duties of satisfactorily cleaning debris and garbage’s from the aqueduct inlets. In this context, it is also noted that the overall management efforts seem not to be adequate.

• The lack of reliable and valid data, as the existing databases are limited. Runoff measurements in the main streams have not been performed, and the existing meteorological stations network is not sufficient for the needs of such a megalopolitan concentration. Measurements on an experimental urban watershed have only recently being implemented.

**Major flood events and loses**
The major flood events are summarized in the following:

• 5 and 6 November 1961 with 40 casualties (80mm/24hr)
• 2 November 1977 with 37 casualties (70mm/24hr)
• 21 and 22 October 1994 with 9 casualties (17.5mm/10min, 67.7mm/1hr)

**3.2.3 Management options and recommendations**
The existing management practices as well as the overall responses to the floods following the above-mentioned argumentation were analyzed and presented. As a result, Table 3.2.3.a classifies the categories of applied flood management responses at the Greater Athens area.

In this context, Athens is an area with a high concentration of population and activities, haphazard urban and water related systems development, characterized by almost the absence of maintenance capital of marginal and decaying infrastructure. The existing databases are incomplete and conflicting. Water resources planning and management efforts seem not to be conducted in a sustained and comprehensive fashion. Flood control operation and maintenance practices also seem to be inefficient and the existing water law is inadequate for a modern megalopolis. The information technology seems not to be incorporated in water resources management practices. However, given the presented
existing uncertainties in the Athenian environment, and the limited meteorological data series, such a fact needs to be further investigated. It would also seem that flood crisis management approaches were prevailing. The decision making process may be characterized by marginal integration among experts, administrators, managers and politicians.

<table>
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<tr>
<th>Resources</th>
<th>Data</th>
<th>Organizational</th>
<th>Policy</th>
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Given such considerations, the following recommendation may be drawn concerning both tactical and strategic options. Briefly, the tactical responses to floods should be focus on:

- The establishment/completion of an integrated meteorological stations network for the monitoring of the rainfall – runoff phenomena.
- The usage of the information technology for the rainfall runoff transformation area wide simulation.
- The development of a flood risk area map (GIS, etc).
- The design and implementation of flood control works using criteria of environmental sustainability and the preservation of the natural collectors’ properties. Practices such as covering of the natural streams should be avoided at all cost.

The strategic responses should be centered on:

- The synergistic efforts with the overall urban planning framework so as to avoid over urbanization. Areas such as park and open natural spaces should be incorporated in the scheme.
- The establishment of a flood prediction – flood early waning system.
- The implementation of coherent flood management responses in a timely and well organised manner, so as to avoid the prevailing crisis management attitude.
- The synthesis of the overall effort with the recently adopted Water Framework Directive by EC. The WFD has far-reaching provisions for the protection of quantity and quality of surface and ground water, integrated planning, and the strengthening of public participation.

3.2.4 References


### 3.3 Experience Gained in the Management of Floods (United Kingdom)

*Linda AUCOTT* (Department of Environment, Food and Rural Affairs, Taunton)

#### 3.3.1 Introduction

This contribution summarises the experience of England and Wales over the last 5 years in dealing and preparing for Flood Emergencies. It indicates the progress made as a result of both forward planning and post flood reaction.

#### 3.3.2 Description of organisations involved

**DEFRA (Department of Environment, Food and Rural Affairs)**

Central Government Department responsible for Flood and Coastal Defence Policy. Provides the majority of funding to the Environment Agency.

**Environment Agency**

A government funded operational agency set up to deliver government policy in many areas of environmental management in England and Wales including flood defence.

**Local Government**

A mixture of elected County, District and Unitary Authorities providing local services to all areas of England and Wales. Funded by a mixture of local rates (taxes) and central government support.

**Police Forces and Fire Brigades**

They are funded by local government at county level but operate mainly under Home Office (Central Government) guidelines and policy.

#### 3.3.3 Past experience

1995

Emergency Management of Floods has been developing rapidly in the UK over the last five years. The initial catalyst was an intention by the Police Forces to no longer undertake the role of passing flood warnings to the public in 1995. In response to this and following consultation between central government, local government the police and the Environment Agency a Government Directive was issued to the Environment Agency to put in place plans
(Local Flood Warning Plans) and systems to ensure the dissemination of flood warnings. This consolidated the Environment Agency's role to not only monitor and forecast flood events but also to issue warnings directly to the public.

