EMERGENCY RESPONSE PLANNING FOR HEAVY RAIN RISKS

Review of the existing vulnerability analysis – Manual

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Contracting authority

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Preface

RAINMAN

The Interreg CE project RAINMAN aims to reduce damages caused by heavy rain in urban and rural regions. The project establishes tools for dealing with heavy rain risks for local, regional and national public authorities. The partners jointly develop a transferable toolbox with various tools. The toolbox is available on www.rainman-toolbox.eu.

Emergency Response Toolkit

One tool is the emergency response toolkit. It supports local and regional authorities with manuals and templates in creating emergency response plans for heavy rain events.

The toolkit is available in two different versions:

SINGLE DOCUMENTS

Here specific topics are available as 8 single downloads.

➔ IMPORTANT: Please note the references between the individual documents.

	General information & application assistance
	Recommendations (.pdf)
Step 1 – Review of the existing hazard analysis	
	Manual (.pdf)
	Templates (.zip)
Step 2 – Review of the existing vulnerability analysis	
	Manual (.pdf)
	Templates (.zip)
Step 3 – Define suitable measures	
	Manual (.pdf)
	Templates (.zip)

COMPLETE VERSION

Here all documents are available as 1 complete download.

➔ IMPORTANT: Please note that the numbering of the chapters differs from the version of the single documents.

	Emergency Response Toolkit (.zip) Content of the ZIP-File Part A – Recommendations & Process flow Part B – Templates

1. Introduction

The vulnerability analysis is the second basic step in the emergency response planning process. In this review of the vulnerability analysis, the existing risk maps should be analysed.

> *Vulnerability in the sense of emergency planning means the vulnerability of an object or subject to a hazard. Vulnerability is a complex and dynamic characteristic of a receptor describing its susceptibility to the negative consequences of a hazard (Sauer et al. 2019). The vulnerability of an object, in combination with the hazard of flooding or the probability of occurrence of a hazard scenario, results in the risk.*

The goals of reviewing the vulnerability analysis are to know if all the region's vulnerable objects have been evaluated, to determine a prioritisation of your region's critical infrastructure and to be able to classify the quality/complexity of the existing vulnerability data.

At the end of the vulnerability analysis, the user will:

- know the quality of the vulnerability data,
- know the project region's vulnerable objects,
- have a prioritisation of the region's critical infrastructure,
- know the region's critical risk points/areas.

VULNERABILITY ANALYSIS - Review				Template
Review current situation				
	Review all your existing vulnerability data and risk maps. If no risk map is available, create one following the *"RAINMAN Tool Assessment and Mapping"*.	Task	V1.T1	B1.1
Receptors				
	What kind of data (spatial planning, census, surveys) was used to locate the receptors?	Question	V1.Q1	B1.1
Consequences				
	What kind of data concerning the consequences was used creating the risk map?	Question	V1.Q2	B1.1
	Where are the critical points/areas with high damage potential?	Question	V1.Q3	B1.2
Data quality and area characteristics				
	Evaluate the vulnerability data complexity.	Task	V2.T1	B1.1
	Evaluate your region's focus area and resources.	Task	V2.T2	B1.1

VULNERABILITY ANALYSIS - Review				Template
Creation of documents				
	Take the "Working Map: Hazard" and the risk map. Define where significant damage may occur.	Task	V3.T1	-
	Additionally mark points where intervention measures might be useful.	Task	V3.T2	-
	Describe and prioritise the significant critical risk points/areas in Form B1.2.	Task	V3.T3	B1.2
	Working Map: Risk	Map	V3.D1	-
	Table: Critical Risk Areas	Document	V3.D2	-
Stakeholder				
	Stakeholder Workshop: Vulnerability	Stakeholder	V4.S1	B1.1 B2.2 B2.4 B2.5

2. Review current situation (V1)

In order to evaluate the data availability and quality of the vulnerability data, the current situation shall be reviewed. All available maps and data shall be re-analysed considering that this information will be used for the planning of measures.

Review all your existing vulnerability data and risk maps. If no risk map is available, create one following the "RAINMAN Tool Assessment and Mapping" — **Question V1.T1**

This toolkit implies that risk maps are already available. Hence, the first process step is to review all the existing data and maps. All further tasks are based on the existing data and maps. If no risk map is available, one should be created following advises in *"RAINMAN Tool Assessment and Mapping"*.

Evaluate which maps are available. Document or list your findings in Form B1.1.

Receptors

Receptors are the objects and subjects (e.g. people, property and environment) exposed to a hazard and potentially susceptible to damages and negative consequences. The vulnerability of a receptor can be modified by increasing its resilience to flooding.

This process step aims to verify the availability and quality of data, with which the receptors were displayed and located in existing risk maps.

