EMERGENCY RESPONSE PLANNING FOR HEAVY RAIN RISKS

Definition of suitable measures - Manual

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[1)] RIOCOM – Office for Water Management and Environmental Engineering

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Contracting authority

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Wasserwirtschaft

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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 third and last basic step in the emergency response planning process is the development of suitable measures. It is one of the overall goals of this toolkit to develop measures in order to minimize damages caused by heavy rainfall events. Damages can be reduced either by minimizing the vulnerability of the receptors or by altering the hazard process itself.

As floods caused by heavy rainfall tend to be events with a very short warning time, measures working during the event need to be accurately planned and well-coordinated. It might be difficult to fulfil all the prerequisites necessary to apply certain measures during heavy rainfall events (e.g. the quality of the forecast data is not good enough to install a highly sophisticated warning and alarm system in order to set up road barriers within a specific time). Hence the measure concept should also include measures concerning mid or long term structural changes or information and awareness raising for citizens.

The goal of the measure planning step is to develop a scenario specific action plan which will be part of the emergency response plan for heavy rain risks. In order to create such a plan, it is necessary to be aware of certain facts applying in your region, like legal responsibility or available resources for setting up measures. Additionally, it has to be considered that all relevant players need to be informed about what to do during flood events.

At the end of this step the user will:

- know how to minimize risks and damages, before, during or after a heavy rainfall event,
- know the responsibilities (legally and actively) for emergency measures during extreme events in your region,
- know the available resources for setting up emergency measures,
- know that higher authorities are aware of the measures,
- know that all relevant stakeholders are informed about the measures,
- know that local citizens are aware of the measures they are affected by and
- know who applies and adapts the measures.

MEASURES				Template
Review current situation				
?	Are there already emergency response plans available, concerning any kind of risks?	Question	M1.Q1	B1.1
?	Who is legally responsible for emergency measures during extreme events?	Question	M1.Q2	B1.1
?	Who are the relevant players for emergency response planning and applying and adapting of emergency measures?	Question	M1.Q3	B1.1
?	What resources do you have available for emergency measures during extreme events?	Question	M1.Q4	B1.1
Data quality and area characteristics				
✎	Evaluate the risk map complexity.	Task	M2.T1	B1.1
✎	Resources (estimated in V2.T2)	Task	M2.T2	B1.1
✎	Reaction time (estimated in H2.T2)	Task	M2.T3	B1.1
✎	Evaluate your obtainable action plan complexity.	Task	M2.T4	B1.1

MEASURES				Template
Creation of documents				
	Define responsibilities.	Task	M3.T1	B1.1 B6
	Develop a simple warning and alarm tool to assess the expected event intensity	Task	M3.T2	B4.1 B6
	Plan communication channels during an event.	Task	M3.T3	B1.1 B6
	Define general measures. Focus particularly on your designated critical points/areas.	Task	M3.T4	Annex
	OPTION: Plan additional measures depending on risk map complexity, available resources and reaction time. Focus particularly on your designated critical points/areas.	Task	M3.T5	Annex
	Action Plan	Document	M3.D1	Annex B6
	Fill out the final Emergency Response Plan	Task	M3.T6	B6 and B7
Stakeholder				
	Meeting Key Stakeholders: Resources (optional)	Stakeholder	M4.S1	B2.5
	Stakeholder Workshop: Measures	Stakeholder	M4.S2	B1.1 B2.3 B2.4 B2.5
	Present the finalised action plan/emergency response plan to citizens	Stakeholder	M4.S3	B2.3

2. Review current situation (M1)

Are there already emergency response plans available, concerning any kind of risks? **Question M1.Q1**

Already existing emergency response plans might help you get familiar with the most important basics for emergency response planning in your region. Eventually these documents already deal with legal responsibility for planning, applying and adapting of emergency response measures. It might also be already organised who sets up measures actively during a heavy rainfall event (e.g. fire brigade, operators of critical infrastructure, etc.). The most useful information will be found in emergency response plans concerning river floods. Depending on availability, other plans could be useful as well.

