

Collection of the available flood risk management plan for the IT test site

Final Version

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1- Introduction

This deliverable aims at presenting the available knowledge regarding the Flood Risk Management Plan for the Italian site, namely the municipality of Ferrara. The documentation is gathered from the authorities in charge for the definition of actions and strategies in case of flood, such as the Civil Protection service or the Region Emilia-Romagna. The structure of the plan is illustrated in the following of this report, as well as the main criteria for deciding the prior actions to take in case of emergency. Briefly, the Flood Risk Management Plan is the set of measures and actions that authorities and population must undertake in case of flood occurrence. It is composed by several steps, starting from prevention measures arriving to post-flood analysis and reconstruction activities.

The Plan is of most importance for Italy, right because it handles with flood-related emergencies. In fact, Italy is a flood-prone country, due to its large and complex watercourses networks and the hydrogeological instability that affects large areas within the country. Some areas are even more instable than others. For example, Ferrara territory, due to its altimetry and natural characteristics, is a critical area for what concerns flood risk. The reader is advised to refer to Deliverable 3.1.1 Part 1, Section 2 for a revision of Ferrara territory characteristics. Consequently, the reader is advice to refer to Deliverable 3.1.1 Part 1, Section 4 and Deliverable 3.1.1 Part 2, Section 2 for a revision of flood hazard and flood risk, respectively. The review of these notions is advisable prior the evaluation of the Flood Risk Management Plan. Indeed, this Plan is developed right considering the results of flood risk assessment, such as flood risk maps, indexes of exposure etc. In fact, flood risk assessment permits to identify the most critical and vulnerable areas of the territory, where damages are greater, caused, on one hand, by a high flood probability and, on the other hand, by valuable and vulnerable exposed elements.

Flood Risk Management Plan (FRMP) follows the European decree EU Floods Directive 2007/60/EC ^[1], which concerns the definition of flood hazard and flood risk, as well as it identifies the criteria to follow for the redaction of the Plan and the main purposes that must be pursued. Moreover, FRMP follows the Italian execution of the EU Floods Directive, namely the decree D. Lgs. 149/2010 ^[2], which regards the flood events, following European directives and postulating details and method that are specific for the Italian case.

For the sake of precision, it is reported in the following the definitions of flood, flood hazard and flood risk, accordingly to the EU Floods Directive 2007/60/EC:

Flood is a temporary inundation, involving transport namely mobilisation of high-density sediments, of typically dry areas. It includes inundations caused by lakes, rivers, creeks, eventually artificial drainage networks, every other superficial watercourse also in a temporary regime, natural or artificial, and flooding of low-lying coastal regions due to sea level rise. It excludes flooding not directly caused by meteorological events.

Flood hazard is the probability of occurrence of a flood event in a determined time interval and in a determined area.

Flood risk is the combination of the probability of occurrence of a flood event and the potential negative consequences – in terms of health, territory, assets, environment, cultural heritage and economic and social activities – derived from the event.

2- Flood Risk Management Plan

Directive 2007/60/EC aims at the creation of a communitarian and homogeneous framework for the management of flood hazards, developed on a European scale. The main goal of the EU Floods Directive is reducing negative consequences raised from floods, especially for the safety of human life, cultural heritage, economic activities and infrastructures. Briefly, the Directive aims at the identification and the priority protection of all valuable elements in the territory. Therefore, flood risk maps are outputs of the EU Floods Directive 2007/60/EC that lead to the elaboration of management plans. Specifically, Article 1 quotes:

The purpose of this Directive is to establish a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activities associated with floods in the Community.

According to the EU Floods Directive 2007/60/EC Article 7, Italy developed its Flood Risk Management Plan (the Italian *'Piano di Gestione Rischio Alluvioni PGRA'*, D.Lgs. n. 49, 23/02/2010) ^[1,2], related to the assessment of flood risk maps.

