Blue Book Two

Macro-Regional Approach through Sharing Experiences in Flood Prevention in the Baltic Sea Region

Editors' Letter

This Notebook is one of nine in the Fourteen Point Three Notebooks collection brought together by the European Union Strategy for the Baltic Sea Region flagship project 14.3 (read: fourteen point three).

Eight Notebooks will present you with findings from our project's four different working groups (named Task Groups C, D, E and F), and one Notebook will introduce a general overview of the whole project.

We hope that the collection as a whole will give you a sense of the unfolding diversity and complexity of the project, whilst retaining homogeneity as a single vision and ideal. The singular Notebooks present concrete results (studies, workshop reports, developed methodologies and scenarios). The structure of the entire collection intends to act as a mirror for the project as a whole, and to reflect on the process as much as the output. Each of the books can be read singularly as a study presenting concrete findings from working groups, at the same time they can be read as a collection. Manifested together we view this as the symbolic added value brought to the macro-regional conversation by the project 14.3. These values could be: the network, the will for cooperation in general terms, the challenges in finding a uniform language among different civil protection cultures and traditions, and the motivation to find commonality amongst the different departure points.

Blue Book One and Two bring you the body of the Task D work. Within this task, a group of experts and prevention practitioners from six Baltic Sea region countries sat down together to jointly discuss prevention of one hazard which by now, is common or very likely to every country in our region, namely – flooding. Flooding has long been one of the more common risks for most of our countries, and thus each one has developed a variety of individual ways to deal with it. However, regardless of our geographic proximity and landscape/climate similarity, specific and different types of flooding which have occurred in each country in the region were treated separately. Expert conversation has now shifted to highlight that with flooding appearing more regularly and consequences developing more rapidly in the region, the time has come to bring this segmented knowledge together.

Task D experts delivered an extensive State-of-the-Art study, which for the purpose of Fourteen Point Three Notebooks was split in two parts. While a basic flooding cartography of the Baltic Sea region was brought to you by Blue Book One, Blue Book Two highlights the particular project 14.3 – Task D input into the overall discourse on flood prevention in the Baltic Sea region. The prominent input here is the considered thematization, presentation and discussion of particular flooding cases, which highlight topical prevention scenarios. These have for the first time been considered as material for founding a macro-regional approach towards flood prevention.

It is our pleasure and honour to be sharing with you a vision of cooperation through our Blue Books in particular, and the Fourteen Point Three Notebooks in general.

Editors of Fourteen Point Three Notebooks
Egle Obcarskaite – Anthony Jay Olsson

14.3 was a project implemented under the EU Strategy for the Baltic Sea Region (EUSBSR), Priority Area Secure (Priority Area 14 in 2009 version of the EUSBSR Action Plan). The whole priority area calls for an insurance that contributions in the field of civil protection encompass the overall Strategy objectives (save the sea, connect the region, increase prosperity). The project 14.3 responds specifically to the objectives through addressing the necessities of bringing together and coordinating civil protection stakeholders and bolstering the capacity of individual countries, in order to ensure our region's uniform resilience to macro-regional risks.

14.3 was developed from a belief that considering the nature of the world that we live in today, only by ensuring a proper level of resilience on a macro-regional level can we ensure a higher level of resilience and preparedness on the national level as well.

Project 14.3 was a pioneering effort. →

Not only for addressing the topic of macro-regional risk in the Baltic Sea region (before this project there wasn't even a common concept discussed among the countries in the region), or for bringing up a complex all-hazards approach, but also for bringing together a partnership consisting of all countries in the region, to not only discuss and share but develop together a strategic approach to civil protection. As such, it thus constitutes a shift in the whole paradigm of the way civil protection may be conceived on a macro-regional level.

Why it is only now that 14.3 could have happened? →

Some say because there was previously never this level of openness in sharing information on civil protection tools and methods among different countries in the region; this could not have been imagined twenty or even five years ago. Others say it was because countries in our region finally openly recognized their individual vulnerability, as well as the fact that there may be situations to which even the most resourced country would face the need to ask for assistance from a neighbour. 14.3 partners came together admitting it straight: it is not enough to ask – you have to be ready to receive assistance.

Pioneering efforts also meant that 14.3 was a daring effort. →

This was especially visible in how the all-hazards approach had to be adopted for the project. All-hazards approach is a challenging claim even on national level, as it requires crossing administrative and institutional boundaries. Which is the best way to achieve this? The answer is yet to be formulated.

Project 14.3 proposed to take one step at a time and responded to the all-hazards challenge through structuring the project in four thematic tasks. There were three tasks dealing with the following hazards: floods, forest fire and nuclear accident. Whereas one task – Task C – engaged in an overall strategic discussion on how can risk be assessed and analysed on a macro-regional level, and how a common risk-discourse can decrease societal vulnerability of each singular country in the Baltic Sea region, as well as that of the macro-region as a whole.

Working Together on Macro-Regional Risk.

Project 14.3

Was the First Time that the Countries Around the Baltic Sea Worked Together on Macro-Regional Risk*

Why do we focus on MACRO-REGIONAL RISK?

Because risks - and their impact - do not pay attention to national borders

Develop scenarios – identify gaps

Why do we take an ALL-HAZARDS APPROACH?

Because this is the only way to find out whether we are really prepared for emergencies that may occur in our countries, in our region

* There are various risks that we might have to face in our region in the near to long-term future. At this point, we decided to start assessing the following six: Storm; Forest Fire; Flood; Pandemic Flu; Accident at Sea; Nuclear Accident.

To Become a Platform for Further Deepening Our Experience & Sharing

What is the mission of a project like 14.3, – first of it's kind?

To locate cooperation barriers, to open doors to cooperation and to push further to minimise unpreparedness and risk levels

OUR ANSWER IS: a common method, common approach channeled through one network

Here are the types of questions we asked ourselves in workshops and expert groupings

Fourteen Point Three Notebooks

Collection of Fourteen Point Three Notebooks is Set to Launch a CIRCULAR LOOP in which ONE PART Manifests The Whole and THE WHOLE Manifests One Part ⟶

Task C ⟷ **Macro-Regional Risk** What will it take for us to have a common approach to risk and a common method to assess it? Do we need it? Why? → RED BOOK ONE / TWO →

Task D ⟷ **Floods** How can we best share our experience in coping with floods? Could this help us to reduce the national costs associated with flood prevention, preparedness and response? → BLUE BOOK ONE / TWO →

Task E ⟷ **Forest Fire** What fire risk models are used already in the Baltic Sea region? How can these be bolstered? What kind of common system would we need and why? → GREEN BOOK ONE / TWO →

Task F ⟷ **Nuclear Accident** Would we be able to cope with a nuclear emergency which would impact several countries in the region? How can we create a common response and alertness mechanism? → ORANGE BOOK ONE / TWO →

... Red Books represent the contribution

from our Task C experts whose main concern centred on beginning a discussion on the risk-assessment challenges in the Baltic Sea Region; a discussion that, for the first time, would include all countries from the area. In their two Notebooks they bring to us an insight on how our countries meet the challenge of assessing overall risk. They also question and explain what methodology can be used together, and they bring us their first attempt to develop a common language by drawing six different risk scenarios.

... Blue Books represent the outcome

from the Task D Grouping who have discussed flood prevention practice in the Baltic Sea region. Floods are an annual occurrence for most of the countries in our region, and each one of them has developed a strong national know-how of coping with this type of emergency. However, the discussions focused on how can we increase the effectiveness of our actions in dealing with this emergency by sharing experiences of individual singular-country specific cases? The Blue Books give us a picture of various flood prevention experiences in the Baltic Sea region, as well as their conclusions and recommendations for further know-how sharing.

... The Green Books focus on our regions foliage,

vegetation and forest cover and what happens when fire occurs. As our Task E experts discovered, all countries that participated in the work of Task E have their own national fire risk systems. These systems are both, similar and different at the same time. The question asked of experts was whether the region needs to have one fire risk system for the whole region? What would that system entail and how would that system borrow elements from other systems already developed elsewhere? This is to be decided in the future. For now, we have made a first step in this process providing you with an overview of existing fire risk systems in the Baltic Sea region.

... Our Orange books investigate nuclear accidents

The nuclear question is probably one of those regional questions which we cannot afford to overlook in a macro-regional context judging by its potential impact. To show you why this is so, Task F experts developed a scenario for an hypothetical accident in Finland that may have severe consequences on other countries in the region. The second part of their task work was to assess this developed scenario and provide recommendations for further activities that would increase our preparedness towards accidents of this complex kind. The scenario and workshop report are both delivered to you in our Orange Books completing the circle.

The EUSBSR flagship project 14.3 was a novelty on various levels

Two of the most important 'firsts'

...partnership of diverse civil protection actors from every country of the Baltic Sea region was built

...the focus of the project was concentrated on an all-hazards approach through a macro-regional lens

The questions we asked ourselves were

How can we acknowledge and communicate the project's complexity, and capture it without reducing or subordinating it at the same time?

How can we talk about the methods and the substance of inquiry at once, whilst keeping both on an equal footing?

Blue Book Two gives you an overview of six concrete flooding cases that have happened in the Baltic Sea region over the past few years and which were analysed during the Task D workshops. In the Second Part of Blue Book Two you will find an overview of selected flood prevention measures implemented within the Baltic Sea region, as well as a tailor-made Strengths, Weaknesses, Opportunities and Threats Analysis which is to become one of the foundation pillars for implementing a macro-regional approach to flood prevention and response in the Baltic Sea region in the near future. →

Task D Fact Sheet

18 Months of...

MEETING →

Tallinn → Riga → Warsaw

The task was led from Frederikssund, Denmark

WORKING together →

Frederikssund-Halsnæs Fire & Rescue Service (Denmark) – Estonian Rescue Board – Hamburg Fire Service Academy (Germany) –State Fire and Rescue Service of the Republic of Latvia – Main School for Fire and Rescue Service in Warsaw (Poland)

SHARING experiences →

(Core Group of Experts)
Kim Lintrup, Nanett Mathiesen, Amalie Møller Janniche (DK) – Robert Stacey (UK) - Kady Danilas, Kristi Tekko, Ivar Kaldasaun (EE) – Jürgen Krempin, Tim Sufin (DE) – Jevgenija Petuhova, Ivars Nakurts, Rūdolfs Āzens (LV) – Tomasz Zweglinski, Wiktor Gawronski (PL)

KIM LINTRUP Task D Leader:

"It did not take much for this project to bring added value that was not there before. It was enough to organize a few workshops and to write a state of the art study – by doing this we had already reached a new level of practical information exchange on floods that had not been reached in the Baltic Sea region before. This project provided us with a great opportunity to practically discuss a problem that especially concerns me as a Chief Fire Officer in Denmark, namely – flooding. This problem is not only relevant for the Baltic Sea region, it is a global one. Yet we have to start addressing it macro-regionally, for in all of our countries we have a lot of knowledge collected. It is very important to enable the sharing of this knowledge"

TASK D Gave Us

➝ A detailed questionnaire to collect data on current flood prevention across the Baltic Sea region.
➝ An overview on floods and flood prevention in six Baltic Sea region countries.
➝ A list of specific identified gaps in flood prevention practice in six Baltic Sea region countries.
➝ An overview of some future priorities in flood prevention in six Baltic Sea region countries.
➝ Recommendations and a platform for further cooperation and knowledge exchange in the Baltic Sea region as a whole.

