

Initial results of the implementation of Directive 2007/60 on the assessment and management of flood risks: Flood Risk Management Plans

The introduction of European Directive 2007/60 on the assessment and management of flood risk into Spanish law in 2010 is already producing results. Given the geographical and climatological characteristics of Spain, however, the starting point in terms of risk awareness, infrastructure, institutions and procedures for addressing the risk of flooding was already notable. The implementation of this policy is taking place in phases: identifying the competent institutions and authorities; assessing the risk of flooding and identifying areas where this risk is potentially significant; flood hazard mapping and developing plans for flood risk management. These plans encompass a number of measures that involve land management and urban planning, civil protection, insurance, early warning and improving the condition of rivers and coastal areas. This process, which is still ongoing, is already being reflected in a better understanding and general awareness of flood risk.

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1. Introduction

Flooding is probably one of the natural disasters that causes the most damage on our planet year after year and this is reflected in the reports published by different international organizations. Particularly noteworthy is the work done by the United Nations Office for Disaster Risk Reduction (UNISDR). The recent Sendai Declaration, following the United Nations Conference held in Sendai (Japan) from 14 to 18 March 2015, lays the groundwork for disaster risk reduction for the period 2015 -2030.

Within the European context, the European Commission, in response to the severe flooding that occurs year after year, published in 2004 the Communique from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions on the management of flood risk, which ultimately led to the European Parliament to enact Directive 2007/60 / EC on the assessment and management of flood risk on 23 October 2007. This Directive was transposed into Spanish law in Royal Decree 903/2010 of 9 July on the Assessment and Management of Flood Risk.



In our country, due to the climatic variability that exists and the fact that the entire country suffers from serious flooding from time to time, flood risk management is something that has been around for a long time. Flooding is common in the Cantabrian Mountains and Galicia and can be exacerbated by the effects of maritime storms. In the central part of the peninsula, frequent and significant episodes of flooding affect the Duero, Tajo, Guadiana and Guadalquivir river basins and this is also true for the entire Mediterranean coastline, including the severe flooding seen in recent years in the Ebro River basin and the Balearic Islands. The same is true for the Canary Islands, where episodes of very intense rains cause major damage, especially in

Tenerife and Gran Canaria. Finally, neither Ceuta nor Melilla are strangers to these types of phenomena, where a significant percentage of the land area is currently flood-prone.

Because of the significant damage caused by floods in Spain, we keep a systematic inventory of past floods known as the National Catalogue of Historic Floods which is coordinated by the Directorate General of Civil Defence and Emergencies. Thanks to this record-keeping, Spain is the European country with the biggest number of historical flood data on record. For example, in Spain the area with the greatest number of historic floods is the Guadalentín River in the Segura River basin, where more than 187 floods have been recorded in the past according to information dating back from the present day to the 12th century.

As a result of the severe damages caused by flooding, in the nineteenth and twentieth centuries, major flood defence plans were developed and these have been very beneficial to society. Notable among these plans are the ones devised for the Segura River basin or the diversion of the Turia River in Valencia following the floods of 1957, as well as countless structural works in most of our country's cities and towns. Also worthy of note is the fact that the idea for the institution that is now known as the Consorcio de Compensación de Seguros first came about in the mid-twentieth century.

As society has evolved and has acquired more knowledge and especially with the technologies available, new measures have gradually been implemented to reduce the damages caused by flooding such as the creation of the Automatic Hydrological Information Systems (1984, Júcar) or the Basic Guidelines for Civil Protection against Flood Risk (1994). These criteria have gradually been incorporated into urban planning, as can be seen from the results of the Special Commission on Disaster Prevention and Assistance created in the Senate in 1997. Among other things, the Commission was set up to try and learn from the dramatic effects of the Biescas flood of 6 August 1996, where 87 people died.

As far as water management is concerned, one of the basic objectives of the Framework Water Directive (2000), is to prevent, protect and improve aquatic ecosystems and dependent terrestrial ecosystems and to prevent any further deterioration of these ecosystems. This directive was supplemented in 2007 with the Flood Directive, which aims to establish a framework to reduce the adverse consequences of flooding on human health, the environment, the cultural heritage and economic activity.