In developing the new role the Environment Agency identified a number of aspects that needed to be improved if the new flood warning role was to be undertaken successfully. These included:

- **Public awareness**: to initiate a better response from the public.
- **Emergency planning**: to co-ordinate the response between organisations.
- **Flood risk area mapping**: to identify where a warning service is required and cover more areas.
- **More accurate forecasting of floods**: to maintain public confidence.

Regional programmes to develop flood warning systems were identified and progressed. The Agency launched its new service in September 1996 with the introduction of a new automated public warning system, improved media warning links and the compilation of Local Flood Warning plans which laid out the local flood warning service to the public and arrangements in place with local government and the emergency services.

**1998**

In April 1998 severe floods affected a large part of the Eastern counties of England. In terms of the numbers of properties involved, these were the worst floods to have occurred in the last 20-30 years in England. The flood warning systems and the emergency planning arrangements in place were criticised in an independent report known as the Bye Report. Over 80 separate actions were identified in the report and a plan to progress (these known as the Easter Floods Action Plan) was undertaken by the Environment Agency. The key actions covered by the plan included:

- Identification of flood risk areas and a database of properties within those areas for the whole of England and Wales.
- Development of a new system of flood warning messages to replace the colour coded warning system in place.
- Increased coverage of flood warning systems to cover all rivers.
- Stronger planning regulations to control development in flood plains
- Developing a more seamless and integrated emergency response to flooding between all organisations involved.

**Lessons learnt**

The Easter Floods of 1998 indicated that although the measures taken in 1996 to improve the flood warning systems were largely appropriate they had not been progressed quickly enough and the scope of improvements planned should have been more comprehensive.

As a result the Environment Agency embarked on an accelerated programme of work to implement the recommended actions of the Bye Report.
1998-2000

As a result of the Bye Report and other planned initiatives a number of key issues were progressed.

- Flood plain maps covering all rivers in England and Wales were completed and issued to local government for planning purposes.
- A national database of all properties in the flood plain, including their relative risk, was compiled.
- A National Strategic study was undertaken to assess the economic value of national assets at risk from flooding and coastal erosion. The purpose of this is to provide information to government on risk and investment needs in the longer term.
- New Government Policy Guidelines on Development and Flood Risk were progressed.
- Emergency Flood Plans were prepared for many locations (towns) identified at high risk of flooding fully integrating the role of the public and the organisations involved in the emergency response.
- A new simplified system of flood warning messages was introduced in September 2000 with a National Publicity campaign. Specific information was directed at the identified high risk properties.

On 9 October 2000, following a wet September a prolonged period of further heavy rainfall and serious flooding affected extensive areas of England and Wales.

3.3.4 Overall lessons learnt

General observations can be made from this summary of the last five years of progress in Flood Emergency Management.

⇒ Too much action has been initiated as a result of reaction to actual flood emergencies and not enough from proactive forward planning and management of flood risk.
⇒ In order to motivate forward planning by organisations, detailed information on flood risk and asset evaluation is vital to clearly demonstrate its high priority and justification, both financial and in terms of social welfare.

3.4 Role of the Media in the July 1997 Floods (Germany)

Manfred FUGER (Brandenburg State Bureau, Potsdam)

3.4.1 Introduction

The disaster started on July 14, 1997 and lasted for three weeks. It hit the Brandenburg part of the Oder between Ratzdorf and Oderbruch along the German-Polish border. There were no deaths and only a few injured people, but 20 000 people had to be evacuated. The damage was estimated to be approximately 325 million Euro.

3.4.2 Short description of event

It was already clear that on July 14, the dramatic situation registered, as a result of the Polish flood, was going to also affect the section of the Oder River flowing through Brandenburg.
This was followed by a mighty media presence along the Western bank of the Oder river, concentrated in Frankfurt (Oder).

3.4.3 Lessons learnt from the media perspective
The organisation of the media-work had to be prepared in only a few days. That included:

- coordination of the whole work with the Press in the Ministry of Interior;
- cooperation with the local Crisis Management Headquarters;
- contact with the Press Officers in the Bundeswehr, which supported the media very effectively during the whole crisis.