Floods and Flooding in the Baltic Sea Region: Six Cases of Severe Flood Incidents and Overview of Flood Prevention Measures[1]

1 Blue Book One and Blue Book Two provide material from the State of the Art Study delivered by the EUSBSR flagship project 14.3 Task D working group. The study has been written and compiled by Dr Robert Stacey (Northumberland Fire and Rescue Service, UK) and Kim Lintrup, Chief Fire Officer (Frederikssund-Halsnæs Fire and Rescue Service, Denmark). Blue Book Two Case Studies were provided by the Task D Core Group participants.

PART 1

Six Case Studies of Severe Flooding Incidents in the Baltic Sea Region

The purpose of Part I of Blue Book Two is to provide some context to the problem of flooding and the challenges of flood prevention within the Baltic Sea region.

This part presents six individual flooding incidents, each of which has occurred within a country in the region during the last 10 to 15 years. These flooding case studies have been taken from Denmark, Estonia, Germany, Latvia, Poland and Sweden. It is worthy of note that some of the storms described within the case studies, for instance Cyclone Gudrun, actually caused flooding in multiple Baltic Sea region countries and details of the damage and destruction experienced by these other affected countries may be available from other sources.

Each of the following case studies describes what happened, what damage was caused, what flood prevention measures were in place prior to the flood and any flood prevention measures that were implemented following the flood. Many of the events described within this chapter had profound impacts upon flood prevention within the regions and countries affected and, in some cases, even had an impact on flood prevention measures implemented within other countries.

DENMARK

Case Study Incident	Urban flash flooding
Location	Copenhagen, Denmark
Date	02.07.2011
Estimated cost of damage	6.7 Million EUR (5 Billion DKK)

Description of the event

On the evening of Saturday 2 July 2011 the city of Copenhagen received extremely heavy rainfall over a very short period of time. This unprecedented extreme rainfall resulted in massive flooding. This flooding had a number of significant impacts, including:

- The sewage system failed which led to contaminated water spilling into the streets and in some cases the water rose through the toilets and fittings within people's bathrooms.
- The trauma centre at the hospital "Rigshospitalet" was temporarily relocated to another nearby hospital when it lost power due to the failure of both the main and back-up generators.
- The city's infrastructure was severely affected by flooding with all train and subway traffic being cancelled and the closure of multiple roads running in and out of the city.
- The basements of residential properties were flooded, some with water contaminated with sewage.

Damage caused by the flood

According to the insurance industry the flood directly caused approximately 5 billion kroner (€6.73 million) worth of property damage. The flooded roads prevented people from getting to work, but no estimates were made as to the costs of the number of work hours/days lost as a result of workers being prevented from travelling to work during the flooding.

Flood prevention measures in place at the time of the flood

Prior to the flood, there were 12 subterranean reservoirs in Copenhagen with a combined capacity of 220.000 m³. These reservoirs were designed and installed to temporarily contain high volumes of water that might result from flash flooding. In addition, urban planners had installed features throughout the city which would lead and encourage water out into the sea and reduce the likelihood and degree of flooding of urban areas. However, the 2011 flood revealed that the subterranean reservoirs proved to be insufficient for preventing flash flooding under these extreme conditions. It was also concluded that the existing sewage system did not have sufficient capacity to handle such large quantities of water.

DENMARK

Flood prevention measures implemented since the flood

Following the flood, the *Institut for Beredskabsevaluering* (Institute for Emergency Evaluation) at the *Beredskabsstyrelsen* (Emergency Agency) compiled a report assessing preparation and preparedness for large-scale flooding incidents. The aim of this report was to portray the incident, response and follow-up processes and to identify some general learning points for preparedness. In summary, the report concluded that operational preparedness was very good and that there was very good collaboration between the multiple agencies involved. The report did, however, indicate some potential improvements in several areas of holistic contingency planning. These potential improvements were summarised within 10 key learning points.

Authorities in Copenhagen are currently working to implement some of the learning points identified in the *Institut for Beredskabsevaluering's* report.
For example, during the 2012/13 budget, the local administration is spending approximately 100 million DKK (approximately €14.5 million) on flood prevention measures. 50 million DKK (approximately €7.25 million) will be spent on the purchase of large pumps and an initiative to protect IT systems from water during future flooding incidents. Approximately €3 million has been given to the Fire Department to enable them to improve their skills, training and capacity to respond effectively to similar flooding incidents in the future.

ESTONIA

Case Study Incident	Storm surge caused by Cyclone Gudrun
Location	West Coast of Estonia
Date	09. 01. 2005
Estimated cost of damage	9.2 Million EUR

Description of the event

Cyclone Gudrun developed over the North Atlantic and travelled over the British Isles, Scandinavia, and Finland on January 7–9, 2005. Multiple factors contributed to a record high storm surge (275 cm) which hit the city of Pärnu and a number of other locations along the western coast of Estonia:

- a high water level within the Baltic Sea at the time of the storm (as a result of a low pressure atmospheric system);
- strong south westerly and westerly winds;
- the trajectory of the fast moving cyclone.

The storm surge caused significant destruction and flooded approximately eight square kilometres of the city of Pärnu.

Damage caused by the flood

The total damage caused to homes in Estonia amounted to nearly €9.2 million. In all, 400 people were evacuated in Pärnu City and 103 in Haapsalu City. There was one fatality as a result of the storm surge. The total direct damage caused by the storm was calculated as around €48 million, of which €28 million was attributed to the private sector and €19.5 million to the public sector. The rainstorm paralysed life and caused power outages to about a quarter of the substations of the national electricity company – Eesti Energia AS. Many fishing harbours, boats and equipment were damaged. Road traffic suffered mainly from fallen trees and some roads were flooded. The Audru polder dam in Pärnu County was breached by storm waves and the polder was heavily flooded. Wells were filled with surface water and needed purification. There were sewage problems and some coastal areas had problems with contamination of drinking water. The storm also had an impact on agriculture. Domestic animals suffered because of power outages, cows were not milked, as equipment did not work with back-up generators. Some farmers also lost fodder (animal feed) because of the flood and some were forced to send their cattle to abattoirs (slaughterhouse) due to a lack of available food.

The strong winds also caused damage to the forests. The forest cover in Estonia is 2.2 million ha (51.5% of Estonia's land territory), of which 40% is state owned. Uprooted trees represented 70-80% of tree damage with fallen trees causing 90% of the power outages. Approximately 17,000 trees fell on wires in the affected counties.

Compensation was paid by the national government and help was given to people at the local level. In addition, Pärnu City Government covered the cost of storm damages for citizens, supporting 208 families.

ESTONIA

Flood prevention measures in place at the time of the flood

A number of flood prevention and response measures were in place at the time of the flood, including:

- early warning systems for flooding and instructions for people affected by flooding (as produced by the Meteorological and Hydrological Institute and Estonian Rescue Board);
- evacuation plans;
- emergency plans and crisis management structures were in place.

However, these measures were deemed insufficient, in part because the early warning was not taken seriously by the population.

Flood prevention measures implemented since the flood

The 2005 flood of Pärnu had a significant impact on flood prevention policies and practices in Estonia. Since the flood, a number of additional flood prevention and response measures have been implemented including:

- establishment of an electronic early warning system (siren) in Pärnu;
- emergency plans were reformed and updated;
- risks were re-evaluated; the legal request to take risks into consideration in case of land use planning was enacted;
- risk communication and public awareness about floods were intensified;
- evacuation guidance was established;
- authority's cooperation system was reviewed and enacted;
- the Estonian Rescue Board's equipment was improved.

GERMANY

Case Study Incident	River flooding
Location	Elbe River Basin, Germany and Czech Republic
Date	August 2002
Estimated cost of damage	18.5 billion EUR (central Europe). Damage in Germany accounted for 9.2 billion EUR of this total.

Description of the event

During the Summer of 2002 heavy rain fell in the upper course of the major rivers of Central Europe. This caused tidal waves with extremely high water levels that flowed rapidly downstream to cause substantial flooding in the lower reaches. The flooding in Germany was concentrated in the South and East of the country within the Elbe River Basin and this particular event is recorded as the most expensive natural disaster in Germany's history.

Although this event is commonly termed in Germany as "the Elbe Flood", this is perhaps misleading as much of the flooding did not occur within the Elbe River itself but within its many tributaries. It was on these many tributaries that horrific devastation was caused.

Damage caused by the flood

The August 2002 floods in the River Elbe Basin caused substantial damage to residential areas, commercial areas, industrial areas, cultural monuments, museums and infrastructure (railways, roads and bridges in particular). This damage was observable for years to come as it took a while to carry out the necessary repairs and reconstructions. The total damage caused in Central Europe was reported to be €18.5 billion, of which €9.2 billion worth of damage was caused in Germany (according to Munich RE).The floods also caused 21 deaths.

Once the flood waters started to recede, numerous and extensive restorative measures were required to heal the significant damage caused, including:

- reconstruction of infrastructure and damaged buildings;
- restoration of damaged cultural monuments;
- repair of flood control facilities and levees;
- psychological care of the bereaved.

Flood prevention measures in place at the time of the flood

At the time of the flood, numerous measures were already in place to prevent flooding and control and minimize damage from rising flood waters. The structural measures that were already implemented at the time included:

- dykes;
- floodplains – natural flood plains, designated flood plains and artificial flood plains;
- flood barriers (for example, Geesthacht);
- dams.

GERMANY

Flood prevention measures in place at the time of the flood

In addition, a system of monitoring water levels in the River Elbe was also in place.

The flood barrier at Geesthacht was effective at protecting the lower reaches of Hamburg against the flood waters. The dykes were very effective in some places, whilst in other places they were unfortunately not effective. It was concluded that the degree of effectiveness was probably related to the level/standard of maintenance of the individual dykes, with those that were better maintained being more likely to contain the flood waters.

While a number of natural floodplains were available for diverting flood water, the number of these flood plains has been reduced by 86% since 1850. Also, some of the designated and artificial flood plains that were flooded were not sufficient because they had been used intensively for agriculture. This type of use is against established guidelines because when flood water is diverted into areas that have been farmed intensively it can cause significant soil erosion which may lead to both short and long-term problems.

Water management of the level of the River Elbe helped to protect some areas, however the largest water masses were actually observed within the Elbe's tributaries. These areas were less protected and, therefore, experienced most of the severe flooding.

This particular flooding incident occurred across numerous administrative boundaries and the most effective response would have been a coordinated multiregional approach. However, the federal structure in Germany stipulates that disaster relief is devolved to the individual German States (Bundesländer) and there is no coordinating mechanism at a regional level. This means that during times of crisis greater attention is often paid to local interests with little attention paid to the wider picture and the potential consequences of taking particular actions to protect particular locations upstream.