> *Evaluate which plans are already available and review them. Particularly focus on legal matters and legal responsibilities as well as how emergency operations are already organised. If plans concerning river floods are already available, you might also revise the detailed measures presented there. Document your findings in Form B1.1. You might again need that information when you are going to fill out the final emergency response plan (*M3.T6*).*

Who is legally responsible for emergency measures during extreme events? — Question M1.Q2

Often, it is regulated by law who is legally responsible for planning, applying and adapting emergency measures during extreme events. These responsible persons can be for instance the mayor, the regional government, local crisis units or sometimes even emergency organisations who are in charge for certain measures. Existing documents dealing with emergency response planning can give a hint on where to find these regulates.

In the end your emergency response plan should clearly state who bears the legal responsibility, who is the operational head of emergency operations and who sets specific measures. A template for an emergency response plan is available (Supplement B6).

> *Evaluate all documents available dealing with responsibilities for emergency operation during extreme natural hazards (existing emergency response plans, specific laws). Eventually you will need help by higher authorities (regional government, etc.). Use Form B1.1 for documentation.*

Who are the relevant players for emergency response planning and applying and adapting of emergency measures? — Question M1.Q3

Beside the legal facts, a number of other players are relevant for emergency response planning and applying and adapting of emergency measures. These can be – in addition to those legally responsible – emergency organisations (fire brigade, rescue service, police), local crisis units or operators of critical infrastructure. Sometimes – especially during flash flood events with very short warning time - it might be useful, that those players who are setting up measures during emergency operation can decide independently.

> *Identify the relevant players in your region for emergency response planning and applying and adapting of measures. Talk about what they can decide independently or what has to be advised by the operational head. Use Form B1.1 for documentation.*

What resources do you have available for emergency measures during extreme events? — Question M1.Q4

Based on the estimated resources availability (V2.T2) a detailed evaluation of the available resources should be carried out. Resources for emergency measures can be people or material necessary for setting up measures. It is further important to know where these resources are located in relation to potential emergency sites.

As already said before, heavy rainfall events tend to be events with very short warning time. Hence a good knowledge of the availability and the localisation of your resources is indispensable, to set up your measures in a well-coordinated manner. Local knowledge might be useful for this step.

> *Evaluate which resources you have available for emergency measures during extreme events. Document your findings in Form B1.1. Optionally you can host a meeting with key stakeholders (M4.S1).*

Input:	*Estimated resources availability hazard (V2.T2)* *Local knowledge (M4.S1)*
Output:	*Detailed knowledge of available resources ⇨ M2.T2*

3. Data quality and area characteristics (M2)

After reviewing the current situation, this process step works like a decision-making tool to find out which complexity of action plan is obtainable in your region. All the existing and/or collected data from previous steps (hazard analysis and vulnerability analysis) have a certain quality/complexity. The classification of quality/complexity of the data situation makes it possible to determine which complexity of action plan in reachable. In addition, the available resources and scenario specific reaction time have to be considered.

Evaluate the risk map complexity. **Task M2.T1**

The risk map is the combination of the hazard map and the vulnerability map. The risk of damage to certain receptors can be assessed with different criteria describing the hazard situation (e.g. water level and flow velocity) and the vulnerability of objects (e.g. prioritisation, damage potential). This toolkit implies that risk maps are already available. In previous process steps these existing maps where reviewed and the data complexity regarding the single documents was assessed. This process steps aims to finally assess the complexity of the risk map.

Assess the complexity level of the risk map. Use all previous classifications and information, which were assembled in the hazard analysis (H2.T1) and the vulnerability analysis (V2.T1). 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*
Risk Map Complexity			

Input: *Overall hazard data complexity (H2.T1)*
Overall vulnerability data complexity (V2.T1)

Output: *Overall risk map complexity ⇨ M2.T4*

Resources (estimated in V2.T2) **Task M2.T2**

Setting up measures during natural hazard scenarios is also a matter of the available resources. The better your available resources, the better the chance to set up process related measures. If your resource availability is low, consider that measures working on mid or long term structural changes, information and awareness raising of citizens may be more suitable in your region's action plan.

Concerning the detailed knowledge of your resource availability (M1.Q4), try to assign your region to one of the following levels. Consider that this is only a basic assumption which will give you guidance to choose how detailed your action plan could be. Document the assumptions you made and the level you chose in Form B1.1.

Resources
low
medium
high

Input:	*Detailed knowledge of available resources (M1.Q4)*
Output:	*Level of resource availability ⇨ M2.T4, M3.T5*

Reaction time (estimated in H2.T2) **Task M2.T3**

The scenario specific reaction time plays an important role to decide which measures are possible to implement during the heavy rain event. If the critical events in your region tend to have a very short warning time, it might not be possible to reach the emergency site in time. The warning time depends also on the quality of available precipitation forecast.