Making the two directives compatible with one another is achieved through risk management plans and river basin flood management plans as the components of an integrated water management system in which coordination is crucial. The first round of plans for flood risk management is being prepared at the same time as the second cycle of hydrological planning, culminating in the approval of both plans on the same time horizon.

As one would expect, a coordinated approach is being taken to the development and approval process, avoiding duplication and taking advantage of the synergies that have been created. Thus, the same authorities were identified, the same management institutions, the same calendars, etc., the only difference being the inclusion of civil protection authorities and, in particular, the National Civil Protection Commission as the supreme coordination body for the entire flood risk management process.

2. The Phases of the Floods Directive

The initial phase of the directive consisted of identifying the competent authorities and management areas and reporting them to the European Commission, which was completed by the deadline specified in Article 3 of Flood Directive (May 2010). In Spain, the competent authorities were the same as in the Framework Water Directive, except for the inclusion of the Civil Protection authorities mentioned above. As was the case in almost all countries, the management institutions were the same as the ones listed in the Framework Water Directive. Only Ireland and Italy chose different administrative divisions (regions or provinces).

Following this initial phase, the obligations assumed under the Directive involve the following tasks, which must be updated cyclically every 6 years:

a) Preliminary Flood Risk Assessment (PFRA) and Identification of Areas of Potentially Significant Flood Risk (APsFR)

This consists of determining the areas where there is a potentially significant risk of flooding based on the study of the historical flood information, floodplain studies, the impact of climate change, civil protection plans, current land use, and existing flood protection infrastructure. Risk exposure and hazard scales are then established to evaluate the identified damages and thresholds are set to define the concept of "significant" in order to identify areas where the flood risk is potentially significant (APsFR).

From the preliminary assessment of flood risk, 1,342 areas in Spain with a potentially significant flood risk were identified, which is one of the highest figures in Europe.