Flood prevention measures implemented since the flood

A number of flood prevention measures have been implemented and improved since the 2002 flood. These include:

- renovation/repair programme for the dyke network. This also included an extension of some of the dykes into the countryside area surrounding Hamburg;
- implementation of the EU Floods Directive 2007/60/EC and the EU Water Framework Directive 2000/60/EC. This is helping local authorities to take a more holistic view and to refocus their attention to "River Basin Districts" rather than simply looking at individual river flows;
- the Federal Government has announced that hazard control will be coordinated across Federal States;
- more attention will be afforded to monitoring water levels and the control of water levels using the existing dams;
- Civil Protection Plans will be developed across State borders;
- Five Point Plan for improving flood prevention has been proposed (Christiansen, M, 2003/04). The five points briefly include:

GERMANY

Flood prevention measures implemented since the flood

1. Establishment of Common Federal and State Flood Protection Programmes.
2. Development of Trans-State Action Plans for Flood Protection.
3. European Cooperation for collaborative transnational projects on flood protection and prevention.
4. Study of River Development – analysis of the impacts of extending the navigable areas of rivers.
5. Implementation of Emergency Measures for Flood Prevention – need for the development of a national common conceptual framework for risk management of natural hazards.

LATVIA

Case Study Incident	Flooding caused by Storm Gudrun
Location	Coastline of Latvia and the cities of Riga, Ventspils, Liepaja, Valka and Jekabpils, Latvia
Date	08.01.2005 – 9.01.2005
Estimated cost of damage	220 Million EUR

Description of the event

Storm Gudrun* hit Scandinavia and the Baltic States on 7-9 January 2005 and was one of the strongest and most destructive storms in Latvia's history. Wind gusts of up to 40 metres per second were recorded during the storm. The storm ripped roofs from buildings and caused widespread property damage. The accompanying storm surge also struck the Latvian coastline and caused flooding in numerous cities, including the capital city of Riga. Properties in the cities of Ventspils, Liepaja, Valka and Jekabpils suffered the most damage. Although no deaths or injuries were reported, the extensive flooding led to the evacuation of low-lying areas of Riga by the military.

Damage caused by the flood

The storm had substantial economic and social impacts in Latvia. The Cabinet of Ministers declared a national energy crisis after thousands of electricity poles were knocked down cutting power to 1.4 million people (60% of the population of Latvia) at the height of the storm. A total of 54,000 km of distribution lines was damaged by the storm which led to a 23-day long emergency situation. According to available data, 20,000 businesses were left without electricity. The response to this crisis represented the largest ever mobilisation of the Latvian electricity business (Latvenergo Ltd.). 6,000 members of staff were tasked with clearance and repair activities, with an initial priority to restore power to critical infrastructure such as hospitals and schools. The cost of the repairs to the electricity distribution network alone totalled €4.7 Million.

Other damage caused by the storm was also substantial. For instance, more than 7 million cubic metres of forest was lost, which equated to more than the normal annual harvest for the entire country. Also, the erosion processes of the storm left a profound impact on 200 km of the Latvian shoreline (40% of the total length of marine shoreline of Latvia). It is estimated that the volume of material (mainly sand and gravel) that was washed out by the storm was approximately 3.1 million cubic metres. Not surprisingly the contours of the coastline were significantly affected by the storm, causing a shift in location of the shoreline of between 3 and 28 metres along the affected area.

Authorities in Riga estimated that the damage caused by the storm would be in the tens of millions of Euros and released €2.9 million for emergency relief measures. The overall estimated damage was calculated as approximately €220 Million. Latvia applied for financial aid of €9.5 Million from the European Union Solidarity Fund, a special fund created in 2002 to assist Member States and acceding countries to recover from major disasters. This financial support was used to restore vital infrastructure and services, including: energy, drinking water, waste water, transport, telecommunications, health and education.

* See p 21 for the storm's definition and impact on Estonia

LATVIA

Flood prevention measures in place at the time of the flood

All stakeholder organisations and institutions carried out prevention, preparedness and response actions before, during and after the storm according to the provisions of the State Civil Protection Plan. In addition, the Latvian Environmental, Hydrological and Meteorological Centre issued sufficient early warning of the approaching storm by issuing warnings using various media channels during the 1-2 days prior to the event.

While all stakeholders performed as required under the existing frameworks, it was identified after the storm that some of the available resources were not sufficient to cope with the scale of disaster and that there were some areas of improvement required for cooperation, disaster management and the emergency planning structure.

Flood prevention measures implemented since the flood

The analysis of measures implemented before and after Gudrun at local and regional level shows that in many cases the storm prompted various local activities to improve preparedness and reduce vulnerability. As such, it served as a "focusing event" for developments and improvements in local planning and policy measures. To provide some specific examples:

- The State Civil Protection Plan was updated and amended according to the provisions of a new Civil Protection Law (2006).
- Changes were also implemented to the Civil Emergency Planning System.
- Local government and the national government allocated emergency financial resources to rebuild and repair infrastructure, although a lack of funding limited the prevention/protection activities that were to be implemented alongside the reconstruction.
- A new building code implements new spatial planning rules which prohibit the construction of any building within several hundred metres of the shoreline. There are also new restrictions on economic activities near the coastline (with several exceptions).

Following the flood, the responsible institutions collaboratively developed four key proposals for improving flood prevention and response in the future:

1. To improve the cooperation and coordination between state institutions and local municipalities by declaring responsibilities for each institution in the case of natural hazards and disasters.
2. To ensure the budget planning process includes provision of reserve funds that can be accessed when storms, flooding and other natural disasters occur.
3. The need for the development of a system of public training and education in the area of civil protection.
4. The need to study possible threats of storms and other natural hazards and to increase applied research to develop optimal systems of hazard mitigation.

POLAND

Case Study Incident	River flooding
Locaation	Małopolskie, Podkarpackie, Lubelskie, Świętokrzyskie, Śląskie and Mazowieckie, Poland
Date	May – June 2010
Estimated cost of damage	2.5 Billion+ EUR

Description of the event

Heavy rainfall during 14 -18 May 2010 significantly raised the water level of the upper basin of the Vistula River. The resulting flood caused catastrophic flooding which swept through 811 municipalities and had the most significant impact in Czechowice Dziedzice, the Chelm region of Śląskie, Oswiecim, Cracow and Sandomierz. Levees on the Vistula River were also broken in Lublin Province (within the municipality of Wilków), Podkarpacke (Tarnobrzeg) and Mazowieckie (Świniary) which led to substantial losses.

The substantial numbers of rescue operations performed in response to the flood were coordinated by The Polish State Fire Service and local administrations. During each day between 17 and 22 May 2010, the number of individuals involved in rescue operations from the State and Voluntary Fire Services numbered approximately 20,000 individuals. From 1 to 25 June 2010, on average 2,000 individuals were involved in rescue operations.

Damage caused by the flood

The total damage caused by the flood was estimated to have exceeded €2.5 billion. The consequences of the flooding were catastrophic in scale and impact. A total of 17,000 people were evacuated and more than 1,300 km of dykes were damaged or destroyed. In addition the flooding caused damage to:

- 18,194 residences
- more than 800 schools and 160 kindergartens
- 1,400 businesses
- 10,000 km of municipal, county and provincial roads
- 1,625 bridges and culverts
- 166 sewage treatment plants
- 210 km of water supply
- 50 km of electricity power lines
- 196 km of telecommunication lines
- 105,152 farms (where a total of 682,894 hectares of agricultural land, pastures and grasslands were flooded)

Flood prevention measures in place at the time of the flood

A number of flood prevention measures were already in place at the time of the flooding, including:

- monitoring of dykes and other hydro-technical facilities;
- construction of new embankments and strengthening of existing embankments;
- raising crown shafts at their lowest points with flood sleeves (filled with water);
- broadcasting of flood warning messages to the general population.

In addition, during this flooding incident a number of actions were taken by the relevant authorities including:

- preventive evacuation and rescue of people, animals and property;
- search operations for drowned people;
- pumping water from flooded areas and facilities;
- clearing of watercourses and hydraulic structures;
- securing berthed ships and barges;
- activation of the National Operational Reserves of the National Fire Fighting Rescue System (NFRS) to mobilise additional rescuers and special equipment;[2]
- The Headquarters of the State Fire Service activated the Satellite Support Mechanism called GMES. Satellite images were collected and pre-analysed during Project SAFER. The images were then used during this incident by the National Rescue Coordination Centre (SFS) and the Government Centre for Security to analyse flooded zones.

Nevertheless, despite the resources that were available within Poland, the severity of this flooding event necessitated a request for international assistance through the Monitoring and Information Centre (MIC)[3] at the European Commission in Brussels, Belgium.

2 In cases of flooding, the NFRS can be activated to provide a range of different resources: evacuation units, high volume pumping units/high efficiency pumping units, slit pump units, flood sleeves, boat units etc.
3 Further information concerning the role of the MIC can be found on the following website: http://ec.europa.eu/echo/policies/disaster_response/mic_en.htm

POLAND

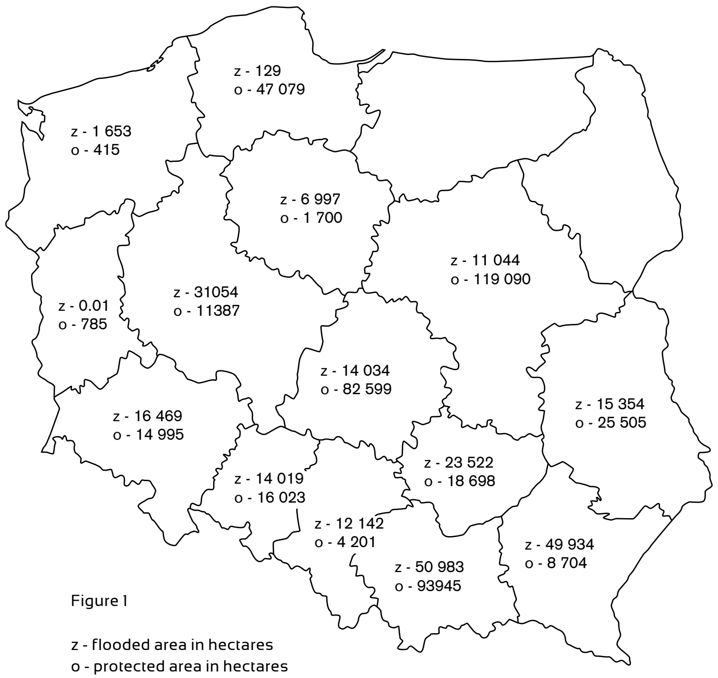


Figure 1

z - flooded area in hectares
o - protected area in hectares

Flood prevention measures implemented since the flood

A number of flood prevention measures have been implemented and improved since the 2010 flood. These include:

- special acts to provide specific solutions related to removing the effects of the 2010 flood;
- renovation/repair program for the dyke network, streamlining and deepening of channels and rivers.