Based on the information you have on past scenarios, on the estimated reaction time in H2.T2 and the quality of the available precipitation forecast, try to assign your region to one of the following levels. Consider that this is only a basic assumption which will give you guidance to choose how detailed your action plan could be. Document the assumptions you made and the level you chose in Form B1.1.

Reaction time
very short
short
long

Input:	*Past flood events (H1.Q1)* *Availability and quality of precipitation forecast (H1.Q1)* *Estimated reaction time ⇨ M2.T3*
Output:	*Level of reaction time ⇨ M2.T4, M3.T5*

Evaluate your obtainable action plan complexity. **Task M2.T4**

The previous analysis, concerning the risk map complexity (M2.T1), the resource availability (M2.T2) and the reaction time (M2.T3) shall now be brought together in order estimate the obtainable complexity of action plan in your region. The **complex version** requires a detailed knowledge of the hazard scenario, precise and early heavy rain warning and a good knowledge of the quantity and the localisation of resources. A **basic action plan** may be more feasible in some cases. It includes measures regarding mid or long term structural changes, observation, information and awareness raising. The basic action plan will also help you reduce risks caused by heavy rainfall events and provides you with a good foundation for emergency interventions.

Based on the information you worked out in the steps M2.T1, M2.T2 and M2.T3, try to assign your region to one of the following levels. Consider that this is only a basic assumption which will give you guidance to determine how detailed your action plan could be. Document the assumptions you made and the level you chose in Form B1.1.

	Level "BASIC"	*Level "COMPLEX"*
Action Plan Complexity (obtainable)		

Input:	*Overall risk map complexity (M2.T1)* *Level of resource availability (M2.T2)* *Level of reaction time (M2.T3)*
Output:	*Obtainable action plan complexity ⇨ M3.T4, M3.T5*

4. Creation of documents (M3)

After all the existing data was reviewed and analysed according to its quality/complexity, in this step the final action plans shall be created. Eventually you have different critical heavy rainfall scenarios defined in your hazard analysis (e.g. flash flood scenarios or long lasting pluvial flooding). If so, for each of these scenarios one action plan (basic or complex) needs to be developed, as intervention measures might differ between the scenarios. Also the intervention maps need to be created for each scenario. If only one heavy rainfall scenario is prevalent in your region, or the vast majority of problems is sufficiently depicted in a single scenario, one action plan (basic or complex) as well as one set of intervention maps is adequate.

Following which data is available, which resources you can rely on and the scenario specific reaction time, different complexity of action plans are possible.

In the last step the final emergency response plan should be filled out with all the information collected in previous steps.

Define responsibilities. **Task M3.T1**

The first part of preliminary remarks in the final emergency response plan deals with responsibilities. In addition, for every single measure a responsible person has to be determined. This is important, because during an emergency operation it has to be clear who gives instructions and who bears the legal responsibility.

> *In M1.Q2 and M1.Q3 you already worked out who bears the legal responsibility for emergency measures in your region and who are the relevant players for implementing the emergency measures. In step* M3.T6 *this information should be brought in the emergency plan document (see template emergency plan (Supplement B6). Also define at least the operational head. Use Form B1.1 for documentation.*

Input:	*Legal responsibilities and relevant players in your region (M1.Q2, M1.Q3)*
Output:	*Emergency control ⇨ M3.T3* *Responsibilities in the emergency response plan ⇨ M3.T6*

Develop a simple warning and alarm tool, to assess the expected event intensity. **Task M3.T2**

In order to get an approximation, which measures make sense to be set during heavy rainfall events, a simple tool which helps you to assess the expected event intensity should be developed. The intensity of a heavy rainfall event is not only characterised by the amount of precipitation. Many other parameters must be taken into account as well. For example, a certain amount of precipitation may not always lead to the same run-off situation. During summer, when vegetation cover is high and the soil moisture content is low, a large fraction of precipitation can be stored on ground or in the soil and hence does not immediately contribute to run-off. Whilst in winter when snow is prevalent, additional precipitation in form of rain may enhance the snowmelt and therefore even worsen the run-off situation.