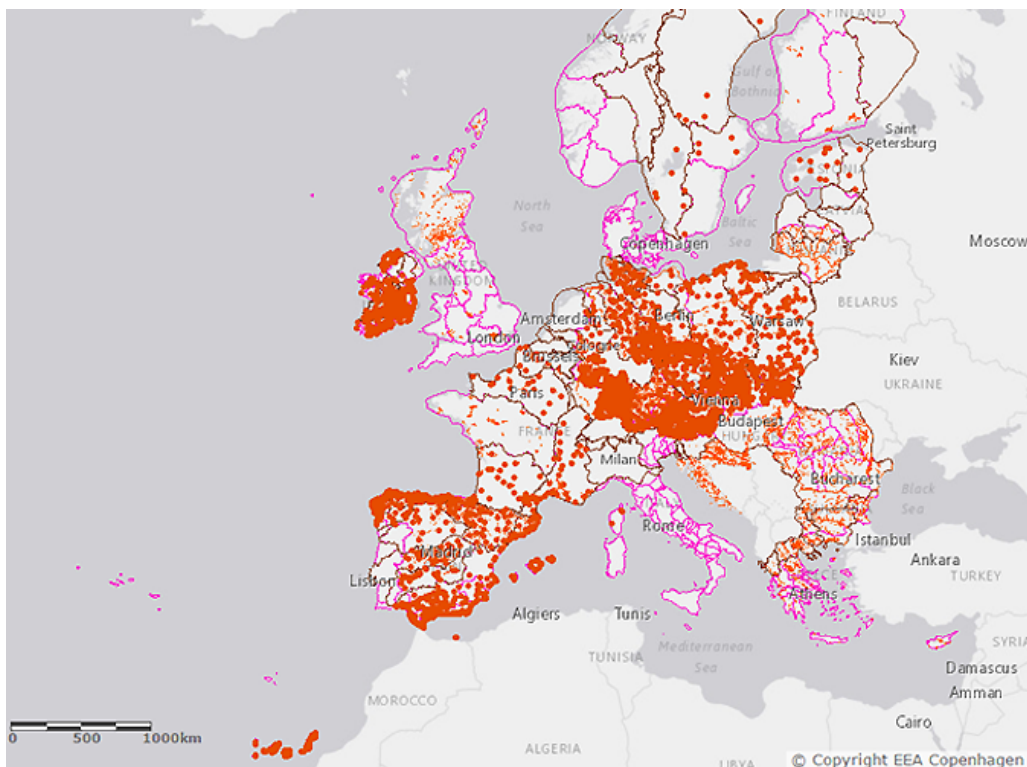


Figure 1. Areas of potentially significant risk in Europe. Note. The European Commission has not yet uploaded the entries for Italy and Portugal. European Floods Directive view (<http://www.eea.europa.eu/themes/water/interactive/floods-directive-pfra-apsfr>).



Figure 2. Image of the areas of potentially significant flood risk on the peninsula, Ceuta, Melilla and the Balearic Islands (<http://sig.magrama.es/snczi/>)



Figure 3. Image of the areas of potentially significant flood risk in the Canary Islands (<http://sig.magrama.es/snczi/>)

	CATEGORIES BY FLOOD ORIGIN				
Magnitude	Rivers	Combined effects river and ocean	Ocean only	Other combinations	TOTALS
No of APSFR	837	44	428	33	1342
Total length (km)	7.720	1.316	1.472	519	11.028
Average length (km)	9,2	29,9	3,4	15,7	8,2

Table 1. Summary of key characteristics of potentially significant flood risk areas

b) Hazard maps and flood risk maps

For the areas of potentially significant flood risk (APSFR) selected in the previous phase, hazard maps and flood risk maps have been developed to delimit flood plains, water depth and the potential damage flooding can cause to the population, economic activities and the environment. The probability scenarios established in Royal Decree 903/2010 are used: high probabil-

ity, where applicable; medium probability (return period equal to or greater than 100 years) and low probability or extreme event scenario (return period equal to 500 years).

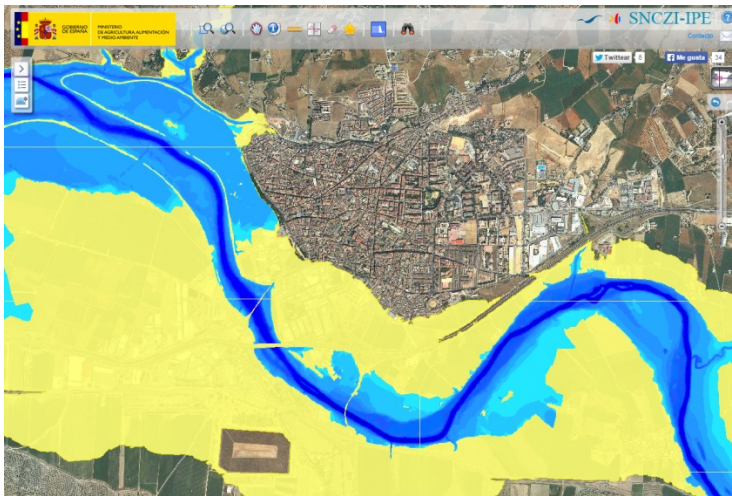


Figure 4. Example of a hazard map (different tones of blue depending on the depth of the flood) for a 10-year return period in Andujar (Jaen) (Guadalquivir river). Cartagena. Flood zone for 500-year scenario shown in yellow <http://sig.magrama.es/snczi/>