Specifically, Article 7 quotes:

- On the basis of the maps related to Article 6, Member States shall establish flood risk management plans coordinated at the level of river basin district, or unit of management referred to in Article 3 [...].
- Member States shall establish appropriate objectives for the management of floods risks for the areas identified by Article 5 [...], focusing on the reduction of potential adverse consequences of flooding for human health, the environment, cultural heritage and economic activity, and, if considered appropriate, on non-structural initiatives and/or the reduction of likelihood of flooding.
- Flood risk management plans shall include measures for achieving the objectives established in accordance with paragraph 2 [...]. Flood risk management plans shall take into account relevant aspects such as costs and benefits, flood extent and flood conveyance routes and areas which have the potential to retain flood water, such as natural floodplains, the environmental objectives of Article 4 of Directive 2000/60/EC, soil and water management, special planning, land use, nature conservation, navigation and port infrastructure.
Flood risk management plans shall address aspects of flood risk management focusing on prevention, protection, preparedness, including flood forecasts and early warning systems and taking into account the characteristics of the particular river basin or

sub-basin. Flood risk management plans may also include the promotion of sustainable land use practices, improvement of water retention as well as the controlled flooding of certain in the case of flood event.

In the interest of solidarity, flood risk management plans established in one Member State shall not include measures which, by their extent and impact, significantly increase flood risk upstream or downstream or other countries in the same river basin or sub-basin, unless these measures have been coordinated and an agreed solution has been found among the Member States concerned in the framework of Article 8.

Member States shall ensure the flood risk management plans are completed and published by 22 December 2015.

Article 7 refers to flood risks maps, that are treated in Deliverable 3.1.1 Part 2. Moreover, it identifies the areas where the plan must be applied: river basin districts, unit of management, portion of an international river basin district lying within the territory and those areas for which the potential significant flood risks exist or might be considered likely to occur.

Moreover, according to Article 7, Flood Risk Management is shared among the State, Regions, Municipalities and citizens. The collective action is demanded to the State and Local

authorities, whereas every person must know the risk to which is exposed and how to face it responsibly.

Concluding, according to the Directive, the FRMP is a strategic plan that aims at providing for consultation, with the administrators, stakeholders and citizens in general, of the priority objectives and intervention measures to be implemented in a time-horizon cyclical six-year period based on dedicated programming. It is also expected verification of the implementation status of interventions in terms of efficiency and effectiveness, on the basis of which the Plan is updated progressively depending also on the degree of achievement of objectives and the occurrence of any new contingency.

2.1. Risk management cycle

As mentioned in Article 7(3) of the European Floods Directive 2007/60/EC, the risk management must consider different steps, such as prevention, protection and preparedness. These steps, together with others which face the in and post event actions, compose the risk management cycle ^[3]. All the phases of the flood risk management are illustrated in Figure 1 and they are explained in the following of this section.

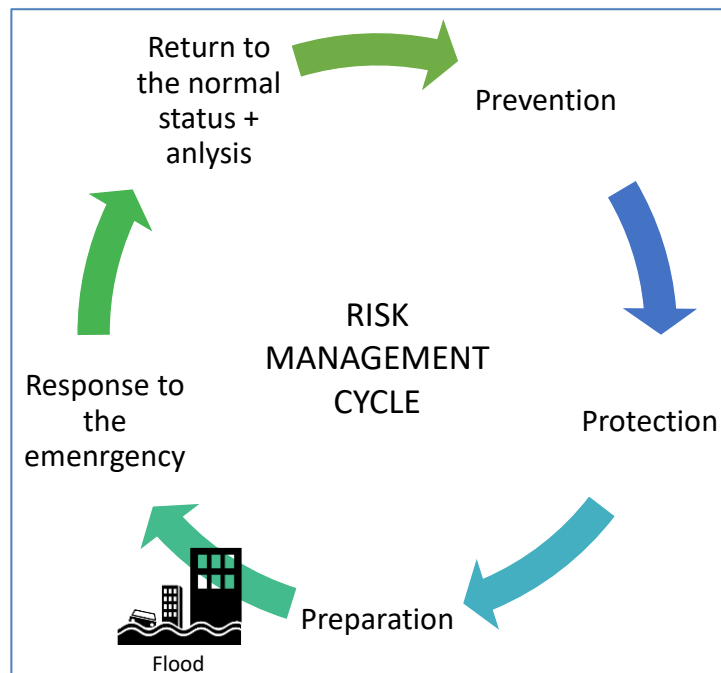


Figure 1. Risk management cycle ^[3].

Risk management cycle can be described within the following five steps.