The suggested warning and alarm tool asks for different estimations concerning some of the most critical parameters which affect the run-off situation. It should be applied always, when a heavy rainfall event is predicted. In order to facilitate the estimation process, it might be useful to frequently collect data regarding the soil moisture content (fairly simple with a timeline of past rainfall events or more sophisticated using measurement data).

> *To develop such a tool, use the template table B4.1. Here especially the scale value for low and high rainfall intensity should be set accordingly. This is why you were asked to analyse the critical damage scenarios in your region (H3.T4).*

To estimate the magnitude of the event, after you received a heavy rain forecast, the following questions shall be answered:

1) What is the maximum predicted intensity of the event? (In mm/h)

2) What is the fraction of sealed surfaces in the area of the expected maximum precipitation?

3) In case of cold conditions/snow: What is the predicted temperature? Will there be additional run-off from snowmelt? Will the precipitation fall as snow and hence not contribute immediately to run-off?

4) What is the current vegetation cover, especially on agricultural land and in forests?

5) How would you assess the current soil moisture content? Have there been previous precipitation events?

Using the classification in the following example table, the expected magnitude of the event can thus be estimated. Blue letters show an example for those parts which need to be filled out for every predicted heavy rainfall event.

Parameter	Current value	Scale
Rainfall intensity	*40 mm/h*	low – medium – high
Ground sealing	*medium*	low – medium – high
Temperature (if snow is prevalent)	*no snow (to be dropped)*	low (precipitation in form of snow) – high (snowmelt)
Vegetation	*medium - hardly any (late autumn)*	much – hardly any
Soil saturation	*low - medium*	low – medium – high
Expected event intensity	*medium*	low – medium – high

If forecasts are not available, you can either develop an alternative warning and alarm concept (e.g. based on observers at critical points), or the measures in your action plan should be mainly focused on mid or long term structural changes, observations, information and awareness raising of citizens.

Input:	*Availability and quality of precipitation forecast (H1.Q1)* *Critical damage scenarios, parameter settings (H3.T4)* *Template B4.1*
Output:	*Warning and alarm tool ⇨ M3.T4, M3.T5, M3.D1, M3.T6*

Plan communication channels during an event. — Task M3.T3

During heavy rainfall events, communication has to be direct and clear to ensure that the measures are set in a well-coordinated manner.

Define who informs whom and where all the information is gathered (i.e. the operational head). In step M3.T6 this information should be brought in the emergency plan document (Supplement B6). Use Form B1.1 for documentation.

Input:	*Emergency control (M3.T1)*
Output:	*Communication channels in the emergency response plan ⇨ M3.T6*

Define general measures. Focus particularly on your designated critical points/areas. — **Task M3.T4**

In this step general measures in order to reduce risks caused by heavy rainfall events should be developed. These measures focus mainly on mid or long term structural changes, observation, information and awareness raising of citizens. These measures are also possible to implement in the emergency response plan even if it was not possible to develop a detailed warning and alarm system.

> *Using the example-catalogue of measures (see annex), plan "general measures" to reduce heavy rain risks. The suitability of measures in the example-catalogue of measures is assessed based on reaction time and resources. In step M3.T6 this information should be brought in the emergency plan document (Supplement B6). Use Form B1.1 for documentation.*

Input:	*Working Map: Risk (V3.T1)* *Table: critical risk areas (V3.D2)* *Warning and alarm tool (M3.T2)* *Obtainable action plan complexity (M2.T4)*
Output:	*Action Plan ⇨ M3.D1*

OPTION: Plan additional measures depending on the risk map complexity, available resources and reaction time. Focus particularly on your designated critical points/areas. — **Task M3.T5**

Have you been able to develop a detailed warning and alarm system? Do you have detailed knowledge about the hazard process and the localisation and the characteristics of the endangered objects? Your resource and reaction time situation allows considering detailed measures? If this is the case, you can plan additional measures from the example-catalogue of measures. These measures are process related (e.g. road barriers or evacuation zones) and can refer to the individual expected magnitudes of the event and thus be set according to the result of the event's intensity estimation (warning and alarm tool).