To prepare for flood rescue operations in Poland, public administrations are required to maintain storage facilities. To provide a specific example, the city of Poznan in Wielkopolska has a flood storage facility containing the following equipment: sandbags, mobile flood protection systems, boats, portable generators, pumps, fuel and electric light poles with lights, grapnels, torches, life jackets, ropes, foil, shovels, wheelbarrows, axes, saws, crowbars, shears for cutting wire and nails.[4] Other storage facilities provide regional storage for flooding equipment. These regional facilities usually store the following types of equipment: boats, generators, lighting sets, pumps, chain saws, life jackets, rescue ropes, sacks, torches, spades, gumboots, grapnels, pickaxes, crowbars, axes, hatchets, wheelbarrows, coats, clothes, mattresses, blankets, sleeping bags, and foil. The emergency services also have their own equipment.

4 Further information concerning the Poznan flood storage facility can be found online at: www.poznan.pl/mim/main/miejski-magazyn-przeciwpowodziowy,p,1443,1745,1791.html

POLAND

Flood prevention measures implemented since the flood

In order to implement the provisions of the EU Floods Directive (2007/60/EC), Poland is developing and implementing a project titled “Informatics System for National Protection against extraordinary natural hazards” (ISOK). The ISOK Project will contribute towards Poland’s implementation of the EU Floods Directive (2007/60/EC) and will be one of the most comprehensive computer systems for flooding and flood prone areas in Europe. By 22 December 2013, the ISOK system will contain the results of Preliminary Flood Risk Assessment (PFRA) and after 2015 it will contain detailed flood hazard/risk maps and Flood Risk Management Plans (FRMPs). The system will contain an infrastructure database which will include specially designed maps that show areas with flood embankments and identified areas that can be allowed to flood when embankments are breached. The system will also show maps that present estimated losses that may occur within specific areas if they are flooded. The incorporation of a public warning system for extreme/potentially dangerous weather conditions (such as high and low temperatures, fog, strong winds, heavy rainfall etc.) is another important function of the ISOK system and will have a wider use and importance beyond simply flooding.

The most important social benefits to be achieved through the ISOK Project will include:

- reduction of losses due to the occurrence of flood risks, by showing the public areas at risk;
- to enable proper planning especially in the context of flood risks occur in river valleys, including those that are caused as a result of failure of water facilities, particularly river embankments;
- to enable informed investment decisions on their location in areas prone to flood hazards;
- increasing the sense of safety of the public;
- reduction of victims in the population because of the presence of natural disasters, in particular floods;
- improve the functioning of crisis management systems at all levels.

SWEDEN

Case Study Incident	River flooding
Location	Arvika, Sweden
Date	November and December 2010
Estimated cost of damage	36.5 million EUR (315 million SEK[5])

Description of the event

In the autumn of 2000 the water system of the Byälven River[6] in western Värmland was hit by severe floods. The region was inundated with three times the annual level of precipitation that is normally recorded during October and November. The limited capacity of the drainage system to discharge water from the lower part between lakes Glafsjorden and Vänern, combined with high inflow from the upper parts of the drainage basin, caused dramatic increases in water levels.

Large areas of the municipality of Arvika which were close to the shore were flooded by the rising water. The rest of the drainage basin also experienced severe damage to the road network and infrastructure, as well as flooding of private properties and agricultural land. The developing situation was extreme and it was clear by the beginning of November 2010 that the municipalities were unable to cope with the situation themselves. The Home Guard and the military were deployed to assist with bunding, pumping and surveillance of the bunds. A number of other agencies also assisted by providing knowledge, equipment, vehicles and personnel, including the Swedish Service Agency (SRSA), SRSA colleges, county fire and rescue services and the Stockholm fire and rescue service.

Damage caused by the flood

A total of €36.5 million worth of damage was caused by the flooding. This total cost includes the costs to the municipalities of Arvika, Säffle and Ede, cost to the County of Värmland, cost for military operations carried out during and after the flooding and the estimated costs provided by Länsförsärkingar Insurance Group. However there is no comprehensive account of the cost of damage experienced by private property owners, farmers and other business proprietors.

The transport network (road and rail) was severely affected by the flooding, as were some buildings. Many roads were flooded and damaged by erosion and had to be completely or partially closed. County roads 175 and 172 were flooded and the National Road Administration had to carry out extensive repairs and regulate traffic. The town park, the port area with its commercial activities, some low-lying streets and a cemetery were all flooded in Arvika. Rail services were also suspended for several weeks, which increased the pressure on bus services.

5 Adjusted to real values in 2009.
6 The drainage basin of the Byälven river covers an area of 4785 sq. km, just under a third of which is situated in Norway. There are a large number of lakes in the area covering a total area of 613 sq. km. Many of the lakes are regulated for the purposes of supplying hydropower. The Byälven River has a number of narrow sections between the outlet from Glafsfjorden and the mouth of the river in Lake Vänern at Säffle, and there is a height difference of only one metre over the 32 km stretch. This small height difference caused significant damming which contributed to the substantial rise in the level of Lake Glafsjorden.

Flood prevention measures in place at the time of the flood

Water flow was already being regulated within the river basin, due to the hydroelectric plants located at various points. However, the existing water flow management measures were ineffective for dealing with the extreme volume of water that entered the drainage system. The substantial number of lakes and the high proportion of forest cover (80% of the land area) within this region usually act as a buffer in flood situations leading to less protracted and more localised flooding incidents. At the end of October 2000, however, the maximum storage capacity for the systems within the areas upstream of Lake Glafsfjorden had been reached and they were unable to prevent large volumes of water flowing onward to Lake Glafsjorden.

In addition, flooding risks in Arvika were analysed in 1991 and 1998, but these analyses did not lead to the implementation of any flood prevention measures.

Flood prevention measures implemented since the flood

The Municipality of Arvika formulated a number of conclusions from the 2000 flooding. Smooth collaboration, clear emergency organisation and good public information are of significant importance for successful operations, as is a good technical planning system. A number of areas for improvement were identified, particularly in relation to map material with better height data, use of Geographic Information System (GIS) technology, personnel planning for prolonged emergencies and knowledge of the resources of adjoining municipalities. Since the incident, the municipalities of Arvika and Säffle have been heavily involved in flooding issues and have taken part in the EU project FLOWS (Floodplain Land Use Optimising Workable Sustainability).

In 2001, Värmland County Administrative Board and the municipalities of Arvika, Säffle and Eda commissioned Karlstad University to investigate what happened during the flood from a scientific/technical perspective and to present proposals for technical measures to deal with a similar event in the future. The investigation found that the flooding was a purely natural phenomenon and that a different regulating strategy in the holding basin upstream of Lake Glafsfjorden could not have prevented what happened. Various technical measures were proposed to protect Arvika and Säffle from future floods. Some of these proposals have been developed in recent years with the aid of EU grants. The measures relate to temporary closure of Kyrkviken at Arvika towards Lake Glafsfjorden when the town is threatened by rising water levels. The possibility of increasing discharge capacity in Säffle, for example through the reconstruction of the sluice, has also been examined.

PART 2

Flood Prevention Measures Implemented Within the Baltic Sea Region

Part II of Blue Book Two will focus on the measures that have been implemented in the Baltic Sea region to prevent flooding from occurring.

Rather than summarise all of the measures currently implemented within each studied country, the chapter focuses on individual schemes and, in particular, on innovative approaches. This part should not, therefore, be viewed as a comprehensive assessment of flood prevention measures implemented within the studied countries/localities, but as a broad overview which is punctuated with some specific case studies.

- The following will, first, provide a brief overview of the two key types of flood prevention measures: structural and non-structural. It then describes heavy engineering schemes used in the Baltic Sea region to prevent flooding, using Hamburg as a specific case study example.

- The next section briefly describes monitoring data collection and early warning systems and then this is followed by another brief section describing flood classification systems.

- The fifth section of the chapter describes the importance of public information and communication strategies for flooding and includes an example of a specific approach adopted in Estonia.

- Flood modelling and prediction is then discussed in a lengthy section which includes a number of examples that illustrate the variety and range of software applications and projects that currently exist within the Baltic Sea region.

- The penultimate section of the chapter looks at the relatively new and highly innovative concept of designing and building flood-proofed cities. This chapter includes information about HafenCity, a "city within a city" which is currently being built to a flood-proofed design in Hamburg. The part concludes with a short section that provides some comments regarding Integrated Flood Risk Management (IFRM) in the Baltic Sea region and the potential benefits that can be achieved by combining structural and non-structural, short and long- term flood prevention measures in an integrated and more holistic way.

Structural and Non-Structural Flood Prevention Measures

There are two key types of methods that can be used to prevent flooding.

Structural measures

Structural measures for flood prevention tend to be heavy engineering solutions, such as altering the level or course of water channels or the creation of flood walls or barriers. In certain locations, for instance in and around towns and cities, structural measures can be extremely effective at preventing flooding. However, the common drawback of these approaches is that the risk of flooding is not necessarily removed: by implementing a structural measure to protect one location, flood risk may actually be transferred to another location. This may be acceptable in some situations (i.e. protection of property within an urban area at the expense of a more sparsely populated rural location), but it may not be acceptable in all situations and may cause significant problems up or downstream (for a river) or further along the coastline.

Non-structural measures

Non-structural measures for flood prevention do not require extensive investment in heavy engineering, but rely instead on the foundations of a comprehensive understanding of flood risk and forecasting systems. Engagement and communication with the general population is an important non-structural measure for flood prevention. To provide a specific example, Early Warning Systems (EWS) that predict future flooding events are a common monitoring tool implemented around the Baltic Sea region to enable authorities to communicate effectively with the general public. EWS should form part of any flood risk management strategy and are an important measure for providing authorities with the means to protect people in the absence of more expansive and expensive structural measures. However, even where structural measures have been implemented (for instance in Hamburg and Riga), an EWS is still required to enable authorities to manage residual risk, for example breaches in dykes or water levels in excess of those that the structural measures were designed to protect against.

Heavy Engineering Schemes for Flood Prevention

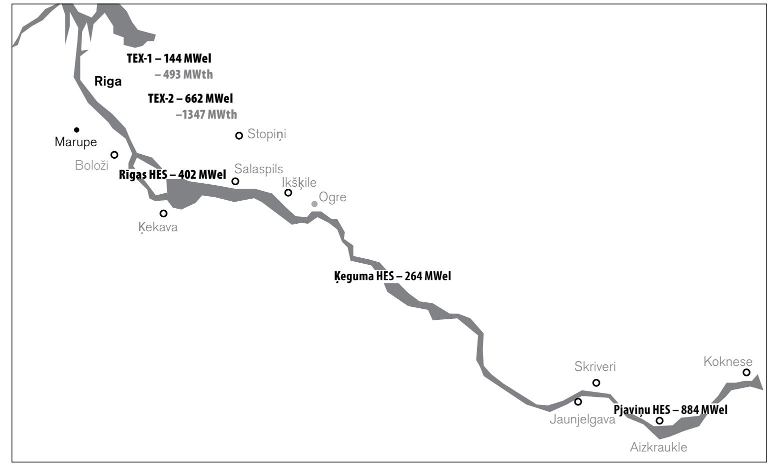


Figure 2 Map of the Plavinas, Kegums and Riga Dams/Hydroelectric Plants along the Daugava River, Latvia

There are numerous types of heavy engineering measures that can be designed and implemented to prevent flooding.