- *Prevention.* Specific actions proposed by the government, such as proper urbanistic plans, adjustment measures (such as hydraulic invariance, subsidence reduction etc.), the creation of flatlands in the proximity of rivers and watercourses, delocalisation of strategic buildings, monitoring campaigns.
- *Protection.* Reconsideration of the already existing hydraulic infrastructures, such as weirs, walls etc. and project of new ones, such as detention basins. Fluvial re-

sectioning and managing and fluvial requalification interventions. Coastal protections.

- *Preparation.* Alerting and prevision methods. Protocols for protection measures management. Alarm systems. Civil Protection risk management plans. Raising awareness in population.
- *Response to the emergency and return to the normal status.* Backup to the normal status and the before-flood condition. In case of necessity, medical and psychological support are given to people in need. A detailed analysis of the occurred flood event is suggested in order to increase knowledge and competencies and improve the efficiency of following actions (*Prevention-Protection-Preparation*) for future floods.

Prevention

Within the *Prevention* phase of the Flood Risk Management Plan, the specific goals are:

- Limiting the flood hazard applying adequate territorial regulations.
- Modifying and integrating PAI plans ('Piano stralcio per l'Assetto Idrogeologico', that is a document aiming at the regulation and the legislation of the hydraulic risk in the Emilia-Romagna Region territory) for floodable areas not analysed yet and, therefore, individuation and actuation of measures depending on the different territorial realities.
- Modifying and integrating PAI plans in order to improve regulations linking hydrological basin plans and Civil Protection plans.

- The reduction of the flood hazard for residential sites already existing. For example, *Prevention* phase promotes both active and passive protection measurements (such as barriers, moving all private possession in higher floors of the house, imposition of the construction prohibition, as well as prohibition of using basements).
- Mitigation of the expected damage caused by residual risk in the flatland area. This consists in the study of the riversides' strength and the related failure risk, understanding the best interventions for reducing it. Furthermore, this aspect involves also a better understanding of how and when water overflows from riverbed. Therefore, these studies lead to an improved analysis of floodable areas, making possible the improvement of emergencies measures and a better identification of preventive solution for risk reduction.

Protection

The *Protection* phase of the Flood risk management provides for different hydraulic solutions in order to re-establish the normal arrangement of watercourses. For example, it considers interventions such as the widening of riverbank areas, flood plains remodelling, the removal, reduction or softening of weirs or other objects that are source of alteration for the natural hydraulic dynamic in the watercourse. Furthermore, the rebalancing of sediments in the watercourse and the reconstitution of vegetal life into the river or canal are feasible solutions aiming at flood hazard reduction.

Preparation

The *Preparation* phase can be divided into several actions:

- Provision and installations of alerting systems related to the previous prevision of flood;
- Planning of actions to face the emergency with an institutional regulation;
- Preventive information campaign for the public concerning flood risk.

2.2. The operational guidelines of the Civil Protection Department

The operation guidelines of the Civil Protection Department (namely Flood Risk Management Plan Part B) contains all measures already adopted or to be adopted for the management in “real-time” of the event, proper of Civil Protection services. The contents of the Plan’s Part B are the following:

Forecasting, monitoring, surveillance and alerting implemented through the network of functional centres.

The Region has defined a communication system for different alert levels that starts from the Civil Protection Agency and reaches the Prefectures, Provinces, institutions and structures of the regional civil protection system and the Municipalities, with the identification of the actions that must be carried out following the activation of the various operational phases.

The activation of the civil protection alert phases requires an in-depth analysis of the territory, the use of specialized tools for forecasting and monitoring, as well as specific skills that daily analyse and assess the risk situation.

The alert procedures provide for the activation of three operational phases (attention, early warning, alarm). Each phase corresponds to increasingly narrower territorial areas, more precise information, increasingly incisive safeguard and coordination actions and the progressive direct involvement of citizens at risk.

Hydraulic territorial protection established through adequate regional and provincial structures and subjects.

The activities of hydraulic protection consist in pre-emptive hydraulic monitoring, specific hydraulic control on the territory aimed at supervision, monitoring and verification of the evolution of the ongoing processes. The subjects responsible for the operation of the hydraulic systems and their organization are the Technical Basin Authorities, the Land Reclamation Consortia and the specific Italian authorities called AIPO (Interregional Agency Po River).

Regulation of outflows also implemented through retention plans.

The management plans must contain a list of the large dams present in the basin, the command and control structures and a summary of the studies on the influence of reservoirs and retention plans for the reduction of hydraulic risk.

Support for the activation of urgent emergency plans prepared by the civil protection bodies.