> *Using the example-catalogue of measures (see annex), plan "additional measures" to reduce heavy rain risks. The suitability of measures in the example-catalogue of measures is assessed based on reaction time and resources. In step M3.T6 this information should be brought in the emergency plan document (Supplement B6). Use Form B1.1 for documentation.*

Input:	*Working Map: Risk (V3.D1)* *Table: critical risk areas (V3.D2)* *Warning and alarm tool (M3.T2)* *Obtainable action plan complexity (M2.T4)*
Output:	*Action Plan ⇨ M3.D1*

Action Plan — **Document M3.D1**

The output of Task M3.T4 or M3.T5 is the "Action Plan" (Supplement B6, Chapter Action Plan). One action plan consists of general measures and optionally additional measures. The measures are described in detailed tables and locally shown on intervention maps (Supplement B7). Hence, it is also necessary to create maps where your intervention measures are located. This can either be done by hand on a base map or by using GIS software. For the layout of the map, refer to Supplement B7.

In the action plan you can (if possible) note the expected event's magnitude for which the individual measures are to be set. This allows you to carry out a detailed selection of measures in individual cases based on precipitation forecasts and the expected event intensity (result of the warning and alarm tool).

If more than one heavy rain scenario is expected in your area that is fundamentally different from the others (e.g. flash floods and long-lasting continuous rain), further, separate action plans and emergency maps are required.

Fill out the final Emergency Response Plan **Task M3.T6**

The action plan(s) together with preliminary remarks (i.e. legal responsibility, description of the area, the potential scenarios, the hazard and vulnerable object), with your existing hazard and risk maps and the intervention maps forms your final emergency response plan (ERP). In the supplements (B6 and B7) you can see examples of how the different parts may look like.

The final emergency plan should consist at least of:

- Preliminary remarks (also possible with references to existing plans)
  - Purpose of the emergency response plan
  - Legal responsibility (M3.T1)
  - Geographical scope of the emergency response plan
  - Structure of the action plan
  - Communication channels (M3.T3)
  - Warning and alarm concept (M3.T2)
  - Description of the hazard situation, potential scenarios and vulnerable objects (H3.D1, H3.D2, V3.D1, V3.D2)
- The action plan itself (M3.D1)
- Maps showing the emergency measures (Intervention Maps, B7)
- Hazard maps
- Risk maps

All the information collected in previous steps (M2.T1, M2.T2, M2.T3) shall now be transferred to the final emergency response plan (Supplement B6).

5. Stakeholder (M4)

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.

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
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 planning of measures (Form B2.3) 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.

Meeting Key Stakeholders: Resources (optional) **Stakeholder M4.S1**

As resources are a highly interesting topic to implement certain measures and the knowledge concerning the quantity and the localisation of available resources might be spread through different organisations in your region, a meeting with key stakeholders can optionally be held.

Host a meeting with the key players for setting up emergency measures (e.g. emergency organisations, operators of critical infrastructure, local crisis units). Work through what they are capable to do in an emergency operation during a heavy rainfall event. A meeting protocol can be found in B2.5.

Stakeholder Workshop: Measures **Stakeholder M4.S2**

In order to properly develop an action plan which is coordinated between all the responsible persons, local knowledge is indispensable. All of the stakeholders were already included in the Stakeholder Workshop: Hazard or in the Stakeholder Workshop: Vulnerability.

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 going to be 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)
  - The legal and operational responsibilities
  - The planned warning and alarm system
  - The planned measures

- Discuss & Participate

  After the informational part, the stakeholders are invited to:

  - Critically review the warning and alarm system
  - Critically review the planned measures
  - Make suggestions how the intervention measures shall be implemented
  - Name people 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 B2.3 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 detailed measure planning 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 B2.3 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.

Present the finalised action plan/emergency response plan to citizens **Stakeholder M4.S3**

After the emergency response plan is finalised, it should be presented to the public. This can be done with an informative event, where the whole local public is invited. The structure of this event can be similar to the information part in the stakeholder workshops.

The following bullet points can give guidance about what could be presented:

- The purpose and the aim of creating an emergency response plan
- A selection of relevant scenarios (start with scenarios showing a lower level of hazard, as extreme scenarios might seem unrealistic to the broad public)
- A selection of areas where significant damage may occur
- The measures you developed in order to reduce the risks for the areas shown before

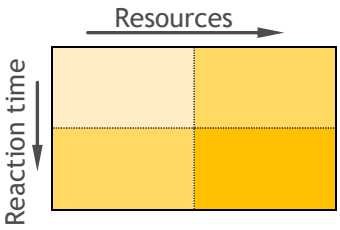
Certain scenarios can also be shown in nature to a selected group of affected citizens.