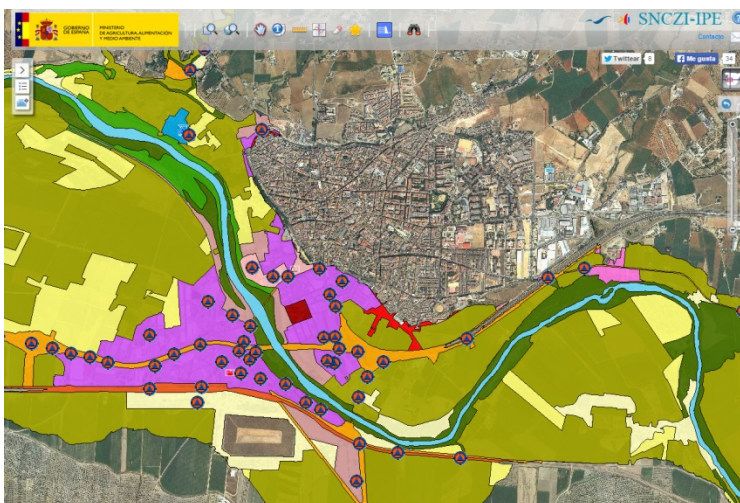


Figure 5. Risk maps in Andujar (Jaen). 500-year flood scenario. Risk to economic activities and points of interest <http://sig.magrama.es/snczi/>

c) Flood Risk Management Plan

As previously mentioned, Flood Risk Management Plans are devised for the hydrographical demarcations and the areas where a potentially significant risk of flooding has been identified. The aim is for the public authorities and society to work together in a coordinated manner to reduce the risk of flooding and the negative consequences of floods. To do so, each administration is responsible for taking measures in the area under its jurisdiction in order to achieve the stated objective, guided by the principles of solidarity, coordination and intergovernmental cooperation and respect for the environment.

3. Content of Flood Risk Management Plans

The overall objective of flood risk management plans is to ensure that the risk of flooding does not increase beyond the current one and to take measures to reduce that risk to the extent possible. These programmes should take into account all aspects of flood risk management focusing on prevention, protection and preparedness - including flood forecasting and early warning systems - without overlooking the characteristics of the basin or sub-basin in question, which becomes even more important when considering the possible effects of climate change.

Thus, the specific objectives of the Flood Risk Management Plan include:

- Increasing awareness of flood risk and self-protection strategies among the population and social and economic agents.
- Improving administrative coordination between all the actors involved in risk management.
- Expanding knowledge for the proper management of flood risk.
- Increasing the ability to predict floods.
- Improving land management and managing the exposure to risk in flood-prone areas.
- To the extent possible, reducing risk by decreasing the danger to human health, the economy, cultural heritage and the environment in flood-prone areas.
- Increasing the resilience and reducing the vulnerability of the elements located in flood-prone areas.
- Improving or maintaining the condition of bodies of water by improving the hydromorphological conditions in order to enable them to reach their greatest potential.

The measures provided for in the flood risk management plans have different territorial scopes. Hence, we have national measures based on national legislation (water, soil, insurance, etc.) and measures whose scope extends beyond a particular region and/or Autonomous Community, such as the weather warnings issued by the National Meteorological Agency (AEMET). Measures at a regional level include those established in the specific legislation of the autonomous communities. Some of the most significant of these refer to land use and urban planning, or the provisions of the regional civil protection plans for flood risk.

Other measures are implemented at the level of the hydrographic basin. These measures are mostly of a hydrological nature, such as coordinating the operation of existing reservoirs or the general plans for watercourse and coastline conservation and maintenance, etc. Finally, there are special measures for areas with a potentially significant flood risk that are aimed at a particular stretch of river or coastline and have a more local focus, such as the restoration of a section of waterway or structural measures such as improving bridge drainage and relocating or removing vulnerable activities or installations, etc.

For the selection of the measures to be included in the flood risk management plans, priority has been given to optimizing the available resources in such a way as to obtain the greatest benefits in terms of risk reduction. Actions at the national/regional level on the one hand and those encompassing targeting specific hydrographic areas on the other have been prioritized so as to impact a larger area. Emphasis has also been placed on the actions that have been proven to be effective in meeting multiple objectives. Many of the measures that focus on management, prevention and preparedness have already been implemented with great success in different areas. In these cases, the flood risk management plans will provide an impetus from an already existing knowledge base and experience.