One very heavy engineering option is to construct one or more dams that can be used to regulate and control the amount of discharge within a river or river system. Dam walls hold water back, usually within a reservoir, and provide the ability to control the release of water downstream. In some cases dams can be used for a dual purpose. For example, there are three dams positioned along the Daugava River in Latvia that are used to control water discharge and generate hydroelectricity (see Figure 2). The key drawbacks of dams, however, are that they are very expensive to construct and there are limitations to where they can be built because they require areas of land upstream to be permanently flooded.

Another heavy engineering option for flood prevention is to adapt existing water channels to increase capacity and/or flow efficiency. This group of techniques is sometimes referred to as channelizing. In summary, specific channelizing measures include:

Channel straightening
removing meanders (curves) in a river to create a straight channel that enables rapid discharge of water through the channel.

Channel deepening
using a dredger to deepen a channel to increase its capacity.

Channel widening
using mechanical means to make a channel wider to increase its capacity. This is a common approach to flood prevention in Denmark and other Baltic Sea region countries.

Creation of flood relief channels
channels constructed to bypass existing urban areas and which are used as overflow channels during times of flooding. Flood relief channels may be used when channel straightening is not an option.

The construction of a large flood wall (commonly referred to as a dyke of levee) is another common heavy engineering approach to the problem of flooding. Dykes are large flood walls, built either adjacent to a river or on a river floodplain[7], which are designed to increase the carrying capacity of the river channel. They are relatively expensive to construct and tend to be constructed to protect high-value property and communities. Dykes must be designed, positioned, constructed and maintained appropriately, as is reflected in the catastrophic experiences of the 1962 storm surge in Hamburg. Following this event, decisions were taken in Hamburg to reconstruct and expand the dyke network to better protect residential areas that had been severely flooded. It was identified that the dykes had been rapidly breached during this flood due to a number of construction deficiencies, including:

- buildings and systems integrated into the dykes;
- the use of the dykes for non-flood control purposes;
- steeply constructed landward slopes.

7 If a dyke is constructed on a river's floodplain then the amount of water it can store is usually considerably greater than a dyke constructed immediately adjacent to a river channel.

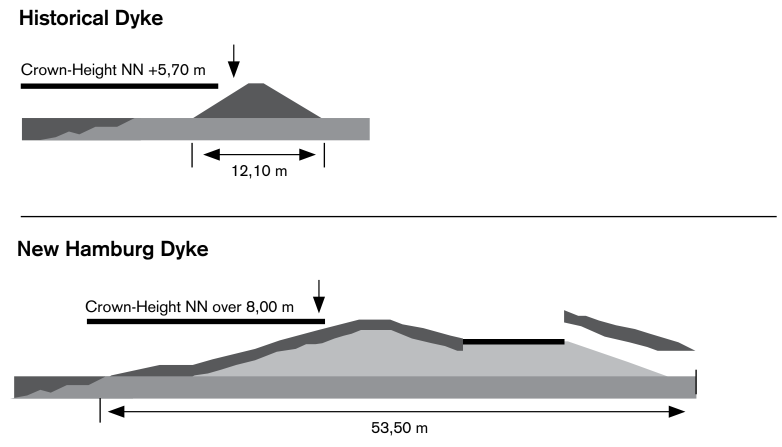


Figure 3 Changes in Dyke Construction in Hamburg since the 1962 Storm Surge

Prior to the 1962 storm surge, the main Klütjenfelder dyke, which was very wide, was being used as a garden allotment site and was permanently inhabited by people who had been bombed out of their homes during the Second World War. The closed grass cover which was essential for the safety of the dyke was absent due to various gardening activities. Consequently, holes in the dyke formed very quickly and breaches followed shortly afterwards. Following the identification of the dykes' construction deficiencies, the size and profile of the dykes was changed (see Figure 3). The new dykes were entirely constructed out of concrete and were built for the sole purpose of flood control.

Another common heavy engineering approach to flood prevention is to construct a physical barrier to flooding, either through the construction of a flood barrier or flood gate. Flood barriers and gates can come in many forms ranging from very small flood gates designed to protect single buildings or small streets to large expansive flood barriers spanning the entire width of a major river.

While the majority of hard engineering solutions discussed so far are specific to rivers and other water channels, there are a number of hard engineering solutions that have been implemented in the Baltic Sea region to prevent flooding along coastal areas. In Mecklenburg-Vorpommern (Germany), artificial lagoons called "Boddens" are situated alongside 1,568 km of coastline. A Bodden is a lagoon of water with a very high level of salinity which is separated from the open sea by spits of land. The Boddens were artificially created in the 19th Century to provide protection from coastal flooding and to this day they provide the Mecklenburg-Vorpommern coastline with good protection against storm surges. In addition to the Boddens, other key flood protection measures that have been implemented along the Mecklenburg-Vorpommern coastline include dykes (212 km) and dunes (105 km). The justification for the expansive flood protection measures along this Baltic Sea coastline is confirmed by the calculation that in the case of a 1 in 100 year event, a storm surge in the region could put 188,000 inhabitants at risk and could inundate 1,100 km of land.

While heavy engineering options have had some significant positive impacts for cities such as Hamburg, they cannot be viewed in any context as a single "miracle" solution to flood risk management. A particularly important lesson that has been learned in Hamburg is that extensive engineering solutions to flood prevention should be regularly and sufficiently maintained in order to provide optimum protection and performance. Engineering solutions for flood prevention should also be reinforced and supported by other complimentary strategies. The following sections of this chapter will now present and describe some of the non-structural flood prevention measures that can be implemented as complimentary or alternative to heavy engineering solutions.

Monitoring, Data Collection and Early Warning Systems

Monitoring of water levels within rivers and coastal waters is of prime importance for the compilation of useful datasets for analysis.

This analysis can subsequently be used as an important evidence-base from which to develop flood prevention plans and strategies. Monitoring data is also a required input for Early Warning Systems (EWS) and flood prediction models (both discussed later in this chapter). All of the BSR countries studied within this report have monitoring systems in place, either along all major rivers and stretches of coastline or along specific rivers and areas of coastline which are deemed to be at high risk of flooding.

While the scale and technical specifications of the different monitoring systems implemented around the Baltic Sea region varies considerably, the systems essentially are designed to fulfil the same purpose. It is therefore still useful to provide an illustration from Latvia. The Latvian Environment, Geology and Meteorology Centre provides qualitative meteorological and hydrological data and manages a national Environmental Monitoring System (EMS). This EMS has been created to provide comprehensive information on the ecological and biochemical status of the four river basin districts in Latvia (the Daugava, Lielupe, Gauja and Venta River Basin Districts). The existing monitoring network comprises of 36 meteorological stations, 64 hydrological observation stations located along rivers and nine observation stations along the Latvian coastline. The monitoring system is capable of measuring the key parameters required for monitoring and analysing data required for both flooding and pollution purposes (climate data, river data, etc.) and the data generated from the EMS is fed into the EWS in Latvia.

Classification Systems for Flooding Incidents

The compilation of historical datasets generated from monitoring and data collection provides practitioners with multiple opportunities for other flood prevention work.

In particular, these datasets provide opportunities to develop classification systems for flooding events. Classification systems used across the Baltic Sea region are of significant value for a variety of preventative, preparatory and responsive activities. The classification systems discussed during the EUSBSR flagship project 14.3 have been based on recorded data which provides a **strong evidence base for effective flood risk management plans (FRMP)**. The classification of river floods and storm surges provides authorities with the ability to predict likely impacts of floods of different severity. To provide a specific example, classification systems can be very useful tools for structuring crisis management responses to flooding incidents. The objective categories identified within a particular system can be used to develop a series of structured crisis management actions which are activated when different thresholds are reached. A specific example of a classification system that has been developed in the Baltic Sea region is the standard classification system used in Hamburg for storm surges/tides. This system defines the following storm surge categories:

- 3.5 to 5.0 metres above sea level = Storm Tide
- 5.0 to 5.5 metres above sea level = Heavy Storm Tide
- More than 5.5 metres above sea level = Very Heavy Storm Tide

Public Information and Communication Strategies for Flooding

While environmental monitoring systems (EMS) and early warning systems (EWS) are of substantial importance for flood prevention, preparation and response activities, the authorities in Hamburg have identified that these systems also need to be accompanied by effective public information and communication strategies.

The general public need information if a flood is predicted and/or an early warning system (EWS) has been triggered. When a flood has actually arrived, the general public then need regular information updates regarding the flooding situation. A Communication Strategy needs to be already in place before the flood occurs. During the flood and after the flood has occurred, this Strategy can be classified as a response activity. The, provision of up-to-date information during times of flooding can help prepare the general public and can help prevent damage, injuries and fatalities. Therefore public information/communication strategies contribute towards preventative, preparatory and response activities. Indeed, an effective public information/communication strategy can also contribute towards the success of recovery actions taken after the passage of a flood.

Flood risk communication has become an important area of work in Estonia, particularly since the destructive floods that affected Pärnu in 2005. The purpose of the risk communication strategy in Estonia is to raise public awareness of flooding and flood risks. The current strategy involves providing the public with risk information through websites and map notifications. In Pärnu, additional public notifications have been erected in the form of flooding posts which indicate the water levels that were reached during the 2005 flood. This is a highly visual communication strategy which emphasises the severity of the previous flooding event and which raises awareness of the need to prepare for flooding and to follow the instructions of the authorities if an early warning is provided.

Flood Modelling and Prediction

Flood modellers use and develop software to attempt to understand and better manage flooding.

The key focus of flood modelling and prediction is to develop models which can produce simulations of what is likely to happen in given circumstances (i.e. if water levels increase where might it flood and how much it might flood). There is a degree of uncertainty with the results produced by all flood models, but simulations and outputs that these models produce can provide valuable insights to practitioners with regards to where they could consider focusing resources for flood prevention, preparedness and response. Flood simulation models are now used in the Baltic Sea region as essential elements of Decision Support Systems (DSS)[8] for preventative work and for rapid response to real-life flooding incidents. Obviously, the requirements for these two different areas of work are significantly different, particularly in view of the speed at which information is required from the models. The result of this situation is that there are numerous flood simulation models and software packages on the market from which practitioners can choose. There are a number of flood modelling and simulation packages currently used throughout the Baltic Sea region. Some specific examples are presented in Table 1 (overleaf).

The following sub-sections now provide further information about some of the specific flood modelling software and projects currently being used in the Baltic Sea region. The inclusion of more information about these specific projects and models does not constitute endorsement by the EUSBSR flagship project 14.3 itself nor the project partners.