What kind of data (spatial planning, census, surveys) was used to locate the receptors? — **Question V1.Q1**

To know about the vulnerable structures in your region it is important to consider all available data concerning the localisation of potentially exposed subjects or objects. The spatial planning data includes information about all plots in the area (location, extent, type of use). Further, census data might have been used as well as additional surveys.

Evaluate which data was used creating the risk map. The focus is on the localisation of the receptors. The following list should give you an idea of what data may be available. For detailed classification see the recommendations in "RAINMAN Tool Assessment and Mapping – Expert Corner". Use Form B1.1 for documentation.

- Spatial planning data (zoning, cadastre, usage of buildings)
- Census data (information on the number of persons in the household, immobile persons)
- Data on traffic areas
- Additional surveys carried out as part of risk mapping

	Level 1	Level 2	Level 3
Receptors Data Complexity	*Analog data and local knowledge*	*-*	*Detailed digital data*

Input:	*Risk map (V1.T1)* *Local knowledge Stakeholders (V4.S1)*
Output:	*Summary and analysis of data used for risk maps ⇨ V2.T1*

Consequences

The term consequence comprises the negative effects such as economic (e.g. damaged property), social (e.g. loss of life, injuries, loss of cultural assets) or environmental (e.g. contamination of soil / water) damages that may result from the exposure of a receptor to a hazard (Samuels and Gouldby 2009). It can be expressed quantitatively (e.g. monetary value), by category (e.g. high medium, low) or descriptively.

Regarding the consequences, the current situation review aims to find out about damage related information and problems on infrastructural objects, people, agricultural and forestry land and the environment, in the endangered areas. Furthermore a prioritisation of the vulnerable objects shall be defined.

What kind of data concerning the consequences was used creating the risk map? **Question V1.Q2**

In addition to the knowledge about the receptors in your regions flood-prone areas (V1.Q1), further damage related information on the identified structures (e.g. object type, basements, underground car parking and hazardous goods) is of great interest. A minimal requirement for further planning is the knowledge on the object type (residential building, industrial and business buildings, outbuilding etc.) of the receptors.

Evaluate which data was used creating the risk map. Use the following example table to estimate what you already know about damage potential in your region and of which data complexity the existing information is. For detailed classification see the recommendations in "RAINMAN Tool Assessment and Mapping – Expert Corner". Use Form B1.1 for documentation.

	Level 1	Level 2	Level 3
Structure Data Complexity	*At least information on object type, no details on building construction and no information on*	*Either some details on building construction or information on water levels and*	*Details on building construction and information on water levels and flow velocity*

	Level 1	Level 2	Level 3
	water levels and flow velocity	flow velocity	
Damage assessment	Description based on observations	Categories based on damage assessment with or without the use of water levels / flow velocities	Quantitative results by the use of damage functions based on water levels and flow velocities

In case there is no available information on the object type of the identified structures, revise and adapt the risk map following the "RAINMAN Tool Assessment and Mapping" (process step V1.T1).

If the quality of the data, which was used for creating the risk map, is rather low, it could be improved by undertaking an additional risk survey. This seems particularly useful if the hazard data complexity is high (Level 3) and the vulnerability data complexity is low (Level1).

The following information can be collected as part of an additional risk survey (Use Form B3.1 to document the additional risk analysis):

- *Type of risk (e.g. to people, to property, functional failure, hazardous to water)*
- *Water entering the building (e.g. cellar window, floor height on the ground floor, backwater from the sewer, unsealed pipe outlets)*
- *People and equipment at risk of flooding (e.g. people in the basement or ground floor, electrical installations)*
- *Flood protection measures (e.g. object-specific operational plan, mobile flood protection, flood protection system, evacuation plan)*

Reasons why an additional survey makes sense:

- *Knowing, where the expected damage is the highest*
- *More details about which measures can be implemented*

Input:	*Risk map (V1.T1)* *Local knowledge Stakeholders (V4.S1)*
Output:	*Summary and analysis of data used for risk maps ⇨ V2.T1*

Where are the critical points/areas with high damage potential? **Question V1.Q3**

Damage can occur to infrastructural objects, to people, to agricultural and forestry land or to the environment. The negative effects and damages can vary widely depending on the detailed design of the objects. For example, a street underpass is probably not affected by an increased water level in its structure, but the presence of people can still lead to a critical risk situation. Hence, it is important to know, whether there are any specific problems regarding the vulnerable structures in your region.

Compile a list all of specific problems in your region regarding negative effects and damages. This may include, for example, basements, oil-fired heating, street underpasses, underground car parking, places with large crowds, etc. Document your findings in Form B1.2.