The most significant measures included in the flood risk management plan are as follows:

- **Land Management and Urban Development**, mainly aimed at reducing the exposure and vulnerability of assets and activities located in flood areas. These are measures that are essentially aimed at adapting the regulations governing land management and urban development to the existing flood risk based on the flood risk and hazard maps, developing guidelines for adapting the elements located in flood-prone areas by establishing the appropriate building construction standards and by facilitating citizen access to flood information by making the existing geographical information available in as many different locations as possible.

- **Civil protection measures** such as those designed to improve the communication protocols between all stakeholders and public advisory protocols or actions to improve the perception of risk among the population through information and outreach campaigns. Another key action in this regard consists of promoting local self-protection and action plans.
- **Measures to promote insurance and especially agricultural insurance**, getting the information out to citizens and at the same time encouraging them to take out insurance to protect against the most devastating natural phenomenon in our country. In doing so, the insurance benefits can be used by the affected parties to recover and resume their normal activities as quickly as possible. Activities of this kind are part of the action programs of both the Consorcio de Compensación de Seguros and the National Agricultural Insurance Entity (ENESA).
- In the framework of the **flood prediction measures** already implemented at basin level, actions include drafting, approving, reviewing and, where appropriate, updating the rules of operation for reservoirs with a significant impact on the hydrological system. This group of measures also includes actions to optimize hydrological information systems (by modernizing and integrating networks, improving communication systems, etc.), development of the Hydrological Alert Protocol established in the National Civil Protection Plan to protect against the risk of flooding and improving coordination efforts with the National Meteorological Agency.



Figure 6. Reservoir management and river basin monitoring systems can significantly reduce the damage caused by floods. The chart reflects the management of the Alcántara reservoir (Tajo) during a flood episode. The water going in (blue line) was much greater than the water going out (green line), which greatly reduce the downstream damages.

- Also at the river basin level, one of the pillars of the flood risk management is the **program for maintenance and conservation of riverbeds**. Actions of this kind are aimed at improving the morphological conditions of the river, with minimum intervention and maximum respect for the environment. The aim is to facilitate the movement of surface water so as to avoiding flooding when the river discharges rise and to restore the natural processes that lead to self-healing of the river ecosystem. There are plans to draft a manual of best practices to optimize the investment in this area.
- In line with the above, some of the most interesting measures are those that focus on river **restoration and natural water retention**. Although the scope of such actions is limited

to a stretch of river, the fact that they achieve multiple objectives makes them extremely effective. These are measures that have been identified by the European Commission to achieve the objectives of the Framework Water Directive, the Floods Directive and the Habitats Directive. For example, the Ministry of Agriculture, Food and Environment is currently assisting in the implementation of the LIFE + Mink Territory project whose financing instrument, LIFE, has received one of the largest funding packages awarded by the European Commission to this type of project.



Figure 7. Recovery of a portion of the Aragon River in Marcilla (Navarra) as part of the LIFE + Mink Territory Project funded by the European Commission, Magrama and the Government of Navarra, which is improving the habitat of the European mink and decreasing the damages caused by flooding, recovering degraded areas and incorporating
[\(http://www.territoriovison.eu/\)](http://www.territoriovison.eu/)

- Another important measure in addressing the areas with potentially significant flood risk consists of improving the drainage of linear infrastructures. One of the measures outlined in flood risk management plans focuses on updating road design standards and improving the criteria for flood risk management. Other measures include identifying priority action points which hinder the flow of water during floods and, where necessary, convincing infrastructure owners to modify and adapt them accordingly.
- Recognizing that sound knowledge is required for these actions to be successful, the flood risk management plans include numerous measures to enhance understanding of the different aspects that have an influence on risk. Examples would include the creation of an R&D+ I group where all agencies and research institutes would be represented and by carrying out specific studies – such as how to improve the assessment of the effects of climate change on floods – to be performed by the Spanish Climate Change Office (OECC). A better understanding of how to manage the program can be achieved through action plans that focus on evaluating, analysing and diagnosing the lessons learned from past flood events and the creation of reports and pilot methodologies or the organization of technical seminars.
- Finally, as a general rule the Flood Risk Management Plans attempt to optimize and prioritize the structural measures or cost-benefit studies that may be needed in the future to select the most worthwhile projects in coordination with the environmental objectives established in the hydrological planning for the different bodies of water.