When the Central Crisis Management Headquarters resumed their work, the Ministry of Interior had already responded to about 7,000 telephone requests, registered from media originating from four continents. The assistants of the Extraordinary Press Center of the Ministry of Interior had been available about 300 times for statements and interviews by the radio. The figures presented by the Bundeswehr in the field of Public Relations were also impressive: its Press center escorted about 500 reporters; 300 press interrogations had been answered daily; a total of 267 press teams had been escorted through the districts affected by the flood.

Lessons learnt

- From the beginning of the crisis, it would be important to manage the work with the press directly from the Ministry of Interior and to hold close contact between the Press Office and the Head of the Crisis Management Headquarters.

- It would be necessary to install an emergency phone line with experts who can give all important information about the level of the river, projections for its level, measures implemented for protection from calamities, and so on.

- There is a need to carry out a daily Press Conference at a fixed time with the Head of the Crisis Management Headquarters and the representatives of other authorities to give actual and concrete information to the media.

4 RECAP OF LESSONS LEARNT AND CONCLUSIONS

Alessandro G. Colombo and Ana Lisa Vetere Arellano (EC, Joint Research Centre, Ispra)

As observed by Dooge and Samuels (1998), in the midst of all the exciting technical and scientific issues regarding floods, it is important not to lose sight of the fact that the task of responding to a real social problem has been set, which affects the quality of life of many citizens.

Floods are the most commonly occurring type of natural hazard and the most spatially distributed across the world. In Europe, all countries have had to cope with some type of flooding throughout these years: the semi-arid regions of the Southern Mediterranean, the sub-arctic and arctic regions of Scandinavia, the mountainous regions of the Alps, Appennines and the Pyrenees, the hilly areas of the Ardennes and the floodplains of many European rivers. From statistics offered by Swiss Re (2001), in the year 2000, floods claimed more than 6,025 lives and accounted for a high proportion of insurance losses (2.8 billion Euro), making 2000 one of the most expensive years for floods in insurance history, along
with 1993, when the Mississippi floods caused huge losses to the insurance industry. The Tokai floods in Japan accounted for 1.1 billion Euro, whilst the flooding in the UK in the wake of Storm Oratia incurred approximately 840 million Euro. These are indications of the often underestimated loss potential of floods.

A clear message that came out of the discussions during the NEDIES Expert Meeting was that flood disaster management should be improved. Furthermore, it was pointed out that such meetings are beneficial to Civil Protection Authorities as they provide a platform of dialogue where experience on inundation events that occurred can be shared. Coping with floods is a general concern that permeates throughout Europe and the rest of the world. Floods can come in various shapes and sizes, as can be observed in the various contributions in this report.

This chapter aims to summarise the lessons learnt by the various European countries, which are grouped according to the main disaster management phases: prevention, preparedness and response. Furthermore, where relevant, the lessons learnt have been grouped into the following areas:

- Regarding coordination of activities,
- Regarding planning issues,
- Regarding legislation,
- Regarding maintenance of infrastructure,
- Regarding allocation of resources,
- Regarding vulnerability,
- Regarding the public.

Lastly, lessons learnt regarding the dissemination of information during the three above-mentioned phases of disaster management are also summarised.

It is important to bear in mind that the lessons learnt are not ordered according to their importance, but mainly according to “logical” considerations.

### 4.1 Lessons learnt concerning prevention measures

**Regarding coordination of activities**

- It is important to set up a permanent emergency management system, which should have the control of the situation all year round. The people responsible for this permanent system should be in contact with other organisations, such as the Civil Protection (local and central services) and weather forecasting institutions on a daily basis.

- Because of the flows’ sporadic character, it is essential to have periodic training at least once a year of all actors involved in the management of a flood event, in order to be ready during red alert situations.

- There is a need to install warning systems where they do not exist and to check the efficiency of the already existing ones.

- The role of the state should be geared towards prevention, incorporating in part, for example, natural retention of water in landscape, financial participation in
technical measures, prevention of risks, public education, information on endangered areas, operation of flood forecasting service, organisational and technical support for rescue operations, preparation of financing mechanism for support of affected individuals and for elimination of damage incurred on the municipal and state properties, and support of individual insurance schemes.

⇒ A Framework Guideline for the organisation and function of local commissions for defence against floods should be elaborated.