8 Further information about DSS can be found online at: http://www.unesco-ihe.org/Flood-Management-Education-Platform/Flood-Modelling-for-Management2/4.2-Decision-Support-Systems-for-Flood-Management

Table 1 **Examples of Flood Modelling Software/Projects within the Baltic Sea Region**

Name of Modelling Software/Project	Examples of use
The "Riga Against Floods" Project	A project for predictive flood modelling in Riga (Latvia) to inform the development of a comprehensive flood risk management plan.
HBV	Hydrological computer simulation model used to analyse river discharge and water pollution in Latvia.
High Resolution Operational Model for the Baltic (HIROMB)	Software used in Sweden and Estonia to model sea circulation in three dimensions (3D).
HWSim	Software used in Hamburg (Germany) for flood prevention planning and response operations.
HYDRAS and HYMER	Two pieces of software used in Latvia to gather raw observational data and produce river flood forecasting.
MIKE 21	Software used to develop coastal flooding simulations in Poland.
Multimedia Decision Making Training using Flood Modelling Software	Software and hardware used to deliver multi-media decision-making training for flooding events to crisis management students in the Main School of Fire Service (Poland).
WAM4 Wave Model	Software used to model waves inside and outside of harbours in Poland.
Zapora	Software used for river flood modelling by three Crisis Management Centres in Poland.

"Riga Against Floods" Project

The city of Riga in Latvia is particularly vulnerable to storm surges from the Baltic Sea and current climate change predictions suggest an increase in the number, severity and economic costs of storm surges in the future. It was for this reason that Riga City Council implemented the "Riga Against Floods" Project between February 2010 and November 2012. The key aim of this project was to identify areas of the city which are currently under high risk of flooding and to predict flood risk areas for the near (2012-2050) and more distant future (2071-2100). This work was then used to develop comprehensive flood risk management plans for the City of Riga.

The project utilised hydrodynamic, hydraulic and hydrological modelling techniques. LIDAR Mapping was completed to produce a 3D relief map of the city. Modelling software was then used to develop 18 different flood scenarios for four different types of floods, presenting likely predictions for storm surges in Riga until the year 2100. The predictive models were then used to develop a cost-benefit analysis for different flood prevention options in different locations. This analysis has enabled Riga City Council to identify areas that would not be cost-effective to defend and those "problem areas" which do require flood prevention measures. The City Council has also considered an assessment of the potential environmental impacts of the implementation of flood prevention measures in particular areas.

High Resolution Operational Model for the Baltic (HIROMB)

The High Resolution Operational Model for the Baltic (HIROMB) is an ocean circulation model with a high resolution which is intended for use in the Baltic Sea region, but which is also used in other regions. HIROMB originated from Sweden where it has been used in operational weather forecasting since 1995. In Estonia, the Estonian Meteorological and Hydrological Institute (EMHI) uses the HIROMB model in conjunction with data obtained through BOOS (Baltic Operational Oceanography System) in order to produce 48 hour marine forecasts (with 1 hour resolution). These forecasts are computed daily and provide forecasts for the following variables:

- Sea level
- Currents
- Salinity
- Temperature
- Ice concentration
- Level of ice thickness
- Deformed ice thickness
- Total ice thickness
- Number of ridges per kilometre
- Mean height of ice ridges

- Ice drift velocity
- Ice convergence or divergence
- Turbulent Kinetic Energy
- Dissipation rate of Turbulent Kinetic Energy
- Turbulent diffusivity

High Resolution Operational Model for the Baltic (HIROMB)

Early warnings provided by HIROMB can be crucial for reducing the risk of flooding to life and property. The HIROMB model has also been used successfully to model marine oil pollution. During the winter of 2006, there were two severe oil pollution events in the Gulf of Finland. The use of both historical analysis and predictive forecasts using HIRMOB and SeaTrackWeb was of significant importance for the practical management of the critical situations that evolved.

HWSim Flood Modeling Software

An important element of flood prevention and protection in Hamburg is the use of a simulation model called HWSim. This model combines a Geographic Information System (GIS) (ArcGIS 10) with a hydrodynamic model to provide a powerful planning tool for the protection of dykes and for flood response operations.

The model simulates the effects of possible floods in the marshes of the Elbe due to overtopping of levees, dam breaches or structural damage in the dyke defence line. The core of the model is a powerful and fast simulation module. An additional analysis module allows the user to complete a detailed analysis and view the simulation results with the Geographic Information System.

This tool has been in use since the storm surge period of 2000/2001 and has proved itself to a large extent in practice. Since the first release of HWSim there have been several updates in combination with updates of ArcGIS. The last release includes the actual data from a laserscan-based Digital Elevation Model (DEM) and an improved workflow that leads the user through the application. Even though this flood model has been specifically designed for use within the Elbe marshes, it can easily be applied and adapted for use in other areas.

Zapora Flood Modeling Software

The Zapora modeling software, developed by GeoInvent, is currently being used to model flooding by three provincial Crisis Management Centres in Poland. The software has a degree of flexibility. It can stimulate the spread of water due to increasing river levels or perhaps during the breach of a dam or dyke. The software allows users to make dynamic changes during simulations (such as creating a temporary dyke) and to alter water levels to predict the range of possible flooding. It is also possible to use the software to determine the number of buildings at threat from a flood and, through inference, the number of people that could potentially be at risk. Users have the ability to run simulations using both two dimensional (2D) and three dimensional (3D) spatial data.

The software developers suggest that there are two key advantages to using Zapora. The first advantage over some products is the relatively short period of time it takes to run a simulation and to receive an output for analysis. The second advantage is that the software has been designed to be user friendly. The flexibility exemplified by the Zapora software and by other similar software packages can provide flooding practitioners with a valuable tool for prevention, preparedness and response. Zapora can be configured to provide users with the ability to develop a range of flooding scenarios, both historical and potential. If additional data can be fed into the software, then a variety of reports can be generated. Some common examples of typical reports include:

- the number of people at risk from the flooding
- the age structure of the population at risk of flooding
- specific addresses (address points) within the flooded area
- potential property losses (on the basis of existing data) within the flooded area

9 Paplińska-Swerpel B. (2005) "Modelling Waves on the Baltic Sea" in Sulisz, W. and Paplinska-Swerpel (eds.) Modelling of Water Waves in Harbours: Book of Abstracts (Gdańsk: IBW PAN, CEM) pp. 17-21.

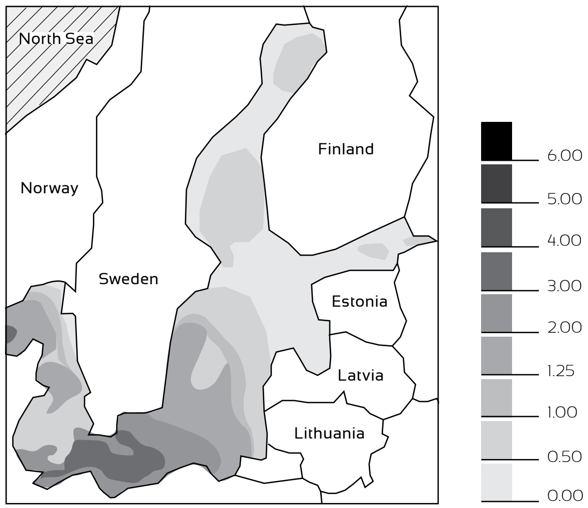


Figure 4 Image of a WAM4 Wave Forecast for the Baltic Sea Region

WAM4 Spectral Wave Model and its Use in Poland

The WAM4 Spectral Wave Model is different to HIROMB because it looks predominantly at sea waves. The model has been applied by The Institute of Hydro Engineering at the Polish Academy of Sciences to model and forecast waves inside and outside ports and harbours along the Polish coastline (see Paplińska-Swerpel B. (2005)[9]). There are numerous variables that influence the generation and modification of waves, including the shape of the basin, bottom topography and wind fields. The WAM4 model was therefore used to incorporate all of the physical processes that impact the development, distribution and dissipation of waves around the Baltic Sea. The model is currently used to provide predictions and forecasts for three key characteristics: mean wave direction, significant wave height[10] and mean wave period. The forecasts produced by the model have been compared against actual observations and it has been concluded that there is sufficient agreement between the two datasets to support the accuracy of the model. The model is now being used as an input to the MICORE Project EWS which provides a prediction of morphological impacts caused by marine storm events. The model is also publicly available online at www.meteo.pl.

10 Significant wave height is the average height of the largest 1/3 of waves.

Multimedia Decision-Making Training for Crisis Management Training in Poland

This final illustrative example demonstrates how flood modeling can be used as a part of a multimedia suite of tools for training students studying for qualifications in crisis management. The Main School of Fire Service (SGSP) in Poland has developed the Multimedia Decision-Making Training (MD-MT) Suite (see Figure 5) to use as an education tool for crisis management students and for national and international training courses. The MD-MT is used to run decision-making training exercises or games which are supported by multimedia tools and computer applications. A suite of rooms and equipment provide a partial virtual reality training situation whereby students are taught in a near real life situation how to manage a crisis. A network of rooms at SGSP includes computer, telephony and other equipment that would be typically available at crisis management centres in Poland. There are also separate rooms for trainers to use to act as representatives of the mass media and/or partner organisations.

The main goal of the flooding scenarios run within the MD-MT is to present students with the opportunity to work as a team within the municipality crisis management structures during a simulated city flood. MD-MT teaches the students how to organize the flow of information, how to implement decision making processes, coordination of the strengthening of dykes, preparations for evacuations and the coordination of communication with the mass media during flooding events. All of the training is designed so that students complete their actions in accordance with the regulations of the Polish Crisis Management Law. Members of staff within the Safety Research Department (SRD) of SGSP have developed an important piece of

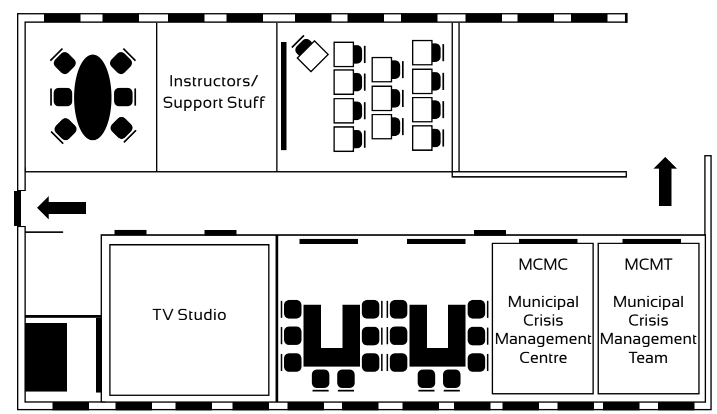


Figure 5 The Multimedia Decision-Making Training Suite at the Main School of Fire Service (Poland)

Multimedia Decision-Making Training for Crisis Management Training in Poland →

software called "Water" which they use within the MD-MT to provide a virtual simulation and realism to the flood scenario. The software is quite flexible and allows trainers to alter scenarios both prior to and during the course of a training session. The software also calculates the cost of any actions taken by the crisis management students with regards to the unfolding event. If students do not address certain problems, then the incident escalates and, in some circumstances, dykes and flood control measures may fail which will lead to flooding of some areas of the city. This will then create additional problems for the students to address.