4. The Approval Process for Flood Risk Management Plans

The process of approving the management plans is outlined in Royal Decree 903/2010, which in turn addresses the need to ensure proper coordination between the competent authorities when drawing up plans for flood risk management as well as the need to have the mechanisms

in place for participation and consultation to ensure public awareness and involvement and to secure citizen support for the actions to be undertaken.

The first step in preparing the plan was to determine the flood risk management objectives. According to the provisions of Article 11.2 of Royal Decree 903/2010, the responsibility for this lies with the river basin organizations along with the Directorate General of Coastal and Ocean Sustainability and the Civil Protection authorities.

Once the objectives were established, specific measures to achieve them were proposed. The contents are keeping with the provisions of Part A of the Annex to Royal Decree 903/2010. As stated in Article 13.1 of Royal Decree 903/2010, each competent authority is responsible for preparing and revising the measures to be adopted, without altering in any way the specific responsibility assumed by each administration as part of the division of powers established by law.

In cooperation with the Committee of Competent Authorities and the Civil Protection Authorities, the river basin organisations then incorporated the measures prepared by the different administrations into the plans and made them available to the public for consultation and information during a three month period (January to March 2015) in the River Basin Districts shared by more than one Autonomous Community, including the Basque Water Agency and the three river basins under the control of the government of Andalusia. The remaining Intercommunity bodies have initiated the process at different times in 2015, as can be consulted on the Magrama website.

Upon completion of the public information and consultation period, the final phase of obtaining the mandatory reports of the National Water Council begins. The National Civil Protection Commission has already issued favourable reports for most of the intercommunity river basin organisations. Both reports are needed for the approval of the Royal Decree containing the government's plans which must be enacted before 22 December 2015.

The strategic environmental evaluation set out in Article 13.6 of Royal Decree 903/2010 and the Environmental Assessment Law 21/2013 of December 9 has been incorporated into the procedure for the approval of management plans. This evaluation is taking place simultaneously along with the review of the River Basin Management Plans.

5. The positive effects of implementing the Floods Directive that have already been identified

The implementation of the Floods Directive is already having a very positive impact on our society. One of the most important aspects is the one derived from the implementation of flood risk hazard maps and the associated mapping of public waterways. As a result of this Directive, some 15,000 km of watercourses have been mapped (more than the 9,000 km of Arpsis), which are very useful for managing flood-prone areas and for public water management efforts in general.

These maps are providing legal certainty for many of the authorizations and reports carried out by the different administrations in the area of urban development and territorial planning, for example. The positive feedback that is generated by facilitating and expediting the processing of these cases improves the performance levels of these administrations and the public's image of them.