**Regarding planning issues**

⇒ Land use planning and building codes for the whole territory of each locality should be made available, including also the frequently flooded areas where permission to build should not be allowed.

⇒ A fundamental part to planning at municipal level is to have a specific plan for specific flows (local flows).

⇒ There is a need to analyse the whole area under analysis against floods for any problems that could be linked with high water levels.

⇒ There is a need for better planning of flows within the catchment system.

⇒ There is a need to make plans for rescue operations during floods.

⇒ Catchment flood management plans should be developed for all rivers. Studies should be undertaken to understand the processes of flooding in river catchments, in order to develop integrated plans for the management of the risks associated with high flows to people and the developed and natural environment in a sustainable manner. This large scale planning framework would provide a more proactive management regime of flood risk for the future.

⇒ Plans for defence against the floods and ice at the level of the municipalities, towns and villages should be elaborated.

⇒ For floods caused by dam break, warning-alarming plans should be elaborated for the downstream localities.

**Regarding legislation**

⇒ Legislation regarding a plan for land use planning should be elaborated, where risk assessment should be carried in areas prone to floods and flood-related hazards, such as landslides and soil erosion.

**Regarding maintenance of infrastructure**

⇒ It is recommended that local authorities put in place arrangements for routine attention to drains, gullies, water cuts, and culverts, keeping them clear and facilitating removal of rainfall from roads and other public areas. Arrangements should also provide for clearance at the onset of severe rainfall, where necessary.

⇒ Property owners should be advised to arrange for routine clearance of drains from their property, to avoid or minimise unwanted build-up of water on their property, or flow of flood waters to neighbouring properties. This advice could also be repeated when conditions giving rise to flooding are expected.

⇒ There is a need to permanently protect buildings in flood prone areas, either by structural or non-structural measures.
⇒ It is necessary to regularly check the efficiency of the following:
- technical and functional situation of the major hydrotechnical works for defence against the floods,
- repairing and the rebuilding the hydrotechnical works,
- decisional-informational flux,
- deposits of the materials and means for operative removal intervention,
- organisation conditions of the commission for defence against floods, by establishing the necessary measures, with terms and responsibilities.

⇒ To stipulate impounding bank protections, consolidation and the necessary equipment for highly flood-prone areas.

⇒ To speed up the installation of warning equipment at important dams and at downstream localities, which can be potentially affected in case of dam accidents or rupture.

⇒ To continue river beds maintenance (desilting, vegetation removal, flow capacity recovering of the bridges, etc.).

**Regarding allocation of resources**

⇒ To ensure that national and local systems of collection and distribution of the humanitarian aid, including the Non-Governmental Organisations (NGOs), especially for the affected homeless persons, should be carried out efficiently.

⇒ To ensure that enough funds are available for investment works or other projects in the areas affected by floods.

⇒ To ensure that the allocated funds from the State budget, with purpose of flood control, torrent control or other works towards the minimisation of the flood risk and damages, are really used for the investment and maintenance works at hydrotechnical structures.

⇒ To draw up external funding to improve the management of areas with flood risk and the activity of defence against floods.

**Regarding vulnerability**

⇒ It would be useful to appeal to cities to revise their representations of construction land areas in land development plans. The focus would be on checking the areas affected by flooding that are represented as construction areas in the land development plan, but that do not yet have the right to build based upon development plans or other charters and to change them if necessary.

⇒ It is recommended that local authorities review past flooding experiences and identify vulnerable areas and associated sources of flooding, and consider what procedures might be adopted to mitigate the effects of flooding.

**Regarding the public**

⇒ To ensure that any existing warning system should be adequate in giving all the necessary information to the population. Even for the Civil Protection Authorities, it is generally hard to get real information that could be treated in real time.

⇒ To promote NGOs with social activity objectives regarding the education of the population from the areas with the flood risk.
To use incentives so that works are constructed, which have also the purpose for diminishing the flood danger or reducing the discharge of high water waves.

4.2 Lessons learnt concerning preparedness measures

Regarding coordination of activities

- It is necessary to improve the process of passing on thunderstorm, strong rain and high ground saturation level warnings to the disaster protection authorities and emergency organisations that could probably be affected.

- It is necessary that all operational organisations that have a flood response role should carry out flood risk assessments and prepare contingency plans for their assets in flood risk areas.