These actions are pursuant to article 67, paragraph 5, of the legislative decree n. 152 of 2006 and the previous legislation.

Correlation between water levels, criticality levels and activated alert phases are established within this content. The objectives are the following: (a) provide Local Authorities with a homogeneous reference framework for the development of Emergency Plans in their territorial area, favouring integration and collaboration with the Territorial Government Offices and the State Bodies on the territory; (b) promote coordinated emergency management, ensuring more effective and timely interventions in the event of floods and other hazards, such as earthquakes, hydro-geological events, forest fires or chemical-industrial risks.

Synthesis of contents of urgent emergency plans prepared by the civil protection bodies.

This issue consists in the identification of the measures envisaged in the planning to achieve the general and specific objectives of emergency management. It is developed by few steps. The first one consists in drafting Provincial Prevention and Prevision Plans, which leads to the elaboration of risks scenarios that show the evolution in time and space of the event and of its consequences on exposed elements. Then it is drafted an Intervention Model at different levels, i.e. regional, provincial and municipal. This model is immediately followed by an alert system. The emergency plan will be effective only if the expected event scenarios are defined as appropriately as possible using all the available knowledge and the related

intervention model, in particular through the immediate and coordinated activation of all the necessary resources available on the territory, in a logic of guaranteeing effectiveness throughout the regional territory of public services that relate to the protection of fundamental human rights.

2.3. FRMP – Objectives and measures

The objectives of the Emilia-Romagna Region referable to the Civil Protection area are focused on the use, implementation and improvement of non-structural measures already adopted by the regional civil protection system, focusing above all on the following:

- Forecasting and real-time management of floods by improving the alert system.
- Emergency planning and related verification activities also for the preparation for unexpected events.
- Strengthening of the hydraulic territorial presence with the involvement of municipalities and civil protection volunteering.
- Training of civil protection operators.
- Information to the population on the risk, on prevention and self-protection actions to be adopted and on emergency plans.

As far as concerns the Po River District, the FRMP aims at the following objectives:

- *Improve the knowledge of risk.*

Promote the development of technical and scientific knowledge appropriate to the management of floods and promote the dissemination of basin training for decision makers and citizens adequate to allow the implementation of good defense practices.

- *Improve the performance of existing defensive system.*

Ensure the monitoring, maintenance, integration and adaptation of the existing systems for active and passive defense against floods.

- *Reduce risk exposure.*

Control exposed elements and goods in floodable areas, even for rare scenarios, and promote the reduction of economic vulnerability of the territory and single goods.

- *Assure wider spaces to rivers.*

Envisage where possible the maintenance and/or the reinstatement of floodplains, which are important areas for floods expansion and in the meanwhile for the protection and conservation of ecosystems, accordingly to the EU Floods Directive 2007/60/EC and the Plan for the Po River District.

- *Defense of cities and metropolitan centers.*

Promote sustainable practices for a better land use. Improve the retention capacity of the land and the control expansion of floods in case of extreme event.

2.3. Measures to undertake in case of emergency

The Civil Protection of Emilia-Romagna Region ^[4] designated some recommended behaviours in order to face emergencies in the best way, i.e. self-defence actions in case of adverse climatic conditions. The first recommended action is to check the daily weather forecast, hence paying attention to the alert messages of the Civil Protection, continuously updated in the website of the 'Agenzia Regionale di Protezione Civile' and shared also by media. Other deeply suggested activities that a citizen must undertake during and after a flood event are listed below.

- Drive prudently following signs and indications given by the authority.
- Do not stop along riverbanks and do not start activities in the proximity of the same.
- If the flood threat is dangerous and the specialist authorities advise to leave the house: wear waterproof clothes and shoes, remember life-saving medicines and documents, switch off the gas and electric systems.
- At the end of the emergency, in case of proper flooding, remember that drive in flooded areas can be dangerous.
- Once back in the house, verify the functionality of systems with a specialist.

Figure 2 represents flood hazard for Emilia-Romagna Region. In particular, the image on the left shows an overall flood hazard frame for the entire region, whereas the image on the right shows the detail for the coastal region within Ferrara territory. According to this figure, the coastal area is characterised by a P1 and P3 level of probability of flood event (see Deliverable 3.1.1 Part 1 for the definition of classes of flood hazard). This hazard is mainly

related to the force of storm surges, which may produce the propagation of waves toward the inner land, breaking land protection infrastructures, such as sand dunes which are very common in this territory. In fact, the Po River Basin Authority identified the coastal area of the territory of Ferrara as a critical site regarding flood hazard and risk ^[6].