Input:	*Risk map (V1.T1)* *Local knowledge Stakeholders (V4.S1)*
Output:	*Collection of points/areas with negative effects ⇨ V3.T1*

3. Data quality and area characteristics (V2)

After reviewing the current situation, this process step works like a filter to filter out the relevant vulnerability points/areas. The existing and/or collected data have a certain quality/complexity. In order to be able to take further steps in the toolkit, it is essential to classify the quality/complexity of the data situation in your region. In addition, the area characteristic plays an essential role in the planning of measures.

Evaluate the vulnerability data complexity. **Task V2.T1**

In the previous steps, levels of complexity were assigned to the available data and information (V1.Q1, V1.Q2). In each previous step the levels of complexity was assigned. Based on these principles, an expert assessment of the comprehensive complexity level should be carried out.

Assess the complexity level of the vulnerability data. Use all previous classifications and information, which were assembled in the phase of reviewing the current situation. The classification should be done based on an expert assessment. Refer to the information shown in "RAINMAN Tool Assessment and Mapping – Expert Corner". If you vary between two levels, choose the lower level. Document the assumptions you made and the level you chose in Form B1.1.

	Level 1	*Level 2*	*Level 3*
Vulnerability Data Complexity			

Input: *Summary and analysis of data used for risk maps (Data complexity V1.Q1, V1.Q2)*

Output: *Overall vulnerability data complexity ⇨ M2.T1*

Evaluate your region's focus area and resources. **Task V2.T2**

The type of project area (rural, semi-urban and urban) often has a direct impact on the availability of resources for action during heavy rainfall events. However, other criteria may also limit or enhance the resource availability.

Arrange the availability of resources of your area - to set actions during heavy rainfall events - into a category. Document all the reasons you found limiting or enhancing your resources. This will be essential for further planning of detailed measures. Eventually refer to the information in "RAINMAN Tool Assessment and Mapping - Expert Corner". Document your assumptions and estimations in Form B1.1.

Focus area		*Resources*
rural	→	*low*
semi-urban	→	*medium*
urban	→	*high*

Input: *Focus area (V2.T2)*

Output: *Estimated resources availability ⇨ M1.Q4*

4. Creation of documents (V3)

After reviewing the existing risk maps and vulnerability data necessary for setting up an emergency response plan, this process steps aim to prepare all the data and maps in a way to be implemented in the final plan. The quality of the existing data (V2.T1) needs to be considered throughout the whole process. All detailed process steps are carried out, already giving thought to the following planning of measures.

Take the "Working Map: Hazard" and the risk map. Define where significant damage may occur. **Task V3.T1**

The vulnerability of an object in combination with the hazard of flooding or the probability of occurrence of a hazard scenario results in the risk. In Task H3.T1 critical hazard points/areas were evaluated. Within these areas, specific points might be present where significant damage may occur. This could be all areas with a high damage potential to people or the environment (schools, retirement homes, hospitals, buildings of public administration, infrastructure for communication and energy supply, train stations, etc.)

Take the risk map and mark all those points or areas where the risk situation might get critical. You can use the "Working Map: Hazard" for additional information on the hazard situation. Consider the quality/complexity of the data, the hazard map was created with (with data complexity level 1, you might not be able to give a reliable assumption of certain critical risk points).

Input:	*Working Map: Hazard (H3.D1)* *Risk map (V1.T1)* *Collection of points/areas with negative effects (V1.Q3)* *Overall hazard data complexity (H2.T1)* *Overall vulnerability data complexity (V2.T1)*
Output:	*Working Map: Risk ⇨ M3.T4, M3.T5*

Additionally mark points where intervention measures might be useful. **Task V3.T2**

After knowing the critical hazard scenarios and critical risk point/areas, the first intervention measures can be considered. In future process steps these ideas will be evaluated according to their practicability.

Take the map you edited in step V3.T1 and add points where intervention measures might be useful. In this early stage all potential places should be considered regardless of how likely you are capable of applying these measures.

Input:	*Points / areas with critical risk situation (Working Map: Risk V3.D1)*
Output:	*Working Map: Risk ⇨ M3.T4, M3.T5*

Describe and prioritise the significant critical risk points/areas in Form B1.2. **Task V3.T3**

In order to document all your findings of the previous steps (V3.T1 and V3.T2) a list should additionally be created where all the information is written down.

Heavy rain events are often events that are characterised by a short early warning time and can vary widely in local extension. In order to be able to set purposeful emergency measures during heavy rain events, it is important to prioritise the vulnerable object in your region.

Take Form B1.1 and describe all your findings. This will help you to get a good overview about your critical risk points/areas.