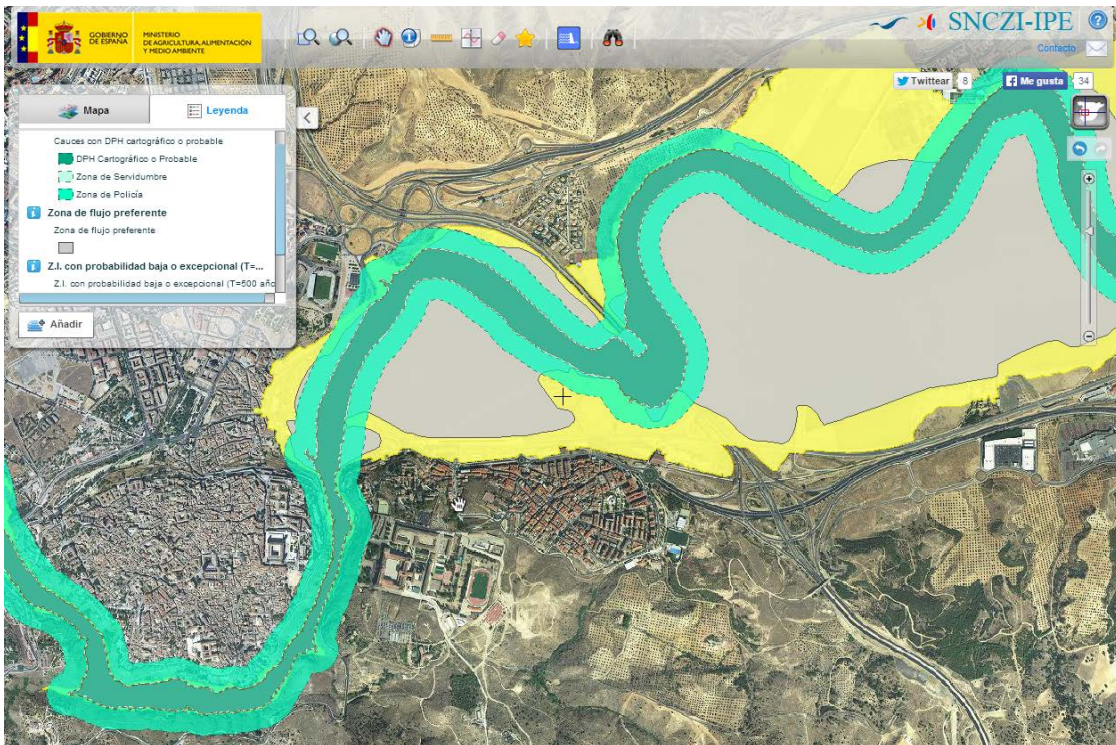


Figure 8. "River area" zoning of the Tagus River in Toledo in the National Flood Zone Mapping System. Dark green indicates public water, light green shows the police area, grey indicates the preferred flow zone and yellows shows the flood zone for a 500-year return period. In the embedded sections there is hardly any difference between the different areas, while in sections with defined flood plains the opposite is true.

These maps have also been remarkably useful in managing specific flood events, such as the ones that have occurred in recent months, by providing Civil Protection authorities with an excellent tool for anticipating the possible effects and areas that may be affected.

This usefulness can be assessed by analysing the number of visits to the different map viewers on the Magrama website, where the National Flood Zone Mapping System is the second most frequently viewed after the Geoportal (which offers all layers of Magrama, including those of the National Flood Zone Mapping System).

The number of visits has grown by 30% over last year, and is expected to continue growing once the cartographic information from the remaining river basins is added. As for mapping layers, floodplains are the most visited on Magrama, with over 150,000 hits per month, almost 40,000 consultations of the public water domain, 45,000 of the risk maps and 20,000 areas with potentially significant risk of flooding.

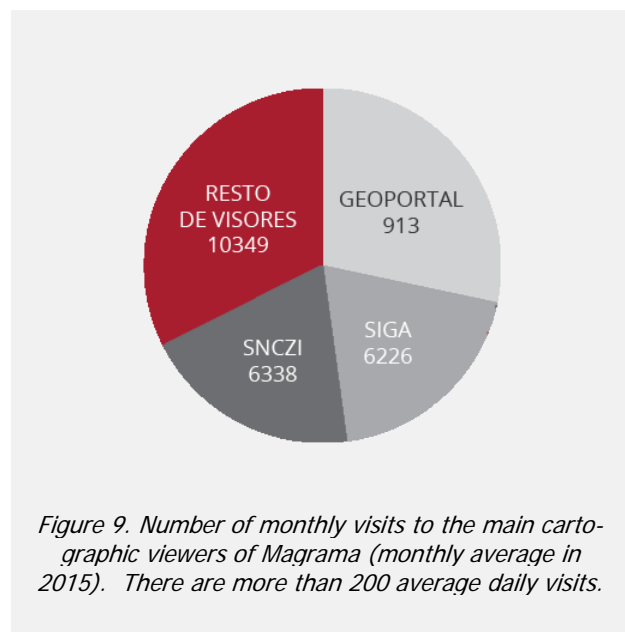


Figure 9. Number of monthly visits to the main cartographic viewers of Magrama (monthly average in 2015). There are more than 200 average daily visits.