Given the observed hazard for the coastal area of Ferrara municipality, the Italian Flood Risk Management Plan drafted a protocol to follow in order to avoid, or at least diminish, bad consequences and risks ^[5].

- It is not allowed to build new urban centres in P3 area;
- Delocalisation of strategic infrastructure from P3 area;
- Promotion of strategic actions that provide for the backing of seaside resorts from the coastline;
- Maintain adequate free beach areas;
- Conservation, maintenance and recovery of sand dunes systems;
- Actions of passive protection for buildings in P1-P2 areas and strategic adjustment actions for buildings in the P3 area;
- Update of knowledge.

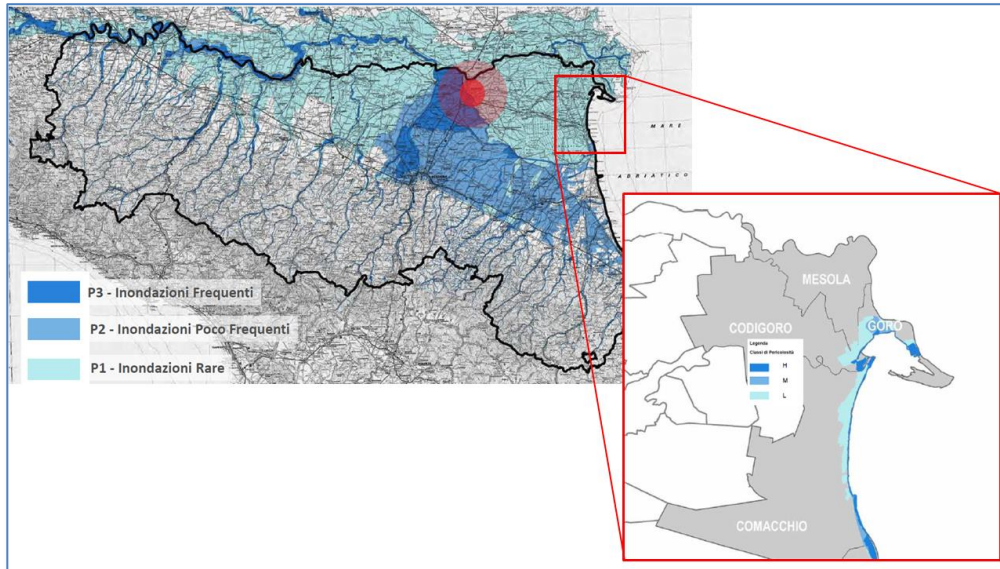


Figure 2. Flood hazard in Emilia Romagna (2015) ^[5] (left), zoom in coastal flood hazard (right).

Data source

[1] DIRECTIVE 2007/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2007 on the assessment and management of flood risks, Official Journal of the European Union

[2] DECRETO LEGISLATIVO 23 febbraio 2010, n. 49, Attuazione della direttiva 2007/60/EC relativa alla valutazione e alla gestione dei rischi di alluvioni.

[3] La Direttiva Alluvioni 2007/60/EC e le attività in corso nel territorio della Regione Emilia-Romagna, Regione Emilia-Romagna, PGRA
<http://ambiente.regione.emilia-romagna.it/it/suolo-bacino/sezioni/piano-di-gestione-del-rischio-alluvioni/brochure-info-da-ed2>

[4] Website Regione Emilia-Romagna – Agenzia per la sicurezza territoriale e la protezione civile
<https://protezionecivile.regione.emilia-romagna.it/>

[5] M. Guida, M. Mainetti – “Piano di Gestione del Rischio Alluvioni” – Convegno Nazionale Acqua di qualità e sicurezza idraulica – Bologna, 20 marzo 2015

[6] Piano di Gestione del Rischio Alluvioni – Piano per la valutazione e la gestione del rischio di alluvioni, Art. 7 della Direttiva 2007/60/EC e del D.lgs. n. 49 del 23.02.2010 – IV A. Aree a rischio significativo di alluvioni, ARS Distrettuali – 2. Schede monografiche, Ambito costiero marino (Emilia-Romagna)