Make a priority list of the vulnerable objects in your region. Always consider the basic prioritisation:

1. *Human health and life*
2. *Environment*
3. *Cultural heritage*
4. *Economic activity*

Input:	*Working Map: risk (V3.D1)*
Output:	*Table: critical risk areas ⇨ M3.T4, M3.T5*

Working Map: Risk **Document V3.D1**

The output of Task V3.T1 and V3.T2 is the "Working Map: Risk". If you know how to use GIS Software, you might digitize your results. Otherwise keeping your results on a paper map is sufficient.

Table: Critical Risk Areas **Document V3.D2**

The output of Task V3.T3 is the "Table: Critical Risk Areas".

5. Stakeholder (V4)

Stakeholders are people who are relevant to be included in the process because they:

- *need to be included by legal reasons*
- *are vital for planning and applying of measures*
- *have additional knowledge (e.g. of the local situation)*
- *collaborated in similar projects*
- *can provide useful connections*
- *can enhance or block the process*
- *represent the public*
- *represent a particularly vulnerable part of the public (e.g. people with special needs, children)*

Often, relevant stakeholders are representatives of the public administration, politics or NGOs. Sometimes it might even be useful to include directly affected citizens.

The following table gives an overview about potential stakeholders for the vulnerability analysis.

Stakeholders	Function	Competences/Input	Level
Users of the emergency response plan			
Regional government	Head of operations	Regional knowledge, experiences	Regional
Local government, mayor	Head of operations	Local knowledge, experiences	Local
Local/Regional Crisis unit	Support of operational head	Local knowledge, experiences	Regional/Local
Emergency organisations	Fire brigade, police, rescue service	Local knowledge, experiences	Regional/Local

Stakeholders	Function	Competences/Input	Level
Technical input			
Operator of critical infrastructure	Technical Input	Local knowledge: electricity and gas supply, fresh water supply and waste water removal, road network, critical infrastructure	Regional/Local
Local experts	Technical Input	Local knowledge, experiences, past/historical events	Local
Connections			
Emergency response units	Technical Input, Nationwide coordination	Knowledge of planning and applying of measures	Nationwide/Regional
Public			
Citizens, interested people, affected persons	Potentially affected, volunteers	self-provisioning, participation at exercises	Local

Another considerable group is the common public, which can also be included in the participation process. Nevertheless the public needs to be at least informed about the results of your planning process (M4.S3).

A checklist on the stakeholder participation as part of the vulnerability analysis (Form B2.2) shall help you to consider all important process steps. In order to document the identification process of the relevant stakeholders, Form B2.4 can be used.

To make sure that all the relevant stakeholders were invited, it might be useful to evaluate the entry list after the first stakeholder meeting.

Further meetings with key stakeholders are also possible.

Stakeholder Workshop: Vulnerability **Stakeholder V4.S1**

In order to review the current vulnerability situation and all your available data and maps, local knowledge regarding the vulnerable objects and critical infrastructure is indispensable. Most of the stakeholders were already included in the Stakeholder Workshop: Hazard. Stakeholders who take part for the first time are operators of critical infrastructure and local experts concerning technical information on the vulnerability of exposed structures. In order to be well prepared for the workshop it is essential to deal with the existing vulnerability data as well as with the basic concept of this toolkit (i.e. what steps are planned to build up an emergency plan, what is the structure of an emergency plan), before the stakeholder workshop is held.

The following bullet points give information about how the stakeholder workshop can be organised.

- Inform

  In the first part of the workshop, the participants are informed about:

  - The purpose of the emergency plan
  - The planned steps to build up the emergency plan
  - Expectations on the participants (i.e. what should be worked out together)

- Relevant vulnerability data depicted in the existing risk map
- What kind of damage potential is shown in the existing risk map

- Discuss & Participate

  After the informational part, the stakeholders are invited to:

  - Bring in their knowledge following the questions concerning the current situation
  - Review the content of the existing risk maps and identify critical points/areas with high damage potential
  - Make suggestions where intervention measures might be useful
  - Name persons who may have additional useful knowledge

Prepare the stakeholder workshop

Review all the existing material and make yourself confident with the planning process. Identify the entire relevant stakeholders using the table above and document the relevant stakeholders in Form B2.4. Use Form B2.2 as a checklist.

Host the stakeholder workshop

Host a meeting/workshop where stakeholders are informed about your planning process. Furthermore all the questions concerning the current vulnerability situation as well as points/areas with high damage potential and suggestions on intervention measures shall be discussed. For the procedure of the workshop refer to the above list. All the feedback of the stakeholders shall be documented (Form B2.5).

Follow-up processing

After the workshop was held, sort out all the relevant feedback and document it in Form B1.1. Use Form B2.2 as a checklist. If it turns out that it might be useful to discuss additional topics within a smaller group, further meetings with key stakeholders are possible.

RAINMAN Key Facts

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