Regarding planning issues

- It is recommended that emergency services review their plans and arrangements for flooding events, to ensure that they are prepared to respond to flooding in an effective and efficient way. Reviews should include inter-organisational aspects of the response.

- Planning should include consideration of the possibility of persistence of flooding for significant periods. The recession time of flood waters can vary from a few hours to a few days and even could persist for far longer periods, which inevitably leads to a greater and sustained demand on emergency services, including need for support and shelter for people displaced by floods.

- It is recommended that emergency services, voluntary organisations, and other organisations likely to be involved in the response to flooding, also consider the hazards linked to the safety and health of personnel that may arise in such response. Consideration should include arrangements for the safety of personnel working in or traversing flood waters, including standing water and flowing water.

- In reviewing plans and arrangements, local authorities should look at arrangements for putting traffic diversions in place around flooded sections of roads. Where practicable, in respect of diversions from main routes, two diversion routes should be used to minimise difficulties with contra-flow traffic of large vehicles. Provision should be made for clear signage at all junctions on diversions.

- It is recommended that information be prepared and made available to the public, particularly in areas with a history of flooding, setting out advice on measures to reduce the effects of floods, action to be taken in the event of flooding, and recovery from a flooding event, including reoccupation of buildings, reinstatement or repairs.

- Businesses should be encouraged, as part of business continuity planning, to prepare for flood events, making arrangements for reduction of the effects of flooding, response to flooding, and recovery.

Regarding legislation

- It is important to put flood emergency planning on a firm statutory and financial basis.
It is necessary to launch the activities aimed at preparing relevant legislation concerning flood protection, and, under relevant ministries, to start special programs aimed at flooded area definition, control of emergency situations, restoration of areas after floods and realisation of flood protection structures.

4.3 Lessons learnt concerning response measures

Regarding coordination of activities

› It is important to call a state of emergency at an early stage so that the locally responsible disaster protection authority can take over the centralised direction of emergency. This is a prerequisite for efficient and cost-effective emergency action. This allows the direction of emergency operations to be with the locally responsible county administrative authority because they are the only one who can have the detailed knowledge of the local situation necessary for decisions on emergency operations. Thus, the political and administrative direction in emergency operations is taken over by a small disaster protection leadership group in the county administrative authority chosen according to the situation, while the operation tactics are managed locally by local leaders of operations who are appointed ahead of time and appropriately trained.

› It is very important to continuously train the leadership personnel and helpers properly in dealing with floods. The personnel employed should be well trained throughout and their roles should be clearly identified. This would contribute to the success of operations.

› The location of the Major Emergency Plan response group is vital to its effectiveness (i.e. with immediate access to secure communications, staff resources and back up, access to emergency plans, records, documents, etc.).

› It is important to have arrangements for contact with and between organisations, particularly out-of-hours. The need to have emergency contact telephone numbers kept up to date and supplied to relevant organisations is essential.

› It is necessary to ensure that there are enough receivers to accommodate the emergency number 112 callers asking for assistance, so that they do not queue up during a flood situation.

› The value of disseminating up-to-date and accurate information on the flooding situation and the use of Internet web sites for this purpose should be promoted.

› There should always be cooperation between the emergency services and voluntary organisations in responding to an inundation event. Their commitment and professionalism in providing a sustained response to the flooding could enhance the service given to affected communities.

› It is necessary to build scenarios to help prioritise interventions.

› The warning and alert made to the Civil Protection Authorities should be sent preferably by fax or communicated directly to the person in charge during a crisis situation.

› It is fundamental that Civil Protection Authorities disseminate information to increase public awareness and understanding regarding floods.
There is a need for efficient communication and collaboration between all the services involved so as to have an efficient crisis management, and above all, to implement an efficient warning and alert system in the Civil Protection network, its actors and the public.

It is important that a system of automatic data transmission be established to allow the monitoring of water levels in strategic reference points in the main hydrographic basins of the most important rivers.

Adequate means of telecommunication should be used between the police, civil protection, army and other actors in flood emergency management.

**Regarding planning issues**

- The existence of emergency plans, which have already been put to test in the past, should be used as critical success factors.

**Regarding legislation**

- During the legislation of warning and alert systems, it is important that roles and responsibilities must be designated, procedures must be established and equipment must be properly installed and maintained.

- An integrated Civil Protection policy should be cultivated and activated by the Civil Protection Authorities.