Host an informative event where your finalised action plan / emergency response plan is presented to the interested public. Use Form B2.3 as checklist for the preparation.

Annex

Example measures

In the following chapter a catalogue of example measures will be presented. Further, the purpose of all the measures is generally described. Each measure will be assessed according to its **suitability** for certain resources and reaction time conditions. Therefore the following matrix is applied. Each field in the matrix represents a certain combination of required resources and the scenario specific reaction time. Resources and reaction time are increasing from left to right and from top to bottom, meaning the lower right field indicates a high resource demand and a long reaction time.



The suitability of each measure for all the resources/reaction time combinations is then assessed using the following signs.

◦◦◦◦	Very suitable
◦◦◦	Suitable
◦◦	Little suitable
◦	Poorly suitable

In addition, next to the **general** and the **additional measures** a triggering state is given. This provides a recommendation when certain measures should be applied following the expected event intensity of your warning and alarm tool, developed in M3.T2. For example, measure *"G1"* should be applied every time you receive any kind of heavy rain warning, irrelevant of the expected event intensity. The other **general measures** are mainly to be triggered if at least a medium intensity event is expected (indicated by the brown colour). The **additional measures** may only to be triggered if a rather extreme event is predicted (indicated by the red colour). Detailed triggering states may vary depending on local conditions. Hence, a further check depending on your region's characteristics is necessary.

> Example:
>
> You want to implement the measure *"G2 Establish the operation control"* in your action plan. First, consider the reaction time of your rainfall scenarios on which this measure shall work on. If the scenario specific reaction time is long, this measure is suitable or very suitable, if the scenario specific reaction time is rather short, this measure is little or poorly suitable. In combination with your available resources to implement this measure, you will get a hint on the overall suitability of it. If your resource availability is high and the scenario specific reaction time is long, the measure *"G2 Establish the operation control"* is very suitable for your action plan. The triggering state states that this measure should be executed if at least a medium intensity event is expected.

Note:

Keep in mind that these measure assessments only provide a basic estimation which measures are suitable in which cases and when to trigger them.

No.	Category	Measure	Triggering state	Suitability
PREVENTIONAL MEASURES (P)				
P1		Consider areas where changes in building structure may improve/worsen the run-off situation		○○○○ ○○○○ ○○○○ ○○○○
P2		Information and awareness raising events for affected citizens		○○○○ ○○○○ ○○○○ ○○○○
P3		Support for self-provisioning of affected citizens		○○○○ ○○○○ ○○○○ ○○○○
P4		Training for the citizen observatory concept		○○○ ○○○○ ○○○ ○○○○
P5		Regularly check your resources and your material necessary for your measures		○○ ○○○○ ○○○ ○○○○
GENERAL MEASURES (G)				**PLAN 1**
G1		Receive and assess the heavy rain forecast/warning		○○○○ ○○○○ ○○○○ ○○○○
G2		Establish the operation control		○ ○○ ○○○ ○○○○
G3		Inform relevant persons in charge		○○ ○○○ ○○○ ○○○○
G4		Inform affected citizens		○○○ ○○○ ○○○○ ○○○○
G5		Hazard Observation / Citizen observatory		○○○ ○○○ ○○○○ ○○○○
G6		Check the available/needed resources for an emergency intervention		○○ ○○○ ○○○○ ○○○○
ADDITIONAL MEASURES (A)				**PLAN 2**
A1		Set up road/pathway barriers		○ ○○ ○○○ ○○○○

No.	Category	Measure	Triggering state	Suitability	
A2		Evacuate the endangered area		○	○
				○○○	○○○
A3		Traffic management		○	○
				○○○	○○○○
A4		Protect endangered objects		○○	○○○
				○○○	○○○○
A5		Remove hazardous/vulnerable goods		○○	○○○
				○○○	○○○○
A6		Remove hazardous situations		○○	○○○
				○○○	○○○○

Legend:

 Preparation / Mitigation

 Organisation

 Observation

 Information

 Closure

 Evacuation

 Protect objects

 Remove goods

 Remove hazard

P1	PREVENTIONAL MEASURES	

CONSIDER AREAS WHERE CHANGES IN BUILDING STRUCTURE MAY IMPROVE/WORSEN THE RUN-OFF SITUATION

Responsible for the measure (recommendation): *Local authorities*

Structural changes can improve or worsen the run-off situation. Hence it is useful that areas where the run-off situation can be positively or negatively affected are kept in mind for all future planning processes. A map or database of these areas might be useful.