Another advantage of this Directive is the already visible improvement in the coordination among the different administrations. With the creation of a joint working group, the many synergies that have been created are greatly facilitating the implementation efforts. This was the case of the basic LIDAR mapping that was done by the National Geographic Institute (IGN), as a result of which we now have a LIDAR flight for all of Spain and a high precision digital terrain model (5 meter cell size) for the entire country which is freely accessible on the IGN website.

The implementation of these plans will bring significant benefits in addition to reducing the damages caused by flooding: increased citizen awareness, job creation, R&D+I and the contribution to meeting water-related environmental objectives. Public participation is encouraged as a means of bringing the population closer to the public administrations.

Similarly, one of the essential tasks to be accomplished according to the United Nations Office for Disaster Risk Reduction (UNISDR) and the European Commission is to educate the citizenry by making people understand that flooding is a natural phenomenon which generally cannot be avoided and that our job is to manage this risk, limit the damages to the extent possible and recover as quickly as possible from its effects.

This idea clashes with the generally held public view. While people do not blame the government for other natural disasters, when it comes to flooding the public often blames the administration for the results, either for not keeping the waterways "clean" or for faulty drains in upstream reservoirs.

Working out these misconceptions is one of the essential tasks of the Flood Risk Management Plan. In order to minimize flood damage, it is essential to increase risk awareness and self-protection strategies among the population and social and economic agents. The success of many of the proposed measures to improve the different variables involved in risk of flooding depends on the adequate disclosure of the flooding phenomenon in general and diagnosing the actions taken to deal with flooding problems locally. To do this, one of the most effective tools is to train / inform local managers and local leaders, government personnel and informers (media), and to jointly design communication strategies that facilitate the transmission of key messages on the one hand and ensure that they respond to the reality of the phenomenon on the other. Effective communications should be supplemented with efforts to educate citizens and economic agents through conferences, brochures, guides, etc., in order to drive home important concepts such as risk perception and self-protection.

To do this, a collaboration agreement was signed by the Ministry of the Interior, the Ministry of Agriculture, Food and Environment and the Consorcio de Compensación de Seguros in May 2015 including a series of proposals to improve the perception of flood risk and to train local agents.

Conclusion

Flood Risk Management Plans, as designed, lay the groundwork for the various administrations to work together in a coordinated way with citizens and economic sectors to reduce the harm caused by flooding year after year and to recover as quickly as possible once a flooding episode occurs.

Spain has extensive experience with many of the measures contained in the current plans, such as those relative to the role of insurance, where the roles of the Consorcio de Compensación de Seguros, the National Agricultural Insurance Agency and Agroseguro have been essential and is now being replicated in many parts of the world.

In this regard, it is essential to reinforce the role of the flood risk management cycle, focusing on prevention, protection, preparedness, recovery and reports on the lessons learned. Continuous feedback will allow us to advance in the reduction of flood damage, while at the same time achieving many additional and complementary objectives, not the least of which is understanding the possible effects of climate change, since it appears that the frequency of this natural phenomenon is on the rise.

Links of interest

Official website of the United Nations Office for Disaster Risk Reduction (UNISDR):

<http://www.unisdr.org/>

Flood risk management contents on European Commission website:

http://ec.europa.eu/environment/water/flood_risk/index.htm

European Floods Directive :

<http://www.eea.europa.eu/themes/water/interactive/floods-directive-pfra-apsfr>

Flood risk management contents on the website of the Ministry of Agriculture, Food and the Environment:

<http://www.magrama.gob.es/es/agua/temas/gestion-de-los-riesgos-de-inundacion/>

National Flood-prone Zone Mapping System:

<http://sig.magrama.es/snczi/>

LIFE+ Mink Territory Project:

<http://www.territoriovison.eu/>