- Where flood response plans exist, it is essential that they be carried out in an adequate manner. Where no plans exist, there is a great need to plan in "real time", as co-ordination can be difficult in some locations.

- It is important to develop a policy for the provision of sandbags and that joint "call off" contracts for the supply and distribution of filled sandbags should be investigated. Furthermore, the capacity to supply large numbers of sandbags in an emergency should be assessed.

**Regarding maintenance of infrastructure**

- A command system of real time water level forecasting must be installed, tested and maintained operational where necessary.

**Regarding allocation of resources**

- It is necessary to procure and use the emergency equipment required in due time.

- It could be helpful if resources would not be deployed until an assessment of risk had been carried out, so as to ensure that valuable resources are deployed only where necessary.

- It is very important to have stocks of sand and bags available and accessible for prompt deployment. It is also suggested that larger size sandbags may be useful in the event of deeper floods or a need to put extensive barriers in place.

- Alternative solutions to the use of sandbags should be investigated.

- Roads and bridges for re-establishing the circulation to isolated areas should be temporarily reconstructed, where reasonably possible.
Regarding the public

⇒ Surveys have revealed that there is likely to be a need for regular public awareness campaigns if effective public response and limitation of flood damage is to be achieved. Survey results indicate that there is value in providing information to the public to enable them to take action for themselves. A national public awareness campaign would continue to increase the understanding that action must follow the warning messages. A risk of complacency amongst those not recently affected by flooding has been identified.

4.4 Lessons learnt concerning dissemination of information to the public

⇒ It is recommended that organisations making information available to the public on conditions brought about in severe weather or other emergencies take reasonable measures to ensure the accuracy of reports and promptness in their dissemination.

⇒ It is important that people suffering from floods get proper information, and if possible, get the information before they have asked for it.

⇒ It is important to use as many channels as possible to disseminate information to the public, such as:
  - Media,
  - internet,
  - information offices,
  - home visits.

⇒ Press conferences would be useful in disseminating information, however, they must be well prepared beforehand via meetings between the following groups:
  - county administration and chief officers of the municipalities concerned;
  - chief officer of the municipalities concerned and rescue operation staff;
  - chief officer of the municipalities concerned, politicians and police;
  - chief officer of the municipalities concerned and chief of information office.

⇒ Where the service is active, it is necessary to ensure that 112 callers asking for assistance do not queue up during a flood emergency situation.

⇒ It is important that a complete supply of radiotelephones and/or mobile telephones is available for use by the personnel involved in the operative emergency actions.

⇒ There is a need of a good collaboration between the water management systems and the informing-alarming system of the Civil Protection Authorities so that informative and synthesis reports could be adequately transmitted (also to the public) for defence against the floods.

4.5 Conclusions

4.5.1 Key lessons learnt

Most of the EU Member Countries, and also some Accession Countries, have experienced similar key lessons learnt. In particular, it has been agreed that improvements are required in the following areas:

- Strategic co-ordination,
• Role designation,
• Task prioritisation through risk assessment and forward planning,
• Training and formation of all stakeholders,
• Inter-disciplinary collaboration,
• Inter-organisational collaboration,
• Forecasting, alert and warning systems,
• Availability of material and human resources,
• Allocation of material and human resources,
• Communication strategies,
• Dissemination of information to the public,
• International co-operation.

4.5.2 Identified needs

The main needs identified are as follows:

• The outcome of the NEDIES Flood Meeting should be circulated amongst other people within the experts’ institution of origin, and also amongst other organisations involved in risk management so as to improve the considerations on “lessons learnt”. To this purpose, it was proposed and agreed upon that a one page summary of the meeting be sent to the participants, so that it could be circulated within the experts’ organisations.

• The transboundary nature of floods should be taken into account, especially with regards to the harmonisation of co-ordination procedures. The collaboration between Finland and Sweden on this regard (Arvika flooding in the area of Lake Glasfjordens) has proven to have worked well.

• The standardisation of dissemination of information both to the public and amongst organisations should be promoted.

• The participants of the meeting highlighted the importance of NEDIES Expert Meetings, as they provide a platform for dialogue amongst Civil Protection Authorities in Europe, and also facilitate the exchange of experiences from different countries regarding issues on disaster risk management.