P2	PREVENTIONAL MEASURES	

INFORMATION AND AWARENESS RAISING EVENTS FOR AFFECTED CITIZENS

Responsible for the measure (recommendation): *Local authorities*

As heavy rainfall events tend to be events with only a short warning time, it is highly important that affected citizens are aware of how their property is endangered. This measure can include regular informational events, where modelled hazard scenarios are presented.

P3	PREVENTIONAL MEASURES	

SUPPORT FOR SELF-PROVISIONING OF AFFECTED CITIZENS

Responsible for the measure (recommendation): *Local authorities*

Like Example Measure P2, this measure shall prepare the affected citizens for to heavy rainfall events. Here you could plan measures, where affected citizens are directly informed by experts about what they can do in detail to minimize risks for their property.

P4	PREVENTIONAL MEASURES	

TRAINING FOR THE CITIZEN OBSERVATORY CONCEPT

Responsible for the measure (recommendation): *Local authorities*

Following a definition by the European Commission, citizen observatory describes a community-based environmental monitoring, data collection, interpretation and information delivery system, generally based on mobile devices (smartphones, tablets, etc.). Communities should be empowered with the capability to monitor and report on their environment and enabled to access the information they need to make decisions in an understandable and readily usable form.

To implement a citizen observatory system in your region, any form of web-based application needs to be provided. In order to guarantee that the information you obtain by citizens is reliable, training for a specific peer group should be planned.

P5	PREVENTIONAL MEASURES	

REGULARLY CHECK YOUR RESOURCES AND YOUR MATERIAL NECESSARY FOR YOUR MEASURES

Responsible for the measure (recommendation): *Local authorities or emergency organisations or crisis units*

All the resources needed for emergency interventions need to be checked on a regular basis. They need to be checked not only for availability but also for functionality. The resources to be checked can be mobile flood protection barriers, pumps, road or pathway barriers, etc.

Here you can list what needs to be checked, by whom, when, and where to document it. An additional overview map of all the locations where material is stored, as well as detailed photographs of the exact position might be useful.

A	*Describe here which material needs to be checked (Location A).*
B	*Describe here which material needs to be checked (Location B).*

G1	GENERAL MEASURES	
	RECEIVE AND ASSESS THE HEAVY RAIN FORECAST/WARNING	
Responsible for the measure (recommendation): *Local authorities or emergency organisations or crisis units*		
Depending on the developed warning and alarm system and the available forecast data, any information about an upcoming heavy rainfall event will be delivered. This will trigger the detailed action plan and has thus to be documented.		

G2	GENERAL MEASURES	
	ESTABLISH THE OPERATION CONTROL	
Responsible for the measure (recommendation): *Local authorities or emergency organisations or crisis units*		
When a heavy rainfall event, reaching a certain triggering state, is forecasted, an operation control should be built-up. *The head of the operation control gives instructions about when and where the measures need to be set. He or she needs to be informed about every step. Consider the legal responsibilities when the operational head is established.*		
A	*Name the operational head (e.g. mayor).*	
B	*List further persons who should be members of the operation control.*	

G3	GENERAL MEASURES	
	INFORM RELEVANT PERSONS IN CHARGE	
Responsible for the measure (recommendation): *Local authorities or emergency organisations or crisis units*		
After a heavy rain warning was received, persons who are relevant for further actions need to be immediately informed. All the communications must be documented accordingly.		
A	*Describe here who needs to be informed (Person A).*	
B	*Describe here who needs to be informed (Person B).*	

G4	GENERAL MEASURES	

INFORM AFFECTED CITIZENS

Responsible for the measure (recommendation): *Local authorities or emergency organisations or crisis units*

After a heavy rain warning was received, affected citizens need to be informed. It is important to point out an impending flood and the resulting preparatory measures.

- *Information on the size of the expected scenario (based on the meteorological forecasts)*
- *Information about imminent restrictions (road or pathway barriers, etc.)*
- *More information as needed*

All communication has to be documented accordingly.