The MD-MT that has been developed by SGSP is a valuable tool for providing near real-life experience to crisis management students. This practical experience is complementary towards the knowledge-based learning which the students are also required to complete. The practical training is of particular value for preparing students for the reality of managing an emergency situation. The added benefit of the MD-MT is that trainers can simulate 54 hours of virtual response time into a 2 hour training session.

Designing Flood-Proofed Cities

The unprecedented rate of urbanisation in cities and other urban areas of the Baltic Sea region implies that exposure and vulnerability to flooding is likely to increase.

The probability is made even more likely in view of climate change predictions and, for some areas, predicted sea level rise. While increased concentrations of people living within flood prone areas of the Baltic Sea region is of significant concern, it is also true that cities and towns in these areas can contribute towards more sustainable development if they are appropriately planned, governed and managed (see Jha, Bloch and Lamond (2012)[11] and Dodman, 2009)[12]. The growth of towns and cities through rapid urbanization presents opportunities for integrating flood risk management concerns into the design of new settlements as they are built, rather than trying to implement IFRMP to settlements which are already constructed and where there are already limitations to the degree to which they can be flood-proofed and protected against flooding.

The concept of flood-proofing cities is now becoming more prominent in Europe and the Baltic Sea region. As space to construct new cities, and space to expand existing cities is gradually reduced, urban planners need to take advantage of undeveloped areas of land that are perhaps less well-suited for urban development. In particular, some areas of land may be situated on floodplains and/or in other areas that are known to be prone to flooding. Practitioners have learned during the last few decades that if cities must be built in flood-prone areas then their design needs to be adapted and more innovative to ensure better protection to life, property and the environment. One basic technique of flood-proofing residential areas of new cities is to raise the height of new buildings so that any flooding that does occur is not able to encroach upon the main living areas of peoples' homes. Similar approaches can be taken for industrial and commercial buildings, perhaps through the construction of a car park in the basement or lower ground levels and the positioning of offices and other operational facilities above ground level. Other common approaches to flood-proofing include

11 Jha, A. K., Bloch, R. and Lamond, J. (2012) Cities and Flooding: A Guide to Integrated Urban Flood Risk Management for the 21st Century (Washington D.C.; The World Bank)
12 Dodman, D (2009) "Blaming cities for climate change? An analysis of urban greenhouse gas emissions inventories" Environment and Urbanization 21 (1) pp. 185-201.

the creation of large open public spaces which can be used as retention basins for floodwaters[13] and the creation of raised roads and pathways to enable access at all times (for instance in Copenhagen, Denmark).

While flood-proofing has been developed and implemented in a comparatively basic form within some areas of the Baltic Sea region, other areas have developed more complex and comprehensive flood-proofed designs. The HafenCity Building Programme in Hamburg, Germany, is currently Europe's largest inner-city development programme. The "city within a city" will eventually cover a land area of 126 hectares and will extend the size of the City of Hamburg by 40%. The development is taking place within the old docks and industrial areas which are situated on the waterside along the main dyke line. The pre-construction elevation of this land, which is situated directly on the flood plain of the River Elbe, ranges from 4.4 to 7.5 metres, which leaves the area prone to flooding and, especially, flooding caused by storm surges. A key element of HafenCity's design is innovation in flood prevention and control. In order to create a flood-proofed area for mixed residential, commercial and leisure land use, a number of innovative design measures are being implemented in HafenCity:

- all buildings are being constructed on compacted plinths that are 7.5 to 8 metres above mean sea level;
- almost every public road and bridge and all buildings will be elevated to the minimum height of 7.5 m above sea level;
- buildings' foundations will be constructed as ground floor garages which can be flooded during extreme events; no above-ground parking facilities within buildings are allowed;
- roads and footpaths are being constructed above the flood line to ensure unrestricted access for the fire and emergency services in the event of an extreme storm tide.

HafenCity is an expensive and long-term programme, with completion expected in 2025. This approach is obviously not suitable for inner city developments within all areas of the Baltic Sea region, but the lessons learned in HafenCity over the next decade could and should serve as an important foundation for the implementation of future similar projects in Germany and the region.

13 Retention basins are used to store excess water to prevent other areas from flooding. They are commonly constructed adjacent to larger rivers and upstream of a urban areas. They are used to store water in times of high discharge caused, for example, by periods of higher than normal rainfall or snow melt during the Spring.

The Concept of Integrated Flood Risk Management

Many of the previously mentioned specific schemes represent one of many components that form a more comprehensive Integrated Flood Risk Management Plan (IFRMP).The devastating flooding events documented in this Notebook have all prompted lengthy discussions and debates regarding the improvement of flood prevention measures within the Baltic Sea region. The immediate response to the 1962 storm flood in Hamburg, like many severe floods that have occurred throughout the region, was the implementation of a large-scale engineering project to repair and expand the dyke network. However, during the last two to three decades, Hamburg and other localities within the region have moved away from the concept of focusing on a single solution for flooding problems.

The dominant approach in the Baltic Sea region countries studied is now the implementation of a concept called Integrated Flood Risk Management (IFRM).

An IFRM strategy usually requires the implementation of short and long-term and structural and non-structural measures for flood prevention. A report published by The World Bank advocates that there are 12 key principles to Integrated Urban Flood Risk Management (UFRM) [14]. These 12 principles form the basis of a useful foundational framework for IFRM in the Baltic Sea region and are summarised in Table 2 (overleaf).

Flooding has and will have a major impact on thousands of people throughout the Baltic Sea region and flood prevention measures need to be designed and implemented with a view to balancing short and long-term priorities and structural and non-structural approaches within an integrated and holistic approach. Integrated approaches are being developed and implemented across the region and they are now more commonplace.

However, there are still some gaps in integration at the local and national level and there is perhaps an even more pronounced lack of integration when flooding is viewed at the macro-regional level. A number of rivers within the Baltic Sea region flow through multiple countries and the implementation of structural measures in a country or locality upstream may have ramifications for flood prevention in a country or locality downstream. Anecdotal evidence exchanged during the EUSBSR flagship project 14.3 Task D Workshops suggests that there is sometimes a lack of

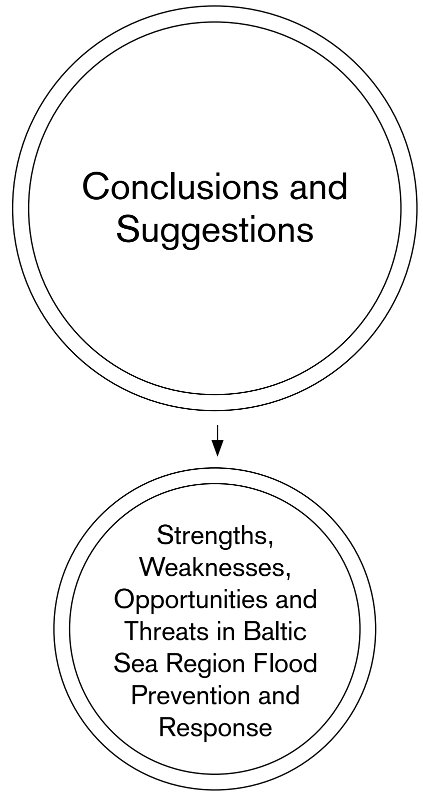
14 It could be argued that many of the principles could also be of relevance to IFRM in rural areas.

close cooperation and collaboration between authorities in neighbouring countries or localities when designing and implementing flood prevention measures that may have an influence on flood risk downstream or along the coastline.

The key conclusion from this small survey of flood prevention measures in the Baltic Sea region is therefore that there is a strong need for more integration and collaboration at the macro-regional level.

Table 2 **12 Principles to Integrated Urban Flood Risk Management**

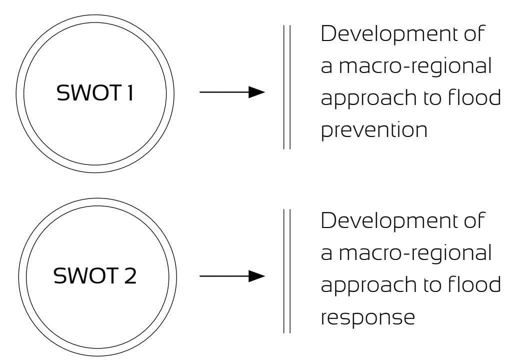
No.	Principle
1	Every flood risk scenario is different: there is no flood management blueprint
2	Designs for flood management must be able to cope with a changing and uncertain future
3	Rapid urbanization requires the integration of flood risk management into regular urban planning and governance.
4	An integrated strategy requires the use of both structural and non-structural measures and good metrics for "getting the balance right".
5	Heavily engineered structural measures can transfer risk upstream and downstream
6	It is impossible to entirely eliminate the risk from flooding
7	Many flood management measures have multiple co-benefits over and above their flood management role.
8	It is important to consider the wider social and ecological consequences of flood management spending
9	Clarity of responsibility for constructing and running flood risk programs is critical
10	Implementing flood risk management measures requires multi-stakeholder cooperation
11	Continuous communication to raise awareness and reinforce preparedness is necessary
12	Plan to recover quickly after flooding and use the recovery to build capacity.



Following the completion of the activities organised through Task D of the EUSBSR flagship project 14.3, a number of countries within the Baltic Sea region are now looking at how they can work together more closely to better prevent, prepare for and respond to major flooding incidents.

It was not possible for the partners within the Task D to create an ultimate mechanism for a common macro-regional approach to risk assessment and flood prevention in the Baltic Sea region, nor was it possible during the project to establish jointly adopted practice. However, the partners did take an important step during the Final Workshop held on 10th April 2013 in Warsaw (Poland) when they collaboratively developed two SWOT analyses. A SWOT analysis is a common structured planning tool commonly used in many professional fields to identify favourable and unfavourable factors for achieving a specified objective. The acronym SWOT stands for Strengths, Weaknesses, Opportunities, and Threats, and these four key elements form the basis of the SWOT matrix.

During early 2013, the lead partner of Task D, Frederikssund-Halsnæs Fire and Rescue Department (Denmark) proposed that it would be useful and beneficial for the partners to collaboratively identify the favourable and unfavourable factors for achieving the objective of macro-regional collaboration in flood prevention in the Baltic Sea region. The partners then took the decision to develop two closely related SWOT analyses:



Flood prevention was the key focus of Task D, but it was decided that the addition of a SWOT analysis on flood response would provide an interesting point of reference. Following the decision to develop the SWOTs, Frederikssund-Halsnæs Fire and Rescue Department defined the four key elements of the two SWOT matrices in more specific terms:

Strengths (Internal factors)
characteristics of the Baltic Sea region that provide an advantage for macro-regional collaboration.