4.5.3 Final considerations

The participants consider NEDIES Expert Meetings on Lessons Learnt very useful because the experts are:

• made aware of the similarities and differences in approach to coping with disasters in the different countries of the European Union,
• facilitated in the exchange lessons learnt in disaster risk management,
• able to have a roundtable discussion regarding disaster risk management at various scales: international, national, regional and local.
4.5.4 References


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ANNEX
Flood definitions, flood types and a checklist of flood precautions

FLOOD DEFINITIONS

- Flooding is a natural and recurring event for a river or stream. Flooding is a result of heavy or continuous rainfall exceeding the absorptive capacity of soil and the flow capacity of rivers, streams, and coastal areas. This causes a watercourse to overflow its banks onto adjacent lands. Floodplains are, in general, those lands most subject to recurring floods, situated adjacent to rivers and streams. Floodplains are therefore "flood-prone" and are hazardous to development activities if the vulnerability of those activities exceeds an acceptable level.
  http://www.oas.org/usde/publications/Unit/oea66e/ch08.htm

- Flood is a temporary covering of land by water as a result of surface waters (still or flowing) escaping from their normal confines or as a result of heavy precipitation.
  (Floodings and Insurance, Munich Re, 1997)

Other flood-related definitions can be found at:
http://ks.water.usgs.gov/Kansas/flood/definition.html

FLOOD TYPES

Due to the complex inter-related processes that can cause flooding, it is not a simple task to classify them. Two approaches are shown here:

1) Penning-Roswell and Peerbolte Classification (Penning-Roswell and Peerbolte, 1997) (slightly modified)
   - Winter rainfall floods
   - Summer convectional storm induced floods
   - Convective frontal storm induced floods
   - Snowmelt floods
   - Groundwater-driven floods (in permeable catchments)
   - Urban sewer flooding
   - Sea surge- and tide-induced flooding
   - Dam break-induced flooding.

2) Munich Re Classification (Munich Re, 1997) (slightly modified)

   a) Floods emanating from surface water
   - River floods caused by:
     - heavy rainfall
- snowmelt
- rising groundwater and saturated ground (especially in permeable catchments)

- Coastal floods caused by:
  - storm surge
  - tsunami
  - sea level rise
  - coastal subsidence, land subsidence, land settlement

- Rising lake-water levels, backwater in rivers
- Seiches (resonance oscillations)
- Glacial lake/ice dam outburst floods
- Jokuhlhaups
- Dam and dyke failures.

b) Local floods often not linked with large bodies of surface water or surface flowing water

- Flash floods
- Debris flows
- Backwater in storm-water drainage systems
- Rising groundwater, ground settlement
- Urban sewer flooding.

CHECKLIST OF FLOOD PRECAUTIONS
(Munich Re, 1997)

The following precautions should be taken in the event of an imminent flood:

* Turn off gas and electricity.
* Pull out the plugs on electrical appliances.
* Put dangerous liquids, especially combustible ones, in a safe place and close containers securely.
* Tie down mobile containers containing inflammable or combustible liquids.
* Take important supplies, documents, and valuables to a higher place.
* Take furniture and mobile objects to upper floors; drive vehicles to places that will not be flooded.

* Have the following important supplies ready at a safe place:
  - food, drinking water
  - first-aid equipment, medicines
  - bucket, cloths, scrubbers
  - spades, shovels, tools
  - flashlights
  - covers and blankets
  - wooden planks, nails
- sandbags, if available.

* Put sandbags by exposed openings (basement windows, doors); secure objects that are in the open.

* Anchor tanks in the house or cellar properly to prevent them from floating or being carried away; extend tank ventilation pipes until they are above the maximum water level expected.

In general, **during a flood** it is wise to remember the following:

* Turn on a (battery-driven) radio in order to be able to better assess the situation (information or warnings from civil defence can save lives).

* Avoid areas that can be flooded suddenly.

* Leave areas immediately that are exposed to flooding (i.e. dips, low-lying areas, eroded areas, etc.).

* Avoid areas that are already flooded and fast-flowing sections; do not try to cross water courses on foot if the water is more than knee-deep.

* Check the depth of water in depressions and underpasses before driving through them in your car (the road bed under the water may be eroded); if your car gets stuck, abandon it immediately.

* Take additional care at night as dangers are often more difficult to recognise.

**References**


Mission of the JRC

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.