G5	GENERAL MEASURES	

HAZARD OBSERVATION / CITIZEN OBSERVATORY

Responsible for the measure (recommendation): *Local authorities or emergency organisations or crisis units*

Hazard observations are not only important for the ongoing emergency interventions but also to properly document the event. This can deliver important data for adapting your emergency response plan. Observation can be carried out by inspectional trips to the observation points developed in H3.T2.

Further, the citizen observatory concept can be used here. If you provided any kind of web based application and trained a specific peer-group accordingly, this can deliver useful information for future adaption of measures.

In the following list you can describe the observation points. Also provide an overview map where to find them. All inspections and observation need to be documented accordingly. Form B1.1 can be used here.

A	*Describe the relevant observation points here (Point A).*
B	*Describe the relevant observation points here (Point B).*

G6	GENERAL MEASURES	

CHECK THE AVAILABLE/NEEDED RESOURCES FOR AN EMERGENCY INTERVENTION

Responsible for the measure (recommendation): *Local authorities or emergency organisations or crisis units*

If additional measures with high resource requirements have been planned, it might be useful to quickly check if all the resources are available. Anyway, if you followed the preparative measures, this should have been done prior to a heavy rainfall event.

A1	ADDITIONAL MEASURES	

SET UP ROAD/PATHWAY BARRIERS

Responsible for the measure (recommendation): *Local authorities or emergency organisations or crisis units*

It may be useful to install barriers on specific streets or pathways, in order to avoid people entering the endangered area.

List the points were barriers are to be set up and by whom. Additionally provide a map where the road/pathway barriers are located.

A	*Describe the road /pathway barriers (Location A)*
B	*Describe the road /pathway barriers (Location B)*

A2	ADDITIONAL MEASURES	

EVACUATE THE ENDANGERED AREA

Responsible for the measure (recommendation): *Local authorities or emergency organisations or crisis units*

If inundation lasts longer than just a few hours or affects objects with highly vulnerable persons, evacuation may be useful.

List the evacuation zones by priority. Additionally provide an estimated number of persons to be evacuated. Evacuation zones should be additionally shown in the intervention map.

A	*Evacuation zone A (No. of persons (mobile/immobile))*
B	*Evacuation zone B (No. of persons(mobile/immobile))*

A3	ADDITIONAL MEASURES	

TRAFFIC MANAGEMENT

Responsible for the measure (recommendation): *Local authorities or emergency organisations or crisis units*

During flash flood events, significant amounts of water can run-off above roads. Although they may still seem safe to pass, dangerous situations might develop rapidly. Hence, traffic management measures in order to regulate the traffic on certain roads might be useful.

List here the locations where traffic management is useful. Additionally provide an overview map.

A	*Location for traffic management A*
B	*Location for traffic management B*

A4	ADDITIONAL MEASURES	

PROTECT ENDANGERED OBJECTS

Responsible for the measure (recommendation): *Local authorities or emergency organisations or crisis units*

For certain objects, specific object related protection measures shall be built up. Describe in this measures where, when and by whom these measures are set.

List all locations where object related protection measures shall be built up. Prioritise them if your resources are limited. Additionally provide an overview map of the locations.

A	*Object related protection measure A*
B	*Object related protection measure B*

A5	ADDITIONAL MEASURES	

REMOVE HAZARDOUS/VULNERABLE GOODS

Responsible for the measure (recommendation): *Local authorities or emergency organisations or crisis units*

In some objects, hazardous or highly vulnerable goods may be stored. This measure is to plan the removal of such goods.

List all locations where hazardous or vulnerable goods shall be removed. Prioritise them if your resources are limited. Additionally provide an overview map of the locations.

A	*Describe location of hazardous/vulnerable good A*
B	*Describe location of hazardous/vulnerable good B*

A6	ADDITIONAL MEASURES	

REMOVE HAZARDOUS SITUATIONS

Responsible for the measure (recommendation): *Local authorities or emergency organisations or crisis units*

In some areas critical hazardous situations (like log jams) may develop during a heavy rainfall event. In order to avoid the occurrence of backwater above log jams, this measure can be planned. This shall only be carried out using appropriate devices and only if safety for the operator is guaranteed.

List here where critical log jams may occur. Inspect those points frequently during an emergency operation. Additionally provide an overview map.

A	*Critical log jam A*
B	*Critical log jam B*

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