Weaknesses (Internal factors)
characteristics that may provide a disadvantage to macro-regional collaboration.

Opportunities (External factors)
elements that the Baltic Sea region could exploit to its advantage for developing macro-regional collaboration.

Threats (External factors)
elements in the environment that could cause difficulties for macro-regional collaboration.

As noted in the bullet points above, the "strengths" and "weaknesses" to be identified within the two SWOTs were designated as internal factors, i.e. factors from within the Baltic Sea region flood prevention/response practitioner community that represent strengths and weaknesses to developing a macro-regional approach. The "opportunities" and "threats" to be identified were designated to be external factors, i.e. factors outside the influence of the Baltic Sea region flood prevention/response practitioner community.

The two SWOT Analyses that were produced (presented in following pages) represent the results of a number of discussions and debates and present some key observations identified throughout the entire EUSBSR flagship project 14.3 (within Task D).

The SWOT analyses are presented to provide a concise summary of some of Task D's key conclusions and, subsequently, to provide a foundation and springboard for future discussions on the issue of macro-regional cooperation and collaboration on flood prevention.

Following the development of the two SWOT Analyses, the Task D partners decided to formulate three very specific recommendations for improving flood prevention in the Baltic Sea macro-region in the future. These recommendations are now summarised briefly below.

1

a) The need to facilitate future cross-border discussions and exchanges

The activities delivered during Task D of the EUSBSR flagship project 14.3 identified the key challenges in the Baltic Sea region with regards to flood prevention. However, to further develop local, national and macro-regional capacity and coordination, there needs to be more cross-border discussion and exchange of knowledge, information and good practice. The EUSBSR flagship project 14.3 provided temporary facilitation of these discussions and exchanges but a more sustainable long-term solution should be sought. One specific suggestion from the Task D partners is that an online contact database could be developed to provide contact information (for instance, website address, generic contact details) for all of the flood stakeholders in the Baltic Sea region Region. This central database would provide a means for practitioners to easily identify and communicate with key stakeholders around the macro-region.

b) The need to develop an information system for flooding and flood prevention practitioners

During Task D of the EUSBSR flagship project 14.3, the project partners and invited external experts gathered substantial amounts of data and information regarding flooding and flood prevention. This useful data has been gathered from around the World and could be extremely useful and beneficial to all practitioners working around the Baltic Sea region. However, at present there is no single location where this kind of information is stored and through which it can be shared. The Task D partners therefore recommend that an online information system for the Baltic Sea region should be developed in the future to store and enable the exchange of knowledge, experience and good practice on flooding and flood prevention knowledge.

During Task D, the project partners decided to begin compiling a list of useful resources. Lists of these resources are presented within the Bibliography at the end of this Notebook.

2

a) The need to develop an ice-jam database

Following and in conjunction with Recommendation 1.b., the Task D partners recommend that an ice-jam database could be beneficial for the Baltic Sea region, replicating an approach adopted in the United States of America. Ice-jamming is a particularly significant problem in some countries of the region, including Latvia. It is extremely difficult to predict where flooding will occur as a result of ice-jamming, and it is therefore important that all sources of data on this issue can be gathered and made available to inform future strategies and approaches. Also, a number of countries experience infrequent episodes of ice-jamming and therefore do not have much data or experience to develop a comprehensive knowledge base to address future ice-jamming incidents. The development of an ice-jam database in the Baltic Sea region would be of significant benefit to all countries in the region experiencing ice-jamming, however frequently or infrequently it may occur. The significant benefit of developing a macro-regional approach is quite clearly illustrated here, whereby information held at a national level on ice-jamming is shared macro-regionally to the benefit of all nations and to the benefit of the macro-region itself.

During Task D of the EUSBSR flagship project 14.3 Flagship, a number of likeminded and highly motivated flood prevention professionals have been gathered together to share information, exchange good practice, and discuss current issues regarding flooding and flood prevention.

While the publication of this informative report represents the start of a long journey, many of the key obstacles to embarking on this journey in the first place have been overcome during the project because many of the stakeholders in the region are now more connected. All of the Task D partners remain committed to furthering the ultimate objective of developing a more coordinated macro-regional approach to flooding and flood prevention in the Baltic Sea region. The key recommendation of the Task D Core Group is, therefore, that its documented results (as they are represented in Fourteen Point Three Notebooks) should be considered as an important foundation and springboard for further discussions and debates that aim to progress this important agenda.

SWOT Analysis - Macro-Regional Approach to Flood Prevention in the Baltic Sea Region

Strengths

→ Relatively effective Flood Prevention Management Structures exist within the Baltic Sea region countries included within the scope of this report. These form a good foundation from which to build regional and macro-regional structures.

→ There is already some cross-border networking between flood prevention experts working within Baltic Sea region countries. There is also some limited networking between experts working within the region and those working within other parts of Europe and the World. This networking represents a key strength for assisting in the development of a macro-regional approach because it shows that there is cross-border work on flood prevention issues in the Baltic Sea region.

Weaknesses

→ While effective Flood Management Structures exist within the Baltic Sea region countries studied, many of these existing structures are not currently linked. If the structures are not linked at a regional or local or national level then there are indications of difficulties in achieving more interconnected and interlinked management structures at the macro-regional level.

→ Flood management structures within many Baltic Sea region countries currently involve numerous organisations and this makes planning and implementation difficult and sometimes protracted. If existing flood management structures are brought together at the macro-regional level then there could be difficulties uniting so many organisations together in a common approach. Again, common national issues present a weakness for macro-regional collaboration on flood prevention.

→ Partners suggested that a weakness of Baltic Sea region flood prevention practices is a tendency to focus on “living in a box” and only looking within that box for inspiration (i.e. a tendency to be inward-looking). This narrows the scope and potential for innovation and macro-regional collaboration.

Opportunities

→ The EUSBSR flagship project 14.3 presents some key opportunities for the future realisation of macro-regional collaboration and cooperation on flood prevention issues. The Task D Work Group has successfully brought together a number of highly skilled and motivated organisations and individuals, including numerous external experts who are senior advisers in their fields. The networking facilitated during the project will provide a springboard for future cooperation.

→ To address the weakness of being inward-looking, there is an opportunity for flood prevention practitioners in the Baltic Sea region to look beyond their macro-region to gather inspiration and to import knowledge and experience from other parts of the EU and the wider World.

→ There are numerous software packages currently available on the market that can be used as useful tools for improving flood prevention practice. Software is continually being developed and improved and this area of expertise represents a significant opportunity for developing and enhancing flood prevention (and response) at the local, national and macro-regional level. However, practitioners need to be willing to work with software developers to unlock this potential.

Threats

→ While software represents an important opportunity for closer cross-border collaboration on flood prevention in the Baltic Sea region, it also represents a potential threat. The speed of development and rapid innovation in this field means that software is continually outdated and updated. Ensuring all countries within the macro-regional area are able to keep up with the pace of change of flood prevention software may be a possible challenge to macro-regional collaboration.

→ While the EU Directives provide a consistency of approach to flood prevention across the EU, the stipulations of the Directives may represent a substantial task for some countries which may limit their ability to cooperate at the macro-regional level.

SWOT Analysis - Macro-Regional Approach to Flood Response in the Baltic Sea Region

Strengths

→ There are systems already in place to facilitate flood response at the macro-regional level. For example, the EU Civil Protection Mechanism facilitates cross-border sharing of flood response resources (for example, High Capacity Pumping Units) around the World. Requests and subsequent donations of resources are coordinated through the EU Monitoring and Information Centre (MIC). There are also bilateral agreements in place between individual Baltic Sea Region countries.

→ As Task D of the EUSBSR flagship project 14.3 has identified, broadly speaking the countries of the Baltic Sea region have similar flood risk profiles, which means that they experience similar flooding problems. This is an important strength for developing common interest and understanding between countries in the region.

→ There are a number of innovative multimedia tools available on the market for flood response coordination. There is also significant potential for innovation in this field in the future.

Opportunities

→ While the EUSBSR flagship project 14.3 has focused on flood prevention, a number of the participants in the Task D are also involved in responding to floods and so the project will provide potential opportunities for future cooperation and networking on flood response.

→ All countries of the Baltic Sea region have a long history of responding to emergency incidents, including floods. There are existing banks of knowledge and experience regarding how to structure and coordinate flood response, action and planning. This knowledge and experience has and can be shared to provide opportunities for developing macro-regional flood response plans for the Baltic Sea region.

→ Baltic Sea region countries are already gathering and sharing knowledge regarding good practice in information management, cooperation and flood response. The EUSBSR flagship project 14.3 represents an opportunity for partners and experts to further develop more coordinated and comprehensive mechanisms for facilitating these exchanges.

→ The development of flood maps as part of the EU Directive will provide an opportunity to enhance national flood risk management systems. The subsequent enhanced systems can be exchanged and discussed by the Baltic Sea region countries to provide an opportunity to further develop risk management systems across the region (and perhaps this will provide an opportunity to develop a risk management system for the entire macro-region?).

Weaknesses

→ It was suggested by Task D participants that there is currently insufficient exchange of information on good practice and innovation in flood response within the region and between Baltic Sea region countries and other countries around the World. Cross-border communication on this issue is therefore determined to be weak and in need of development.

→ There is currently insufficient data on flooding incidents within the Baltic Sea region. In addition, some of the existing data is not analysed and used to the limit of its potential.

→ Within some Baltic Sea region countries, difficulties exist surrounding the identification of clear responsibilities for water level monitoring equipment, meteorological data and flood protection measures. Task D partners believe that this problem at the local and national level could also be replicated at the macro-regional level. Therefore, there could be associated difficulties defining a coordinated flood response strategy for the Baltic Sea region.

Threats

→ The cross-border sharing of resources is always problematic, even under existing frameworks. There is a threat that any flood response personnel who are shared between Baltic Sea region countries might experience difficulties with language barriers and cultural differences. This could lead to misunderstandings of instructions and/or behaviour of colleagues from another country during a flooding incident. At best this could lead to inefficiency, but at worst it could represent a health and safety issue.

→ While innovative tools for flood response represent a key strength for a macro-regional approach, there is also an associated threat: multimedia tools are predominantly being developed by private commercial companies which may limit their implementation across the Baltic Sea region.

→ Political commitment to a macro-regional approach to flood response in the Baltic Sea region is a key external threat. The development and implementation of a macro-regional approach would require sustained political support across numerous terms of office.

→ Climate change and predicted rises in sea-level will be a challenge for all countries in the Baltic Sea region. However, there may be a particular threat to macro-regional cooperation if some countries of the Baltic Sea region are more severely affected by sea level rise than others (i.e. some countries may be called upon to act predominantly as resource recipients while some may be called to predominantly be resource donors). This could lead to political tensions.

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Notes

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Fire and Rescue Department under the Ministry of the Interior of the Republic of Lithuania
Norwegian Directorate for Civil Protection and Emergency Planning (DSB)
The Main School for Fire Service in Warsaw (SGSP)
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Swedish Institute

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14.3

COUNCIL OF THE BALTIC SEA STATES

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